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TATA FISON AND RALLI bonder on the mysteries of nature!

*There's no explaining the Mysteries of Nature, said Tata, in his best professorial vein.

'The birds, the bees, the flowers...' said Fison, getting lyrical.

... and girls, said Ralli.

Unperturbed, Tata continued, 'Take this rubber sapling, Consider its life-blood, thin, white, unpretentious...'

'You've got to hand it to nature,' said Fison.

Rosalie, said Ralli wistfully, her name was

'... in the rubber sapling,' Tata said sternly, 'nature reveals her bounly. Tyres, suspenders, conveyor belts, toy balloons...'

Catapults, added Fison.

'Now,' said Tata coldly, 'for the commercial: Rallis "Tree Brand" fertilisers produce better rubber crops. Tata Fison pesticides protect them for bigger yields.'

and not to know her surname, said Ralli sadly.



Table 3

Classification of Holdings and Estates According to Size at the End of 1966-1967

1.	Size	No. of units	Area in hectares
	Small holdings (20 hectares and below) 2 hectares and below		nectare:
	and below	71095	55968
	Above 4 hectares and upto and including 4 hectares	6558	19006
	Above 4 hectares and upto and including 6 hectares	1863	9568
	Above 10 hectares and upto and including 10 hectares	1275	10272
	Above 10 hectares and upto and including 20 hectares	897	13190
	Estates (Above 20 hectares)	81688	108004
	Above 20 hectares and upto and including 40 hectares Above 40 hectares and upto and including 200 hectares	339 242	9993
	Above 200 nectares and upto and including 400 hostones	32	19808 8352
	Above 400 hectares and upto and including 600 hectares	20	9737
	Above oou nectares and upto and including 800 hectares	4	2697
	Above 800 hectares	10	12169
	Total:	647	63256
	Grand Total:	82335	171260

Table 4
Statewise Distribution of Area at the End of 1966-67
(Area in hectares)

	Holdings (20 hectares and below)		Estates (Above 20 hectares)		Total	
State	No. of units	Area	No. of units	Area	No. of units	Area
Kerala	80422	104756	593	56318	81015	161074
Madras	1208	2952	41	5130	1249	8082
Mysore	56	272	10	1572	66	1844
ndamans			3	236	3	236
pura	1	8			1	8
Bearashtra	1	16			1	16
15 ST.	81683	108004	647	63256	82335	171260





Table 1

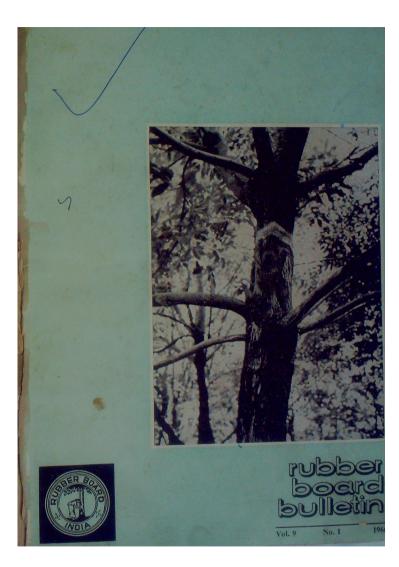
Area Under Rubber at the End of Each Year

Area Under Rubber at	Area in hectares
Year	69001
1950-51	69279
1951-52	69924
1952-53	70271
1953-54	71487
1954-55	83867
1955–56	94839
1956–57	106027
1957-58	115970
1958-59	123612
1959-60	129905
1960-61	140880
1961-62	146149
1962-63	152946
1963-64	155324
1964-65	164713
1965-66	171260
1966-67	

Table 2
Planted Area Under Different Planting Materials at the End of 1966-1967
(Area in hectares)

	(Area in 1	loc tax to	Tota
Planting	Newplanted area	Replanted area	area
Ordinary Budded Clonal	74917 21430 45396	1941 9877 12027 27576*	7685 3130 5742 9440
yielding Total	66826	29517	1712/
Cond Total:		a to the lof the Di	revious two I

^{*} Includes unclassified area also, hence may not tally with the total of the previous two f



A second year of the most cruel drought has Placed the well-being and even the lives of millions of our countrymen in extreme jeopardy

'I appeal to every individual to come forward in a big way to assist our distressed countrymen in the drought and scarcity areas.

Cheques and contributions in cash or kind may be sent to the P. M.'s Drought Relief Fund, Prime Minister's Secretariat, New Delhi-II."



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INDIRA GANDHI Prime Minister

Minister's Drought Relief Fund Contribute

Gener ously

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GENEROUSLY TO PRIME MINISTER'S
DROUGHT RELIEF FUND

Contribute Generously to Prime Minister's Drought Relief Fund Contribute Generously

The Rubber Board

RUBBER BOARD BULLETIN

Vol. 9

No. 1

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The Rubber Board, Kerala State, India.

Inland: Rs. 2, 00 Foreign: Rs. 3, 00

Cover: Pink disease of rubber



Utilise the Opportunity

Since the introduction of the Replanting Subsidy Scheme in 1957, a total area of 45,550.23 acres was replanted and an amount of Rs. 2,71.03,613.88 has been disbursed as subsidy till the end of August, 1966. Tapping certificates have been issued to 1122 replanting permit holders for opening 5.780.83 acres for tapping. It has been reported that the uneconomic small holdings replanted in 1957-58, which have now come under tapping, are yielding as much as 1,000 lb per acre. In most of the cases, it is gratifying to note that tapping certificates could be issued in the fifth or sixth year after replanting, thus bringing down the immaturity period. It has also been proved that the entire cost of replanting operations could be met from the subsidy instalments and the income during the first year of tapping.

Over 2,500 rubber growers had applied for replanting, under the subsidy scheme, of 15,112.28 acres during 1966. But it is estimated that only about 60 percent of the area has actually been replanted during the year. There may be various reasons for this short fall in achievement. The prevailing high price of natural rubber and the consequent reluctance of rubber growers to cut down the old trees and plant afresh is considered to be the main cause of this set back.

Whatever may be the reason for the present reluctance of growers to replant their old uneconomic rubber areas, it cannot be considered a healthy trend when taking into account the long-term interests of the rubber plantation industry. While seeking immediate profits the future of the industry should not be lost sight of.

Our target for replanting during the rest of the Fourth Five Year Plan period is 40,000 acres at the rate of 10,000 acres each year. We should strive to achieve the target.

Replanting rules have now been relaxed by the Rubber Board to enable replanting of all poor yielding and uneconomic rubber planted in or prior to 1945, irrespective of the planting materials used. Previously subsidy was granted only for replanting low yielding unselected rubber planted in or prior to 1956 and registered with the Board prior to April, 1958. As per the liberalised rules, irrespective of variety, areas planted in or prior to 1945 will also be eligible for subsidy for replanting, provided they are proved to be low yielding.

At its fiftyfourth meeting the Board has also decided to permit replanting in alternate areas provided the area selected for planting is considered by the Board to be suitable for rubber cultivation in every respect. This amendment to the rules has been made with a view to enabling rubber growers having old rubber areas situated on poor soils, or areas with unsuitable climatic conditions, or areas situated at high altitudes considered unfit for rubber cultivation, to replant on alternate areas which they possess elsewhere in the country and which are suitable for rubber cultivation.

Postponement of the replanting, when the current yield is uneconomic and the cost of replanting ascending year by year, may not be wise. Therefore, all small rubber growers as well as large growers, who have areas eligible for replanting, should fully utilise the opportunity extended to them and replant all uneconomic areas.

The State of the Rubber Plantation Industry*

P. S. Habeeb Mohamed

Resources Position

As the Fourth Plan period is started, it may be desirable to have a look at our resources position. The following figures will give an idea of the collections from cess during the Third Plan period:—

Cess collection

1961—'62		Rs.	33,18,782.93
1962-'63		Rs.	74,91,670.00
1963—'64		Rs.	51,53,750.00
1964—'65		Rs.	1,13,55,803.00
1965—'66	***	Rs.	1,37,36,779.80
1 11			

This will show that our collections from cess have been very satisfactory. The increase in collection during the last 2 years is mostly due to increase in production of rubber and also the fact that some of the writ petitions which had held up the cess collections have been disposed of. We may look forward to a satisfactory rate of collection during the coming years. The following figures will give an idea of the collections to the Pool Fund on account of the price difference between imported rubber and indigenous rubber:—

1961—'62		Rs.	63,088.01
1962—'63		Rs.	21,04,798.00
1963—'64		Rs.	5,84,808.00
1964—'65		Rs.	24,462.00
		Rs.	4,83,534.00
1965—'66	***	Acor	

It will be seen from the above figures that the collections on account of the price difference are fluctuating very widely and we cannot depend upon the collections on account of the price difference as a steady source of income. However, whatever has to be collected will be collected.

It is noticed during inspections of the accounts of manufacturers that quite a number of them are not renewing licences. Out of 201 new licences issued in 1960-'61, only 126 manufacturers renewed their licences in 1961-'62 and out of them only 72 have renewed their licences for 1965-'66. It is not likely that they have completely stopped their business. There is, therefore, suspicion that quite a number of units are operating throughout the country and obtaining their requirements of rubber from clandestine sources. It is, therefore, proposed to open 3 offices immediately in Bombay, Calcutta and Delhi to look to the working of the units and detect cases of violations of the Act and Rules. The 3 offices will also look to the possible scope of rubber plantations even though on a small scale in the areas in the vicinity. We hope to improve our collection of cess by vigilance through these regional offices.

It is against the background of our present position of resources, that we will have to see our programme for the Fourth Plan

^{*}Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 53rd Meeting of the Board, held on 21st April, 1966.

period. During the last meeting of the Board, I had detailed some of the achievements during the Third Plan period. It will be desirable to give the up-to-date figures relating to the Third Plan period before we consider our programmes for the Fourth Plan.

Third Plan Achievements

The registered area as on 31-3-1966 is 4,10,295 acres with 77,250 units, out of which 706 units are large holdings and 76,544 small holdings. During the year 1965-'66, there has been an increase of 80 units in the large holding sector and 5,318 units in the small holding sector. A number of these units are old areas, freshly registered. The increase in acreage during the year 1965-'66 is 26 482 again due to the registration of areas planted with rubber prior to 1965-'66. However, this will show that there has been a steady increase in the acreage under rubber and quite a sizable increase under the small holdings. Though the target at the end of the Third Plan period was only a total area of 3,60,000 acres the target has been exceeded by 50,000 acres and more areas will be added when

Our production of natural rubber during February, 1966 was 1,750 tonnes as against 1,520 tonnes during February, 1965. The production of natural rubber from April, 1965 to February, 1966 was 47,733 tonnes as against 43,202 tonnes for the corresponding period during the last year and the production of 45,616 tonnes for the whole financial year, 1964—65. Synthetic rubber production during April, 1965 to February, 1966 was 14,804 tonnes against 11,633 tonnes during the corresponding period last year. Due to the accident at the Synthetic Rubber Factory at Barcilly, the production of synthetic rubber has been curtailed to some extent. The consumption of all rubbers for the period April, 1965 to February, 1966 was 87,054 tonnes against 77,430 tonnes during the corresponding

period of last year and against the consumption of 85,711 tonnes for the financial year, 1964-'65. The figures of consumption for March, 1966 are being collected. The import of natural rubber during the period from April, 1965 to February, 1966 was 15,568 tonnes against the import of 13,802 tonnes during the corresponding period last year and against 15,003 tonnes for the financial year, 1964-'65. There is a slight increase in the quantum of natural rubber imported which I had indicated during the last meeting of the Board is not due to any liberalising of the policy of imports. The stock with estates, dealers, etc., of all types of rubber was 26,080 tonnes at the end of February, 1966 as against 27,236 tonnes at the end of February, 1965 and against 24,525 tonnes at the end of March, 1965. The price of rubber has also undergone wide fluctuations. Today it is reported at Rs.315/-per 50 kg.

From the foregoing figures, it will be clear that we will be exceeding our forecast of production of 50,000 tonnes by the ead of March, 1966. Complete figures will be available within a few days and in any case we would be exceeding the Third Plan target of 45,000 tonnes set for natural rubber production.

The accurate statistical data relating to the Third Plan period will be compiled in our Rubber Statistics Hand Book which will be published shortly and the information will also be placed before the next meeting of the Board.

The stock position of natural rubber continues to be bad. The Board had recommended that the gap between the requirement of rubber in 1966—'67 and the production of rubber should be met by imports but the final position is not clearly known. It is, however, reported that there is a move to issue import licences for about 5,000 tonnes of natural rubber and 5,000 tonnes of synthetic rubber. The prices are likely to go up unless steps are taken by the

Government to fill up the gap between the Commission subject to the continuance of production and consumption of all types of the replanting programme.) rubber.

Fourth Plan Programmes

It is against this background of our achievements of the Third Plan period and the over all shortage of rubber that we have to consider our programme for the Fourth Plan. As you are aware, the Ministry had set up a sub-group to report on rubber for the Fourth Plan. The sub-group had submitted its report in 1964 and this report was considered at a meeting held by the Planning Commission on 24-2-1966. The Fourth Plan in general has been approved eventhough the targets for replanting and the question of the continuance of the replanting scheme beyond 1966 are still under discussion and correspondence with the Planning Commission. The Board, as you are aware, has recommended the continuance of replanting programme beyond 1966, but the final decision would be known only later. Very recently, the Director of the Planning Commission, Mr. Moorthy, was here to discuss with us about replanting programme and other programmes in general. The following targets have been indicated for the Fourth Plan period:

Production of natural rubber - 72,000

The following are the other targets:-

85,000 acres for newplantation of which 50,000 acres will be in Kerala, 10,000 acres in Mysore, 5,000 acres in Madras, 5,000 acres in Tripura and Assam, and 15,000 acres in Andaman-Nicobar Islands. It would be necessary for us to spread our activities to other States.

Replanting target of 10,000 acres per year. (This target and continuance of the replanting programmes are still under discussion.)

Planting materials and fertilisers to be given to replanting small holders free of cost. (This has been approved by the received applications for replanting 16,268

The target of 15,000 acres under the Loan Scheme for small growers.

Free supply of planting materials under the Loan Scheme. (We have already

Under the Up-keep Loan Scheme, a target of 2,000 acres per year has been approved. The target of 50 smoke houses during the Fourth Plan period has already been approved.

A scheme for loan through co-operative

Some staff proposals have been worked out on this basis and are being placed before the Board for approval.

Progress of Replanting

As the sub-group has observed, the various programmes during the Third Plan have not achieved the desired progress; particularly the targets of replanting during the Third Plan have not been achieved. The following figures will give an idea about replanting :-

1957		2,839	acres
1958		4,181	,,
1959		3,963	22
1960		3,156	32
1961		5,609	>>
1962		5,530	,,
1963		5,108	- 33
1964*		5,982	95
1965*		7,014	2.0
(* Inco	malete)		

It is reported that by the end of March, 1966 permits have been issued for replanting 8,793 acres and also provisional permits have been granted in the case of 962 acres pending transfer of registration. From this it will be clear that we would be getting between 8,000 and 9,000 acres for replanting in 1965. As for 1966, we have already

acres. After withdrawals we would be able to achieve 10,000 acres during 1966 unless of course the rubber prices start going up and there are heavy withdrawals particularly by the small holders. It would be worthwhile to look into the reasons for the failures under the replanting programme a little more closely.

The Replanting Subsidy Scheme was launched in 1957. The original scheme was to replant 70,000 acres during a 10 year period at the rate of 7,000 acres per year. The scale of subsidy fixed per acre ranged from Rs. 250/- to 400/- for small growers and Rs. 250/- to 300/- for estates above 50 acres in size. At the time the rate of

subsidy in Malaysia and Ceylon was as follows:-

Size of the unit	Ceylon (Rs. per acre)	Malaysia (M. dollars per acre)*
Below 10 acres	1,000.00)	600
10 to 100 acres 100 acres and above	900.00 f 700.00	400

(* 1 M. dollar = Rs. 1.56 approximately)

During the period 1957 to 1959 the area actually replanted was about 11,000 acres as against the target of 21,000 acres for 3 years. The working group for the Third Plan after reviewing the unsatisfactory progress of the scheme recommended the enhancement of

Table 1

Area replanted and rate of replanting

Year	Acreage replanted during the year			Area replanted under the subsidy scheme as % of total registered area (under unselected seedlings) planted in or prior to 1956.		
	Estates	Holdings	Total	Estates	Holdings	Total
Territ		TO HE		%	%	%
1957	1,367	1,472	2,839	1.68	1.53	1.60
1958	2,083	2,098	4,181	2.57	2.18	2.36
1959	1,798	2,165	3,963	2.21	2.25	2.23
1960	1,459	1,697	3,156	1.80	1.76	1.78
1961	2,903	2,707	5,610	3.58	2.82	3.16
1962	2,928	2,602	5,530	3.61	2.71	3.12
1963	3,163	1,945	5,108	3.90	2.12	2.88
1964*	4,345	1,637	5,982	5.35	1.70	3.37
1965*	5,606	1,408	7,014	6.91	1.46	3.95
Total:	25,652	17,731	42,383	3.52	2.05	2.72

^{*} Incomplete.

Note:—According to the Replanting Subsidy Rules only areas planted in or prior to 1956 and registered before 1st April, 1958 are eligible for subsidy.

the subsidy at the rate of Rs. 1,000 per acre and suggested the following targets:—

Year		Area		
1960		7,500 acres		
1961		8,000 ,,		
1962		8,500 ,,		
1963	***	9,000 ,,		
1964		9,500 ,,		
1965		10,000		

The enhanced rate of payment started from August, 1960, by which time the planting season for that year was over. Table 1 shows the area replanted under the subsidy scheme and the rate of replanting.

In Malaysia the Replanting Subsidy Scheme was launched in 1953. At that time about 60 percent of the trees were in the age group of 30 to over 40 years and 20 percent of the trees were in the group of 20 to 30 years. When Ceylon implemented the scheme in 1953, about 72 percent of the rubber was more than 30 years of age and the actual average of all the trees was well over 38 years. But we introduced the scheme only when 34% of the trees were over 30 years old. Our area under unselected rubber can be classified into 3 categories:—

- 1. Pre-1938 planting uneconomic and eligible for subsidy.
- 2. Planting from 1938 to 1956—low yielding but 'not necessarily uneconomic—eligible for subsidy.
- 3. From 1957 to up-to-date planting-low yielding but not necessarily uneconomic—not eligible for subsidy.

When we introduced the scheme in 1957 the area under the first two categories was 95,800 and 81,500 acres respectively. The average age of group (2) was only 9 years. If we take the economic life of a rubber tree as 40 years, including 7 years pre-bearing period, the second group is in the best

yielding stage though, not necessarily high yielding. Generally, the planters are reluctant to cut down such trees. For instance, the acreage planted in 1950 would come into yielding in 1957 and if they replant them in 1957, the planters would have to wait 7 years more without much income. The small holders, particularly those with below 10 acres, comprising 40% of the total area under rubber, will find it difficult to face such a situation. The average yield of unselected rubber planted between 1938 to 1956 will be round about 200 lb per acre. In Ceylon under the Replanting Subsidy Rules, estates yielding below 250 lb per acre are defined as uneconomic and such areas are allowed to be replanted. If we compare the prices of rubber in Ceylon and India, it can be seen that the 200 lb per acre in India for a small cultivator is not an uneconomic yield to-day with the high prices. It is precisely to avoid such a complacent view that we have to work in view of the rapid changes in the rubber plantation economy and the threat faced from synthetic rubber. Therefore, considerable extension work to make the small holder to replant is called for. It is noteworthy that the rate of replanting of small holders is coming down. The figures given below will reveal this:-

Year		Acreage replants (Small holders	
1957—'58		1,472 acres	
1958—'59		2,098 ,,	
1959—'60		2,165 ,,	
1960—'61		1,697 ,,	
1961—'62	***	2,707 ,,	
1962—'63		2,602 ,,	
1963—'64		1,945 ,,	
1964—'65*		1,637 ,,	
/*Provisiona	1)		

A significant increase is noted in the rate of replanting in 1961—'62. The rate of replanting of large growers is given below—

Year		Acreage replanted	
1957—'58		1,367	acres
1958'59		2,083	**
1959—'60		1,798	,,
1960—'61		1,459	,,
1961—'62		2,903	25
1962—'63		2,928	23
1963—'64		3,163	22
1964—'65*		4,345	"
(* Provisional	1)		

The enhanced subsidy rate has considerably increased the rate of replanting of large growers. With this background, you may compare the rate of replanting in Malaysia and Ceylon. Ceylon has replanted 2,15,800 acres out of their 5,30,000 acres under unselected seedlings planted prior to 1938. Thus Ceylon's annual rate of replanting works out to 3.39 percent. According to the report of the Chief Replanting Officer of Malaysia, the small holders' annual rate of replanting is only 3.32 percent. Our annual rate of replanting under the subsidy scheme is 5.06 percent if we take the area under unselected seedlings planted prior to 1938 as the area to be replanted. If we take the area planted prior to 1956 as the area to be replanted, our annual rate of replanting from 1961 to 1965, though not earlier, is 3.30 percent which does not compare unfavourably with Ceylon's or Malaysia's. Even in Malaysia, where replanting has been done very systematically, the rate of replanting fixed per year by the authorities is only 3 percent and from this point of view, it may be correct to say that even our low rate of replanting is not unsatisfactory. In this connection, the following points may also be noted when we compare our rate of replanting with Malay-

In Malaysia, the area to be replanted by each estate during a period is determined in advance. In the case of estates, it is 3% of their total area to be replanted in a year or 21% within a period of 7 years. In the ease of small holders, the total area to be replanted was fixed at 33½% within 7 years

and limits were also laid down for individual holdings. In India only yearly targets for the industry as a whole has been fixed. The Board is examining the question of fixing individual targets for replanting.

In Malaysia, within the ceiling fixed for replanting for individual estates, the estates are allowed to replant, new-plant or replant with other specified crops within the ceiling. In India the question of replanting with other crops does not arise as our idea is to extend the area under rubber.

Malaysia and Ceylon have almost reached a saturation point as far as newplanting is concerned. So they can undertake replanting in a systematic manner. But our planters are still undertaking newplanting also.

Most of the holdings below 10 acres are interplanted with other crops. The small holders are, therefore, reluctant to cut other trees and plant their entire area with rubber. The Board allows only certain minimum number of other trees to be planted along with rubber. The total area under small holdings of below 10 acres size is estimated to be 40% at present.

The subsidy for replanting prior to 1960 was inadequate.

Replanting is necessarily a slow and gradual process. It takes 7 years for replanted stock to reach the first stage of production on a commercial scale. Any owner dependent on revenue cannot afford to have more than about 20% of his total area out of production at any one time. That means that the rate of replacement cannot prudently be at a greater average annual rate than about 3 to 4%.

Conditions in India and Malaysia

It will also be interesting to review the progress both for newplanting and replanting in this country and Malaysia. As rubber tree takes 6 to 7 years to start giving yield the result of recent newplanting and

Table 2
Registered Area of Small Holdings (India)
Cumulative area at the end of each year
(Thousand acres)

Year	High yielding	Unselected	Total	as percentage to Col. (4)	
1	2	3	4	5	
1956-'57	18-1	96.2	114.3	15.9%	
1957-'58	30.7	109.7	140-4	21.9%	
1958-'59	41.3	121.1	162.4	25.4%	
1959-'60	51.5	127.4	178.9	28-8%	
1960-'61	58.5	130.2	188-7	31.0%	
1961-'62	71.8	138.0	209.8	34.2%	
1962-'63	80.4	140.3	220.7	36.4%	
1963-'64	92.8	141.4	234.2	39.6%	
1964-'65	99.3	138.2	237.5	41.8%	
Increase in 8 years	81.2	42.0	123-2	25.9%	
Average annual rate of increase	10·1		15·4	3-2%	

replanting cannot be measured in terms of production figures. As an indirect method the acreage figures can be taken as an indicator of progress.

The total registered area of small holdings (50 acres and below) in India at the end of 1956—'57 was only 1.14 lakh acres. By the end of 1964—'65 it went upto 2.37 lakhs. That is, as a result of 8 years newplanting. small holders' total acreage has doubled. The particulars of their acreage figures are given in Table 2.

The 8 year period has recorded an average rate of newplanting of 15,400 acres per year. The rates for the first 4 years and second 4 years were respectively 18,600 acres and 12,200 acres per annum. It is thus apparent that the peak of the newplanting period has

passed. It may pick up again with the present prices.

Another thing is that during the period, 81,200 acres were brought under high-yielding rubber, 16,200 acres by replanting and 65,000 acres by newplanting. Even though we have replanted 16,200 acres during the period, the acreage under unselected seedlings has increased by 42,000 acres. In other words, the acreage brought under unselected seedlings during the period was about 58,200 acres, i. e. 47% of the total newplanted area during the period. However, it is gratifying to note that the use of unselected seedlings is coming down. It is also interesting to note that acreage under unselected seedlings has started decreasing from 1963—764 onwards.

Table 3
Registered Area of Estates (India)
Cumulative area at the end of each year
(Thousand acres)

Year	High yielding	Unselected		Total		Col. (2) as percentage to Col. (4)
1	2	3		4		5
1956-'57	38-9	81.2		120-1		32.4%
1957-'58	44.3	77.3		121.6		36.4%
1958-'59	48-9	75.3		124-2		39.4%
1959-'60	52:5	74.1		126.6		41.5%
1960-'61	59.8	72.5		132.3		45.2%
1961-'62	68.3	70.1		138.4		49.4%
1962-'63	71.3	69.1		140-4		50.8%
1963-'64	78.9	64.8		143.7		54.9%
1964-'65	87.4	59.0		146.4		59.7%
Increase (+) or decrease (-) in 8 years	(+) 48.5	(-) 22.2	(+)	26.3	(+)	27·3%
Average annual rate of increase (+) or decrease (-)	(+) 6·1	(-) 2.8	(+)	3·3	(+)	3·4%

Due to newplanting and replanting the percentage area under high yielding rubber has considerably increased during the period under review. At the end of 1956—'57 only about 15-9% of the total area was under high-yielding rubber and it has increased to 41-8%. The average annual rate of increase is estimated at 3-2%.

The acreage under large growers (above 50 acres) has also increased considerably. The rate of increase is, however, slower than that of small holdings. The statistics of estate acreage figures are given in Table 3.

The total acreage of estates has increased

by 26,300 acres between 1956—'57 and 1964—'65, or approximately 21.9% as a result of newplanting. The average rate of newplanting for the whole period appears to be more or less uniform viz., 3,300 acres per year.

During the 8 years about 48,500 acres were brought under high yielding rubber—20,000 by replanting and 28,500 by new-planting. The extent under unselected seedlings has been brought down from 81,200 acres to 59,000 acres by replanting. Consequently, the percentage area under high-yielding rubber has increased from

Table 4 Estimated Area of Small Holders (Malaysia)

Year	Area eac	Col. (2) as per-			
	High yielding			centage to Col. (4)	
1	2	3	4	5	
1956	155	1,531	1,686	9.2%	
1964	1,068	1,142	2,210	48.3%	
Increase (+) or decrease (-) in 8 years.	(+) 913	(-) 389	(+) 524	(+) 39·1%	
Average annual rate of increase (+) or decrease (-)	(+) 114	(-) 49	(+) 65	(+) 4.9%	

Note: For computing the above figure, the effect of fragmentation has not been taken into account.

32.4% in 1956—'57 to 59.7% in 1964—'65. The average annual rate of increase is estimated at 3.4%.	Acreage newplanted and replanted during 1953 to 1956	
Now we may examine the progress in Malaysia, the highest rubber producing country in the world.	Hence area under un- selected seedlings at the end of 1956 (1686—155)	
Small holders' (below 100 acres) actual	Total area under rubber 1 2,210 at the end of 1964	
known. However, for a comparative study the extent newplanted and replanted since 1953 can be taken as an approximate estimate for high yielding rubber acreage.	Acreage newplanted and replanted from 1953 to 1,063	
estimate for high yielding futors. Based on this assumption, the following figures are estimated:— (Thousand acres)	Hence area under un- selected seedlings at the end of 1964	
Total area under rubber 1,686	The above figures are summarised i	-

Table 4,

Total area under rubber

at the end of 1956

From the above figures it is clear that by newplanting and replanting with high yielding rubber, the acreage under high-yielding rubber has increased from 9.2% in 1956 to 48.9% in 1964. The annual rate of this increase is estimated at 4.99%.

The acreage statistics of estates of Malaysia are given in Table 5.

The acreage of estates devoted to rubber declined by 1,18,000 between 1956 and 1964, as a result of fragmentation and increased planting with other crops. The acreage under high-yielding rubber has increased from 44.6% in 1956 to 74.8% in 1964. The annual rate of increase has been 3.8%.

By newplanting and replanting the area under high yielding rubber in India increased from 24-3% in 1956-57 to 48-6% in 1964-65. The average annual rate of increase is estimated at 3%.

During the same period the area under high yielding rubber in Malaysia increased from 28.5% to 60.5% at an average annual rate of 4%.

During the period 1957-'58 to 1964-'65, 1,29,700 acres in India were brought under high-yielding rubber—93,500 acres by new-planting and 36,200 acres by replanting. Even after replanting 36,200 acres with high-yielding rubber the acreage under unselected rubber during the same period increased by 19,800 acres. In other words, acreage new-planted with unselected rubber from 1957-'58 to 1964-'65 was 56,000 acres (37.5%) of the total extent newplanted during the period).

The average annual rate of newplanting during the period is estimated at 18,700 acres—15,400 acres in small holding sector and 3,300 acres in estate sector.

During the period, the total acreage in India has increased by 8% per annum (13.5% in small holding sector and 2.7% in estate sector). The corresponding percentage increase in Malaysia was only 1.4% per annum.

The total acreage under unselected rubber in estate sector has been decreasing year by year since 1956—57 due to replanting. But in the small holding sector it has been

Table 5

Area under Rubber at the end of each year (Thousand acres)

Year	High yielding	Unselected	Total	Col. (2) as percentage to Col. (4)
1	2	3	4	5
1956 1964	900 1,420	1,117 479	2,017 1,899	44·6% 74·8%
Increase (+) or decrease (-) in 8 years	(+) 520	(-) 638	(-) 118	(+) 30.2%
Average annual rate of increase (+) decrease (-)		(-) 80	(-) 15	(+) 3.8%

increasing steadily up to 1963-'64; only in 1964-'65 a reduction is noted.

During the period the rate of replanting has been 5.6%, per annum of the pre—1938 plantings (unselected seedlings), 4.6% in estate sector and 5.8% in small holding sector. During the same period Malaysia has replanted 5.9% per annum of their pre—1938 plantings.

Schemes for Smallholders

It will be necessary to do a considerable lot of extension work among our small holders. We have already taken steps to strengthen the extension side. The pay scale of the Rubber Instructors has been revised to Rs. 210—425 and is being given effect to from 1st April, 1966. In the coming years, the Small Holders Advisory Service, which has already been approved by the Board and started working, will give good results. Our expenditure on the schemes for the small growers has also showed an improvement as compared to previous years. The following figures will show that the schemes of the small holders have gathered momentum.

Expenditure from Pool Fund

Year	Expenditur (Rs. in lakhs	
1956—'57		Nil
1957_'58		Nil
1958—'59		0.13
1959—'60		0.43
1960—'61		0.33
1961—'62		1.08
1962—'63		1.47
1963—'64		2.18
1964—'65		9.29
1965—'66		40.89

We have spent during the year 1965—'66 Rs. 6 lakhs on account of subsidised supply of fertilisers for the small growers, Rs. 1,22,000/- for the newplanting loan, Rs. 66,000/- for the maintenance loan

scheme, more than Rs. 3 lakhs as loan to cooperative marketing societies, nearly Rs. 1,48,000/- as subsidy for spraying etc. We have also spent Rs. 1,54,220/- for regional nurseries and more than Rs. 22 lakhs on subsidy for replanting to small growers. At our present rate of expenditure the Pool Fund will be exhausted within 14 years.

Research Activities

The research side has been considerably strengthened during the recent period. The Director of Research has been to Malaysia recently and he is revising the Research and Extension programmes though not much of a serious revision is called for. Certain changes may have to be considered in our planting practices, etc. In the place of the monoclonal seeds from Kanyakumari district which we have been recommending so far, we will start recommending the use of hybrid seeds pending collection from our polyclonal gardens in Kanyakumari district by 1970. We will be recommending more liberal use of buddings also. Certain changes in our tapping practices and techniques are called for and intensive tapping studies are going to be done soon in collaboration with some of the bigger estates. Certain changes in our mulching practices also are called for.

We have made arrangements for supply of copper fungicides and copper sulphate for the current spraying season and 40 Mini Micron sprayers have been distributed to the various co-operatives. The demonstration plots have been fairly well iaid out. The programme of planting in Andamans is according to schedule. The Ministry of Rehabilitation has sanctioned our project in full and also released the necessary funds.

and replanting and diversification of our extension services, higher production of rubber is expected. But as I have repeated a number of times, a steady price is essential for the implementation of the Board's programmes.

Incentives for Rubber Production in India

Dr. K. T. Jacob *

Introduction

Agriculture in India is very much underdeveloped due to lack of initiative in adopting new methods. Also many growers in our country believe that their land has reached the exhaustion level, and are unaware that better returns can be obtained by using improved planting materials coupled with better soil management, manurial and plant protection practices. Again, lack of communication or means of transport, absence of adequate storage and marketing facilities and ignorance about processing also adversely affect the profits of the individual grower and ultimately, the development of agricultural industry in this country. Rubber culture is no exception to the drawbacks mentioned above, although it is one of the few plantation crops from which a substantial revenue is derived annually and as such, its production has a great impact on the economical and fiscal policy of the country. The unique position of natural rubber in the world trade of today is only due to its multifarious uses. It is used not only for the production of consumer goods, but also as a strategic material in war.

Kerala State is said to hold the monopoly of the total acreage under rubber in the Indian Union. But rubber cultivation passed through a period of initial neglect and its ultimate complete distribution throughout this State is only another instance where remunerative new crops are striking roots quickly and readily into the agrarian and social economy of India.

Rubber Plantations: Historical Review

A brief review of rubber plantation industry from the time of initiation along with past experience may help to understand the production oriented schemes launched by the Rubber Board.

Rubber is reported to have been planted on an experimental scale towards the close of the 19th century in the erstwhile Travancore State and South Malabar region of Southern India. However, planting of rubber on a commercial scale in an area of about 500 acres is said to have commenced in 1902. In the subsequent years, cultivation of rubber began to spread in different parts of the south west coast of Southern India and by 1910 the area under rubber had increased to 29,500 acres. This sixtyfold increase in the area was attributed to the high prices of rubber, which prevailed during that period. With further plantings, the area under rubber by 1925 was estimated at 76,295 acres. The industry received a severe setback during the slump of 1930-32 and thus the increase in area under rubber, during this period, was negligible. In 1934, however, the International Rubber Regulation Agreement came into operation, whereby production and newplanting of rubber were restricted and regulated. Again, the outbreak of World War II in 1939 changed entirely the pattern of progress of the industry. To obtain rubber required for the prosecution of the war, the rubber growers in India and Ceylon were encouraged to maximise production. Consequent on the removal of restriction on rubber in 1942, there was considerable activity in newplanting and some replanting, which in 1943, covered

Director and Rubber Production Commissioner, Rubber Research Institute of India, Rubber Board, Kottayam - 9, Kerala State.

about 14,599 acres, the largest increase in any one year since 1926. Again, during the fifties, the price mechanism coupled with adequate protection to the industry by the Government, through the Rubber Act enactment (1947) and constituting the Indian Rubber Board and later the Rubber Board, had a salutary effect on the growth and production of this vital industry. Thus the area under rubber at the end of 1951-52 was 1,71,191 acres and it gradually increased to 3,83,813 acres by the end of 1964-65. Consequently, the production also increased from 18,066 tonnes in 1951-52 to 45,616 tonnes in 1964-65.

Rubber Production and Consumption

India is not only a producer, but also a consumer of rubber. But our production is not commensurate with our consumption and the deficit is increasing year by year, as shown in the following statement:

Year	Production of NR in tonnes	Consumption of NR in tonnes
1951-52	18,066	23,203
1955-56	23,730	28, 145
1956-57	24,060	29,998
1961-62	27,446	48,148
1964-65	45,616	61,057
1965-66	50,530	63,765

However, this deficit is being met partially by imports, which again is a drain on our very limited foreign exchange reserves and hence to conserve the foreign exchange resources, it is imperative for us to increase the production of natural rubber.

Possible Ways to Increase Production

The production of natural rubber can be increased by the following methods. Firstly, the yield from the existing rubber plantations can be increased by adopting intensive and scientific cultivation methods.

But the success of this depends upon the age of rubber tree and the planting materials used. Again, production of natural rubber can be increased by bringing more new areas under cultivation. Also, a phased replanting of old unproductive rubber with improved planting materials can not only help to stabilise, but also augment production level.

Incentives

For the realisation of the above objectives growers must have adequate incentives. The general measures necessary to provide such incentives are (1) price policies (2) financial assistance and (3) marketing facilities. Rubber Board has taken up necessary steps to induce planters/growers to participate in the production oriented development schemes, in addition to imparting the technical know-how of rubber cultivation.

Price Policies

The price of raw rubber has been under control since 1943, with a short break in 1946-47. The last revision was made in 1960 after the Tariff Commission had gone into the cost of production of rubber from representative estates. Both minimum and maximum prices were fixed for various grades of rubber and different concentrations of latex. However, the maximum ceiling was removed as from 16th December 1963 The controlled price includes Rs. 9/- extra per 100 lb, as rehabilitation allowance. This the planter earns for future replanting. Cess at the rate of 30 Ps per kg is collected by the Rubber Board from manufacturers of rubber goods and a subsidy of Rs. 1000/per acre is given to the planter at the time of replanting. It may be noted that the subsidy from the Board is in addition to the rehabilitation allowance the planter earns from the selling price. At present, since only the floor price is fixed, the planter is assured of a minimum fair price for his produce; in addition, he can get higher prices whenever the supply is lower than the demand. This pattern of assured price policy, coupled with high local demand for raw rubber should be considered the first and foremost incentive for any grower to increase the production, either from his existing rubber or from newplantings or from replantings.

Development Schemes

1. Replanting Subsidy Scheme

Replanting is the most important programme of the Rubber Board. The need for replanting rubber was felt because:

- (1) the yield from unselected seedlings planted earlier is poor and uneconomical as compared to the yield from modern clones and
- (2) to maximise the production from uni

In order to encourage replanting, in 1957, Government decided to grant subsidy at the rate of Rs. 250/- to 400/- per acre, to replant the uneconomic old plantations with high yielding planting material. But the response to the scheme was not very encouraging at that time, probably due to the low rate of subsidy. In 1960, considering the inadequacy of the earlier provision, the subsidy was raised to Rs. 1000/- per acre after planting and the remaining at Rs. 100/- per acre planting and the remaining at Rs. 100/- per acre acre per year.

The following is an account of the year-war achievement under this scheme.

Replanting (Upto Year August 1965) Year Area replanted (acres) Subsidy paid (Rs) 1957 2,839.07 16,61,820.28 1958 4,181.05 26,72,213.89 1959 3,961.64 26,68,715.41 1960 3,156.22 26,06,707.80 1961 5,609.22 42,24,929.00 1962 5,530.02 37,03,768.00 1963 5,108.01 29,47,337.50 1964 5,982.41 29,60,164.00 1965 7,014.27 26,76,440.00 Total 43,382.89 2,61,20,795.88

Most of the replantings which have come to tapping, show very encouraging results.

2. Loans to Small Growers

The Rubber Board has now a new scheme to assist registered small growers to extend their plantation by bringing additional land under rubber cultivation to a minimum of 5 acres and a maximum of 50 acres and also to assist in maintaining their immature areas. This new scheme will be implemented from 1966 onwards. The old schemes i. e., the Newplanting Loan Scheme and Upkeep Loan Scheme will cease to function hereafter. But the permits and applications pending action, under these two schemes, shall continue to be operated as per the rules laid down therein.

The new scheme combines the existing Newplanting and Upkeep Loan Schemes of the Board. Loan assistance is made available to all "Small Growers," i. e., planters who own rubber area upto and below 50 acres.

For new planters, under this scheme, the loan payable shall be Rs. 1400/- per acre against a minimum security of Rs. 1,800/- per acre. Loan is payable in seven yearly instalments. The first and second year instalments shall be Rs. 500/- and Rs. 250/- per acre respectively and the subsequent five instalments at the rate of Rs. 130/- per acre. Loan is granted to raise the existing small holdings to a minimum area of 5 acres, within a radius of five miles, and above that and upto 50 acres, which may situate even in other districts or States.

For maintenance under this scheme, the maximum loan payable is Rs. 900/- per acre against a security worth Rs 1,000. The first instalment begins from the second year of planting. First instalment shall be Rs. 250/- per acre and subsequent instalments at the rate of Rs. 130/- per acre. Maintenance loan will be granted from the year in which they apply till the end of the 7th year of planting.

Minimum eligible area, under this scheme, shall be one acre.

In the case of "small holders" (those whose total rubber area does not exceed 50 acres) for newplanting under this scheme, the cost of planting materials, if supplied by the Board, or through co-operative societies, may be reimbursed. If seeds have been used, the cost thereof shall be calculated at the rate of 2 seeds per pit.

Manure at concessional rate shall be supplied to newplantings under this scheme done by smallholders.

3. Long-term Loans

The Agricultural Refinance Corporation, Bombay, has approved a scheme drawn up by the Rubber Board to extend long-term loan facilities to rubber planters who cultivate rubber in an area of 15 acres or above. The loan scheme is intended to finance the first year cost of planting and also its upkeep and maintenance for the succeeding six years. The cost of planting rubber has been worked out to be Rs. 1600/- per acre for individuals and Rs. 2100/- for companies. The loan facilities under the scheme will be available to:

- those who newplant rubber, to whon the total cost of planting will be given as loan; and
- (2) those who have already planted rubber in an area of 15 acres or above, and where such area has not reached the bearing period.

The loan will include instalments due for the remaining part of the pre-bearing period and also an amount to clear away debts, if any, incurred earlier for planting and maintenance of the area. As security for the loan, the land brought under rubber and the improvements done therein, bank g arantees, Government securities, national savings certificates etc. will be accepted. During the first seven years, the borrower need pay only interest on the amounts disbursed and outstanding at the end of each year. The

repayment of the loan will start from the 8th year of planting. The total duration of the loan is, however, restricted to a period of 15 years.

The physical target fixed for the scheme is 50,000 acres in 5 years, with 10,000 acres each year. The scheme is to start operation from 1964/65 and to ead in 1978/79. The loans are to be channelised through scheduled banks. A loan of Rs. 4.46 lakhs has already been sanctioned to a rubber plantation in Kerala, under this scheme.

4. Grant for Construction of Smoke-

The scheme aims at assisting the small growers of rubber in producing quality rubber sheets. The rubber produced by a small grower may not be sufficient for the economic operation of a smoke-house of his own. Hence the Board started a programme to help small growers through co-operative societies, in the construction of ideal smoke-houses. This will help the small grower to improve the quality of his rubber sheets and thus obtain better prices.

The scheme envisages a subsidy upto 50% of the actual cost of construction and equipment of smoke-houses, subject to a maximum of Rs. 5000/-. The Board, in addition to financial assistance, offer technical advice at all stages of construction of the smoke-house. Twelve such smoke-houses have been built so far in various parts.

5. Assistance to Rubber Marketing Societies

The Board has also a scheme for financing co-operative rubber marketing societies for the benefit of small growers. According to the scheme, co-operatives undertaking marketing in rubber will be given a loan limited to Rs. 50,000/-. So far II societies have come forward to undertake marketing of rubber.

Proposals for share participation in societies have also been envisaged which are expected to be implemented shortly.

6. Manure and Rollers

Distribution of manure at half cost and rollers on hire purchase are two new schemes the Board has started implementing through co-operatives.

7. Copper sulphate and Sprayers

To enable small growers to undertake plant protection works effectively, the Board is distributing Copper sulphate at half cost and sprayers rent-free, through co-operatives,

8. Formic Acid

Distribution of formic acid through cooperatives at fair price is another scheme of the Board.

9. Planting Materials

By an amendment to the Rubber Rules in 1962, it has been made obligatory to plant rubber only with high yielding planting materials. To ensure the supply of high quality materials to rubber growers, the Rubber Board has made arrangements for collection and distribution of clonal seeds. Considering the inadequacy of the 50 acre rubber nursery at Karikkattoor to cater to the needs of the planting community, the Board has opened four regional rubber nurseries at Alakode, Manjeri, Neriamangalam and Kadakamon. Supply of clonal seedlings, budded stumps and budwood of superior varieties is being continued now, from the Board. Also, small growers who replant or newplant under the Board's schemes, are eligible to get the planting materials free of cost.

Extension Methods

1. Demonstration Plots

To educate rubber growers on improved cultivation methods, the Board has opened demonstration plots in 20 different rubber growing centres throughout the State. Selection of these plots has been made from

the holdings of small growers. The period of demonstration is for 10 years. All the important cultural operations ranging from planting to tapping will be demonstrated in these plots.

Conducting result demonstration trials (composite type) in various centres to show how the yield can be increased from existing plantations by adopting various agronomic and plant protection practices, is another work in this regard.

2. Tappers Training

The Board has recently started a school for training tappers. This school can accommodate 8 candidates at a time. The duration of the course is 8 weeks and each candidate undergoing training is eligible for a weekly stipend of Rs. 12/-.

Proposals were approved by the Board to open ta ppers training schools in other regions. Attached to all the Sub Offices of the Board there are skilled Tapping Demonstrators. Their services a re being effectively utilised by rubber growers.

Expansion of Area

At the instance of the Government of India, the Board in collaboration with the concerned States carried out surveys of land suitable for rubber cal tivation in Mysore, Goa, Assam, Tripura and Maharashtra. In such locations, experimental plantings in small plots (5 to 10 acres) were established in 1963-64. The performance of the trees is being watched for increasing the area in these non-established rubber tracts. However, the area suitable for planting rubber in these tracts can be estimated at 2 lakh acres.

The targetted area for expansion of rubber at the end of Third Five Year Plan w as 3.6 lakh acres. Against this we have achieved 4.10 lakh acres by the end of the Third Plan.

The various development activities of the Board are mainly responsible for this expansion. The plantation schemes of

Kerala, Madras and Mysore have also contributed much to the expansion.

A public undertaking, — Plantation Corporation of Kerala—has been set up by the Government of Kerala for the development of the rubber plantations. This is a centrally sponsored project executed by the State Government. Their financial provision for the Third Plan was Rs. 250/– lakhs. Upto the end of 1964-65 the Corporation has brought 10,200 acres under rubber, Their target for the Fourth Plan is 10,000 acres. Till the end of 1964-65 the Madras Government have planted 2,159 acres.

The sub group for the Fourth Five Year Plan has estimated the total extent of land available for rubber as 85,000 acres as shown below:

Kerala	 50,000	acres
Mysore	 10,000	,,
Madras	 5,000	22
Tripura and Assam	 5,000	,,
Andaman & Nicobar Islands	 15,000	,,
	85,000	

The sub group has also recommended that the State Governments concerned should be urged to evolve schemes for early utilisation of the available areas for rubber cultivation.

With all these possible schemes, assistance and incentives, the difficulties of achieving steady improvement in our production targets cannot be lost sight of. One of the major impediments is the inadequacy of extension services engaged in transmitting to growers the necessary knowledge of improved methods. However, this service is being planned in such a way as to make the fullest and most economical use of the limited number of trained personnel available. In conclusion, it may be stated that the incentives offered through different schemes will go a long way to produce 72,000 tonnes of rubber by the end of the Fourth Plan period, which in turn, will narrow down to some extent the wide gap between production and consumption of raw rubber in India.

A Preliminary Note on the Production of Improved Seed of Rubber (Hevea brasiliensis Mull-Arg) in India*

V. K. Bhaskaran Nair and P. Oommen Koshy

Introduction

The importance of using improved planting material in the cultivation of any agricultural crop needs no elaboration. The need for employing only selected rubber seeds for planting purposes was felt by the Rubber Board as early as 1947. Since then efforts have been taken to collect good seeds from appropriate areas and to distribute them to growers each year, at concessional rates. Most of the seed collection areas are at present restricted to Kanyakumari district.

Rubber tree, like any other open pollinated crop, shows depression of growth and yield characteristics when selfed or inbred (Brookson, 1953). Selfed seed of Tjir 1, however, has been found to be one of the exceptions to this and has been extensively proved as a reliable planting material (Brookson, 1953). The use of any other seeds, which are not proven should be discouraged. The Board has been collecting Tjir 1 clonal seeds from approved seed collection areas for distribution to growers, since 1947. A strict selection and roguing of the collection areas were made in 1962, to eliminate all possible contamination from undesirable rubber trees.

Till now about 381 lakhs of Tjir 1 clonal seeds, sufficient to plant about 1.5 lakhs

*Contribution from the Division of Botany, Rubber Research Institute of India, Rubber Board, Kottayam-9, Kerala State.

Deputy Director (Botany) and Senior Research Assistant (Botany) Rubber Research Institute of India,

acres, have been distributed by the Board. However it was felt that more improved seed materials should be produced indigenously and this would be possible only by establishing polyclonal seed gardens.

Polyclonal Seed Gardens

Therefore it has been planned to establish mixed areas of desirable clones promoting a fair amount of cross breeding among them, Seeds collected from such polyclonal areas have been shown to be far superior to the seeds collected from any monoclonal area-

In earlier days, raising of hand-pollinated seed on a commercial scale was tried. Comparative slowness of this procedure in meeting the increased demand and the high cost of such good quality seeds have led to the establishment of seed gardens with the different desirable clones. The first of its kind was planted by Heussier in 1919 (Dijkman, 1951). He suggested that an isolation screen of oil palms, forest trees or other vegetation, of one kilometre width, would ensure that no foreign pollen was brought into the garden by insects. Where such pollen barriers were not available an isolation belt of two kilometres in width from other Hevea plantings, was suggested by him.

In contrast to Heussier's views d' Angremonnd (1935-Dijkman, 1951) proposed that seed gardens be established in the areas to be replanted ie, within the estates. According to him if an area of 16 hectares be set aside for the gardens the innermost square of 4 hectares would form the actual seed gardens, the remaining area being the necessary isolation belt. The seeds should be collected from the central garden only.

The Rubber Research Institute of Malaya (Planters' Bulletin, 1953 and 1965) is of the view that an isolation belt should be 5 chains in width. No seed, however, should be collected from this belt. The isolation belt, alternatively, may be planted with another crop or left as forest.

Areas for polyclonal seed gardens in India

Over 90 per cent of the total area under rubber cultivation in India is confined to Kerala State. The production of seed in the plantations of Kerala is, however, very much limited, owing to the pod rot disease caused by Phytophthora palmivora. The intensity of rainfall during the months of May to August determines the severity of the disease. The disease is prevalent in areas which receive more than 15 inches of rain in each of these months and its severity increases when the rainfall is more (Ramakrishnan, 1960).

Pod rot disease normally does not occur in Kanyakumari district, where the rainfall is less and does not exceed 13.5 inches in any one month. Therefore the seed gardens have been proposed to be established in Kanyakumari district.

Choice of planting materials for seed gardens

It may take twenty or more years to produce and test a new clone and it may probably require another 16 years to prove its reliability as a good seed parent.

The clones chosen must be good seeder and must produce good seedling families. It is desirable that these clones are also good yielders, so that a good crop is obtained from the garden as well.

For the establishment of seed gardens, reported here, reliance has been given to the choice of planting materials made elsewhere. Two gardens have been established at the Madras Government Rubber Plantations as joint venture by the RRII and the Madras Government Plantations. Two more gardens are being established in the same region during 1966 planting season.

Five Clone (1963) garden (Garden 1)

The first garden was established in 1963 in the Paraliyar division of the Plantations over an area of 81 acres. The northern boundary and a part of the eastern boundary of the seed garden are bounded by the Perunchani reservoir. The staff quarters are constructed on the remaining part of the eastern boundary. A five chain belt of Tijir I clone separates the seed garden from the portions of rubber plantation (PB 86, Gl 1) at the southern and western boundaries.

Budded stumps of five clones were planted at an espacement of 22' × 11' during the months of June-July. The clones planted in the seed garden are Tjir 1, PR 107, LCB 1320, RRIM 605 and RRIM 623, Of these clones Tjir 1, PR 107 and LCB 1320 are primary clones and the other two (RRIM 605 and RRIM 623) are secondary clones. These clones were planted in such a way that no two plants of the same clone are next to one another. The following design used for the five clone garden ensures cross fertilisation as far as possible.

In the above design, ABCD and E represent the five clones and each letter represents one tree. However, due to the difference in length and shape of the contours it was found difficult at times to follow the same

sequence of planting. Hence whenever two plants of the same clone were found to occur next to one another a Tjir I was interposed and the original sequence was again continued. Very careful supervision is required in the planting of clones in a garden. Confusion that may come at the time of planting, on account of the handling of different clones at a time was overcome by painting the bases of stock plants with different colours, one colour for each clone, before budding. These colours remaining on the stocks after cutting back, helped to identify the clones, till the scion shoots were large enough to be marked. Corresponding coloured stakes were also used at appropriate pits while planting, for the guidance of the workers.

Casualties which occurred during the first and second years have been supplied at the proper time.

Three Clones (1965) Garden (Garden 2)

The second seed garden was established in 1965 in Manalodai division, over an area of 35 acres of flat land. The garden is bounded by Perunchani reservoir on the western and south-western sides, rubber nursery on the southern side, forest reserve on the eastern and north-eastern sides and Tjir I budded area on the northern side. The three clones planted in this garden are Tjir I, PR 107 and RRIM 501. The only secondary clone in this combination is RRIM 501.

Budded stumps of the above clones were planted during July and August 1965, adopting square planting with a distance of 16' × 16', resulting in an approximate stand of 170 trees per acre.

The design used for planting was as follows

Each letter that is indicated above represents a single tree. Planting procedure adopted was similar to those described for the previous garden.

Seed Gardens of 1966

Two more seed gardens are now being set up in the Kalikesam division of the Madras Government Plantation (1966 planting).

Three Clone Garden (1966 Planting) (Garden 3)

Area: 10.5 acres.

Combination: RRIM 501, PB 5/51 and

RRIM 623.

ABC ABC CAB Repeat BCA BCA Repeat

Six Clone Garden (1966 Planting) (Garden 4)

Area: 10 acres.

Combination: RRIM 501, RRIM 605 GT 1, Tjir 1, RRIM 623, RRIM 628 Lay out

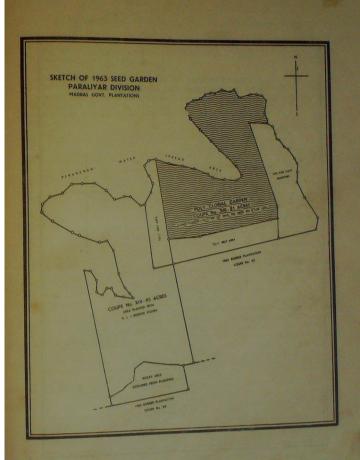
> ABCDEF E F A B C D Repeat DEFAB Repeat

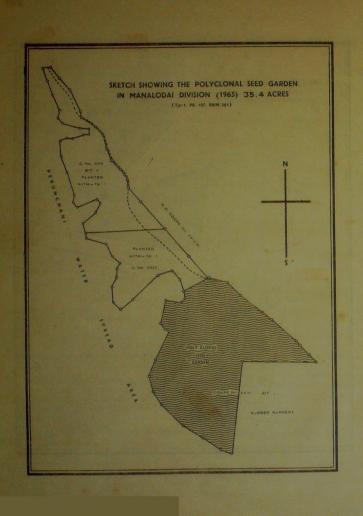
The three clone garden is being set up on a flat area adopting 16'×16' spacing. On the other hand, six clone garden is proposed to be planted on contour terraces at an espacement of 22'×11' since the area chosen is undulating. Tjir 1 buddings are planted as belt area on the outer boundary surrounding both gardens as a whole.

Brief Note on the clones

Tjir 1. Country of origin-Indonesia

This primary clone has proved to be a good parent of both crossed and selfed progenies. It is noted for its average yield and produces a good crop of seeds. This clone has been considered indispensable in seed gardens.





PR 107. Country of origin-Indonesia,

This is also a primary clone extensively used as a seed parent in Indonesia and in Malaysia. However, PR 107 is now reported to be a poor seeder and is lately known to contribute only pollen in seed gardens and hence is not very desirable, in seed gardens (Van Harren 1963). This clone has been included in the 1963 and 1965 gardens.

LCB 1320. Country of origin-Indonesia

This primary clone is a prolific seed bearer and is of average yield. It is used as a seed parent in Indonesia. This clone has been included in the 1963 seed garden.

RRIM 605. Country of origin-Malaysia.

Parentage-Tjir 1 × PB 49

This clone is included because of its high yield, average seed production and desirable parentage. RRIM 605 has been planted in the 1963 garden.

RRIM 623. Country of origin-Malaysia. Parentage—PB 49×Pil B 84

This clone is a high yielder and sets seeds fairly well. This is one of the clones of the 1963 seed garden.

RRIM 501. Country of origin-Malaysia.

Parentage—Pil A44×Lun N.

This clone is a high yielder as well as a good seed parent. It has been extensively used in hand pollinations and has produced many good families. Seed production is above average. There is some bias in planting RRIM 501 because of its marked susceptibility to wind damage and pink disease. However RRIM favours its inclusion in seed gardens, as it has proved itself to be a valuable parent in transmitting yield and vigour to its progenies. Further, even seeds collected from monoclone blocks of RRIM 501 is favoured as a planting material in Malaysia. This clone was used in the 1965 garden and is also included in the 1966 gardens,

RRIM 628. Country of origin-Malaysia.

Parentage-Tjir 1 × RRIM 527

(RRIM 527-Pil B 50 × Pil

This clone was reported to have been used in breeding programme from 1959 elsewhere. It is a good seeder and is also known for its high yield. This clone is a choice for the proposed 1966 garden.

PB 5/51. Country of origin-Malaysia Parentage—PB 56×PB 24.

It is reputed for its high yield and average seed production. The crown formation is conical and with its ideal branching habit, the clone is not prone to damage by wind. The foliage is not dense and leaves are small. Bark character is good. This clone is to be used in the 1966 seed garden.

GT 1. Country of origin-Indonesia

This primary clone has good secondary characters and high yield. Very poor development of male flowers is reported and is said to be male sterile. Hence it is a valuable seed parent. This clone is proposed to be included in the 1966 seed garden.

Discussion

The large scale use of improved planting materials is of prime importance to the industry. In India the production of reliable seeds of improved quality is at present limited to a single type, and falls short of demand. Improved seeds, in addition to their proving to be seedling trees of good performance on commercial planting, may also serve as better stocks for budgrafting

Seed collected from a monoclonal area, except in a few cases, is not very reliable for planting purposes, since rubber, like any other naturally cross-pollinated crop, shows a decrease in yield and vigour when selfad or inbred. Selfed seed of Tjir I, one of the few exceptions, has been proved to be reliable for planting on a commercial scale. Progenies of this clone obtained by crossing with other selected good types are also found equally good. Therefore, the only kind

of indigenous rubber seed recommended for large scale planting in this country was the clonal seed collected from Tjir I monoclonal areas. However, the continued use of such a type is not a sound practice, since further improvement in it is limited. An alternative would be to produce good polyclonal seeds with a view to exploit their hybrid vigour-

Controlled pollination between the desirable clones or trees, is a sure way of getting high yielding progenies with desirable characteristics. The process, however, is tedious and time consuming to meet the increased demand for seeds, in addition to the high cost of the seeds thus produced. Rubber tree being cross-pollinated, an efficient alternative is to establish seed gardens using the desirable parent materials and planting them in such a way as to ensure the maximum cross-pollination. The selection of such parent types for the garden will have to be done with caution. The clones selected should be those which flower more or less at the same time, produce good crop of seed and seedling families, and are good yielders.

Though the first preference goes for clones proved to be outstanding, clones which are only above average in yield with other desirable secondary characteristics are also often included in the gardens. Some clones, which are not recommended for commercial planting on account of their undesirable secondary characteristics, but have proved to result in vigorous high yielding seedling families when used as parents, could be chosen as indispensable parent materials for seed gardens.

Planting in the gardens is generally undertaken in such a way that maximum chances are provided for natural cross-pollination, favouring all possible crosses. Alternating single tree of each clone in sequence would be the ideal way to achieve the same. This method is being followed in the gardens established by the RRII.

Seed production in a polyclonal garden will be greater than that in a monoclonal area. Seed production, however, is dependent on the quality of the planting materials and is greatly influenced by incidence of disease, weather conditions, etc. An acre of seed garden may be expected to produce a minimum of 15,000 seeds (Pl. Bull. 81, 1965) belonging to a number of different seedling families, depending on the possibilities of natural cross-pollination. The seeds are produced as a result of open pollination and the extent of selfed seeds, which may also be present, is not known. However, experience with artificial self-pollination has shown that in most of the cases the percentage of success has always been very low. In general, if every effort is made to further cross-pollination, it is expected that selfpollination in seed gardens is only of minor importance (d' Angremond, 1957). The number of seedling families that could be formed in a seed garden varies depending on the number of parent clones as may be seen from the following table.

Number of clones	Crossed families	Reciprocal crossed families	Selfed families	Total
6	15	15	6	36
5	10	10	5	25
3	3	3	3	9

The 1963 and 1965 gardens are expected to give the first crop of seeds by 1970 and 1972 respectively. This is sufficient to plant an area of over 6000 to 7000 acres and an increase in the production of seeds may be expected during the subsequent years.

Summary

Measures undertaken by the RRII in the production of improved polyclonal seeds have been briefly outlined.

The details of the polyclonal gardens already established and the ones under establishment are mentioned.

General procedures connected with the establishment of seed gardens have been discussed.

Acknowledgments

We are grateful to Dr. K. T. Jacob, Director, RRII for his valuable suggestions and constructive criticisms during the preparation of the manuscript. We are particularly indebted to the Forest Department of Madras Government for permitting us to layout the seed gardens in the Government Rubber Plantations in Kanyakumari district. Thanks are also due to Shri K. Venketakrishnan, General Manager, for his consistent interest, useful suggestions and extensive help in all phases of work connected with the establishment of the gardens.

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The Report of the Results of Fertiliser Experiments with Young Rubber in South India*

K. C. Ananth, C. M. George, M. Mathew and R. G. Unni. ‡

Rubber is a crop which is well known for its wide adaptability and relatively low soil requirements. Though rubber tree grows satisfactorily on less fertile soils, certain minimum amount of plant nutrients are required for proper growth and sustained latex production. The work on manuring and nutrition of rubber was centered mainly on the major plant nutrients, nitrogen, phosphorus and potash with an object to find out how soon young rubber could be brought to bearing by accelerating growth and obtaining the required girth for the commencement of tapping. 1 Any reduction in the immature period or in other words the shortening of the unproductive phase of the tree, no doubt makes an important contribution to the profitability of a plantation. Manuring was reported to have helped to reduce the period of immaturity by 3 to 3½ years in Indo-China, Java and the tapping stage only after 8 years from

The results of experiments carried out in Malaysia and Ceylon also established the importance of manuring in hastening the productive phase by actually reducing the immature period. 3,2,4 Inspite of the widely varying results obtained in many experiments conducted in different countries,

Fertility surveys and soil tests conducted from time to time in the Kerala State revealed in general, the low available status of potash and pohsphate. 7, 8 Possibly because of the above soil condition, while advocating certain general fertiliser schedule for rubber grown in India, a strong accent on potash was given with respect to immediate needs of the tree and the long term conservation of the soil. 9, 10 But the researches conducted in Malaysia revealed a positive response to potash wherever this element is deficient and suppressive effect on growth of young rubber when applied to soils containing adequate potash or in the absence of nitrogen and magnesium ferti-

Therefore, the main object in applying fertilisers to rubber should be to provide nutrients for optimum growth. But despite their general beneficial effect on soil fertility, fertilisers can occasionally have an adverse effect. Unbalanced nutrition of rubber is the most serious problem. Considerable work has been done on this subject in Malaysia and Ceylon. Constable, has established that one sided treatment with

there is some general agreement that phosphate and nitrogen are the most important essential elements for the growth of rubber while potash is relatively not so. ^{1, o} With nitrogen treatment the immediate response of untapped trees is smaller than that for phosphorus, and nitrogen fertiliser requirements are less if trees are grown in association with leguminous cover. ⁶

^{*} Contribution from the Agronomy Division, Rubber Research Institute of India, Kottayam.

[†] Dy. Director, Asstt. Soil Chemist, Senior Research Asstt., Agronomy division, R. R. I. I. and Statistical Officer, Rubber Board, Kottayam.

potash will accentuate mangnesium deficiency in rubber. ¹¹ Bolle-Jones, who made a careful study of the interrelationship of magnesium, phosphorus and potassium in rubber nutrition, concluded that excess of phosphate or potassium caused magnesium deficiency in the rubber plant and that magnesium is important in the early stage of growth of rubber. ¹² Excessive build up of potassium in the soil was advocated to be avoided as secondary deficiencies of magnesium and zinc may be induced. ¹⁴ Likewise, excessive application of phosphatic fertilisers was reported to induce zinc deficiency in rubber. ¹³, ¹⁶

From the careful study of the literature reviewed, it is evident that before recommending any specific fertiliser schedule, the fertiliser requirements of young rubber grown under the climatic and edaphic complexes of Southern India should be assessed. The experimental work described in this paper follows in logical sequence to Malaysian workers' results.

Experimental

NPK factorial experiments were laidout at four locations to study the response of young rubber to the application of the three nutrient elements, namely, nitrogen, phosphoric acid and potash, at different levels and combinations. 5, 10 The design employed at each location was a 3 factorial experiment confounding some components of higher order interaction. The forms of fertilisers and rates used were as follows:

Nitrogen (Ammonium sulphate nitrate) 0-30-60 lb/acre.

Phosphoric acid (Rockphosphate) P₂ O₅ 0-40-80 lb/acre.

Potash (K₂ O) (Muriate of potash) 0-40-80 lb/acre.

The method of application and the quantities applied are detailed below:

1st year: 1956 at ‡ full dose. (one application in September-October)

2nd year: 1957 at \(\frac{1}{3}\) full dose.

(one application in September-October)

3rd year: 1958 at ½ full dose (in two equal instalments in March-April and September-October)

4th year: 1959 at $\frac{2}{3}$ full dose (in two equal instalments)

5th year: 1960 at 3 full dose (in two equal instalments)

6th year: 1961 at full dose (in two equal instalments)

7th & subsequent years 1962 onwards at full dose ent years (in two equal instalments)

During the first year the fertiliser application was made around the base of each plant which was kept clean of weeds, in circular bands of 18 inches or more in diameter and then lightly forked into the soil. The distance of the circular band was progressively increased in subsequent years as the plants grew. From 6th year onwards full dose application was done in between two rows serving four plant points. The two annual applications are being made during March-May, soon after few premonsoon showers and in September-October during a temporary break in the monsoon, when a dry interval of four to five weeks will be usually available.

In all the experimental locations, ground cover of *Pueraria phaseoloides* was established along with planting rubber. Thick ground cover became patchy when the rubber trees closed up at the end of 6th year in all the locations.

Soils and Soil analysis

The type of soils encountered in the four different experimental locations are given in Table 1. Soil samples were collected during

Table-1
Details of Experiments

		L	ocations		
. Particulars	Kulasekaram (Kanyakumari Dist.)	Thodupuzha (Ernakulam Dist.)	Mundakayam (Kottayam Dist.)	Palapilly (Trichur Dist.)	
Soil Type	Lateritic gravelly loam derived from granite	Lateritic loam de- rived from granite and micaceous parent rocks		Lateritic clay loam soils derived from granite	
Planting materi- als used	PB 5/139 (Budded)	Tjir 1 Clonal seedlings	PB 5/60 (Budded)	PB 86 (Budded)	
Number of plants	20	20	30	40	
Spacing	22'×11' (Contour)	16'×16' (Square)	16'×16' (Square)	16'×16' (Triangular)	
Year of planting	1955 seed at stak & 1956 field buddin	1956	1956	1956	
New or Re- planting	New planting	Replanting	Replanting	Replanting	
Recorded growth data period	1959–1965	1958–1965	1958-1965	1958-1964	
Commencement of manuring	September 1956	September 1956	September 1956	September 1956	
Commencement of tapping	September 1963	September 1962	March 1964	September 1965	
Year of covercrop establishment	1956 Pueraria	1956 Pueraria	1956 Pueraria	1956 Pueraria	

1964-65 by which time trees in certain locations reached maturity. The nutrient levels as affected by the main effects are presented in Table 2.

Records

The first set of girth measurements was started from the experimental plots in January 1958, for all experimental locations except Kulasekaram. During January 1959

girth measurements were taken from all locations and subsequently recording was continued at annual intervals. The girth measurements were taken at a height of 50 inches above the union of stock and scion in the case of buddings and 50 inches above the ground level in the case of seedlings.

Results and Discussion

For simplicity and clear understanding

the results obtained under each location are given separately.

Mean Nutrient Status of Soil as

Levels	Kulase- kharam	Thodu- puzha	Munda- kayam	Palapilly
		(Nitrogen	percent)	
No.	0.111	0.162	0.148	Not
N,	0.107	0.160	0.149	analysed
N ₂	0.112	0.159	0.147	
	The later (Available	P mg/10	0 g)**
Po	0.73	0.13	0.33	2.30
P,	3.78	0.17	0.53	4.42
Pg	5.37	0.95	1.93	5.53
	(Available	K mg/10	00 g)***
K.	14.00	15.75	10.22	4.71
K,	16.11	15.53	11.39	8.46
K.	16.72	17.47	11.11	11.75

^{*} Total Nitrogen by Kjeldahl method

Kulasekaram

Girth: The girth data recorded at annual intervals were examined statistically by the analysis of voriance for all the seven years (1959-1965). The results which have been reported cover a period of 10 years following the first application of fertilisers during September, 1956.

Main effects: In all the seven years (1959-1965) the application of nitrogen contributed a positive response. A positive significant effect due to nitrogen was observed only by the fifth year (1961) of the trial and this significant level of response was maintained at all subsequent years. Thus it was noticed that the response to nitrogen application, on growth was maintained upto the final year

of recording, including 1965. Further, it was found that only linear effect was significant in all the years.

Girth increment due to application of phosphate was noticeable in the third year of the trial. At subsequent observations, the beneficial effect was greater and reached statistical significance at five per cent level, during 1961. From 1962 onwards the girth due to phosphate was found to be highly significant (one per cent level). On further analysis it was found that both linear and quadratic components of phosphate were significant in all the five years. Therefore. with this falling off of response to phosphate at increased P levels, it is possible to assume that optimum dose will be below the highest level employed in this experimentation, namely, 80 lb/acre.

The results obtained so far showed no significant indication of any beneficial effect on stem girth due to application of potassium alone. But an examination of the data revealed numerically superior girth at K, level and negative results at K, level, compared to control in all the seven years.

Interaction: The NP interaction was not significant during the first four years of observation. However, from 1963 onwards, including 1965, the NP interaction was significant at five per cent level (Table 3). On further analysis of interaction components, the NP interaction was not strictly linear though the effect was positive in all the years.

Further, NK interaction was significant at five per cent level only during 1952. Beneficial effect of potash was observed only in the presence of highest level of

Girth increase: Though the results were obtained in the above pattern for cumulative girth, study of annual mean girth increase revealed different trends of response.

^{**} Av. P by Bray's Method (O. IN HCI+0.03M NH, F extractant)

^{***} Morgan's extractable K.

Table-3

Mean Girths (Inches per Tree)

Location: Kulasekaram, Kanyakumari Dist., (Madras State).

Nitrogen × Phosphate (1963)

Phosphorus Nitrogen	Po	P ₁	P ₂	
No N	16.816	19.353	18.761	
	17.752	19.515	19.752	
	19.520	19.273	19.540	

L. S. D. at 5% level ± 0.878 L. S. D. at 1% level ± 1.331

Nitrogen × Phosphate (1964)

Phosphorus Nitrogen	Po	P ₁	P ₂	
N ₀ N ₁ N ₂	19.087	21.329	20.869	
	19.468	21.378	21.796	
	21.469	21.067	21.325	

L. S. D. at 5% level ± 0.856 L. S. D. at 1% level ± 1.131

Nitrogen × Phosphate (1965)

Phosphorus Nitrogen	Po	P ₁	P _a	
No N	20.381	22.338	21.947	
	20.745	22.681	23.204	
	22.448	22.061	22.527	

L. S. D. at 5% level \pm 0.778 L. S. D. at 1% , \pm 1.179

Main effects: Analysis of variance indicated that nitrogen was significant for the annual girth increase during 1959-60 and 1960-61 periods only. Actually, mean girth increase over control showed significant response for the stem growth of 12 months from 2½ to 3½ years (N₂ at 5% level) and from 3½ to 4½ years (N, and N, at 1% level). After 4½ years, the increase in stem girth was not significant and thus there was no

consistent positive response to the applied nitrogen treatments.

The applied phosphate showed highly significant increase in annual girth for the 12 months period from $3\frac{1}{2}$ to $4\frac{1}{2}$ years (P_1 and P_2 at 1% level) and from $4\frac{1}{2}$ to $5\frac{1}{2}$ years (P_2 at 1% level) after which response over control was mostly negative upto the last recording in 1965.

Table-4
Mean Girths (Inches per Tree)
Nitrogen × Potassium (1962)

Potassium Nitrogen	Ko	K,	K ₂	
N ₀ N ₁ N ₂	15.138	15.356	13.454	
	15.670	15.250	15.533	
	15.147	16.587	16.218	

L. S. D. at 5% level ± 0.920 , 1% ,, ± 1.394

As far as applied potash was concerned the annual girth increment, mostly, registered negative response. In this, K_2 levels showed consistent suppressive effect on the annual mean girth increase of trees from $3\frac{1}{2}$ to $6\frac{1}{2}$ years. However, there was no statistical significance in the responses obtained and attributable to applied potash (Table 5).

Interaction: There was significant NK and PK interaction for the girth increase during 12 months period from 3½ to 4½ years and again a significant PK interaction was recorded for the 12 months period from 7½ to 8½ years as indicated in Table 5 (a). A depression in girth increase was evidenced for the application of K, level over K, in the absence of nitrogen but in the presence of nitrogen (N₁) and (N₂) no such depressive effect in girth was noticed for the same dose. Further the suppressive effect due to potash was moderated in the presence of phosphate

	Loc	ation:— F	Culasekarai	n, Kanyal	cumari Di	istrict (Ma	dras State)	
ai b d	ears fter ud- Initia ing Girth (956) 2½	1 2½-3½	Befor 3½-4½	Mea e Tapping 4½-5½	an girth in	ncrease Aft	ter Tapping	Girth 8½ (1965)
No	5,000	2.817	3.696	3.136	3.661	2.118	1.126	21,554
N,	5.168	3.017	4.147**	3.152	3.522	1.875	1.329	22.210
	+0.168)	(+0.200)	(+0.451)	(+0.016)	(-0.139)	(-0.243)	(+0 203)	(+0.656)
N ₂	5.471	3.189*	4.216**	3.108	3.460	1.843	1.058	22.345*
	(+0.471)	(+0.372)	(+0.520)	(-0.028)	(-0.201)	(-0.275)	(-0.068)	(+0.791)
Po	4.764	2.867	3.740	3.060	3.598	1.979	1.184	21.192
P,	5.589*	3.059	4.135**	3.104	3.493	1.878	1.100	22.358**
	(+0.825)	(+0.192)	(+0.395)	(+0.044)	(-0.105)	(-0.101)	(-0.084)	(+1.166)
P ₂	5.287	3.096	4.184**	3.232*	3.552	1.979	1.229	22.559**
THE PARTY	(+0.523)	(0.229)	(+0.444)	(+0.172)	(-0.046)	(0.000)	(+0.045)	(+1.367)
K.	5.074	3.059	4.027	3.158	3.615	1.884	1.078	21.899
K,	5,499	3.053	4.043	3.136	3.552	1.867	1.269	22.419
	(+0.425)	(-0.006)	(+0.016)	(-0.022)	(-0.067)	(-0.017)	(+0.191)	(+0.520)
K.	5.006	2.911	3.988	3.103	3.473	2.085	1.165	21.791
2	(-0.008)	(-0.148)	(-0.039)	(-0.055)	(-0.146)	(+0.201)	(+0.087)	(-0.108)

Note: - 1. Figures in bracket indicate difference over control.

2. * - denotes significant difference at 5% level from control

3. ** " " 1% ", from control.

as indicated by the values of P_aK₁ during 1960-61 and P_aK₂ during 1964-65 periods.

Thodupuzha

In this location, girth measurements in two plots, namely, $N_{\rm o} P_{\rm c} K_{\rm o}$ and $N_{\rm o} P_{\rm c} K_{\rm i}$ in one replication were estimated, since the number of trees in these plots were considered inadequate to study the response.

Girth: Main effects. By statistical analysis of the data it was revealed that the girth of trees did not get influenced by applied nitrogen levels significantly in any one year

studied, including 1965. However, a general examination of the data showed numerical superiority of N₁ level over control and N₂.

A highly significant effect on girth was noticed due to the applied phosphate in all the years studied from 1958 to 1965. On further, analysis it was seen that the linear and quadratic components of P were significant in all the years. This result indicates similar trend obtained at Kulasekaram. Here again, the optimum dose of phosphate will be somewhere below the P₂ level (80 lb acre) employed.

Mean Girth Increments (Inches per Tree)

Location: Kulasekaram Nitrogen × Potash (1960/61)

Potash Nitrogen	Ko	K ₁	K ₂	
No	3.771	3.861	3.456	
N ₁	4.217 4.095	4.353	4.201	

L. S. D. at 5% level
$$\pm$$
 0.348 , 1% , \pm 0.527

Potash × Phosphorus (1960/61)

Phosphorus Potash	Po	P _i	P ₂
K	3.960	4.023	4.100
K,	3.567	4.160	4.402
K ₂	3.692	4.222	4.049

L. S. D at 5% level
$$\pm$$
 0.348 , 1% , \pm 0.527

Potash × Phosphorus (1964/65)

Phosphorus Potash	Po	P,	P ₂
K _o K	1.452	0.925	0.858 1.355
K ₂	1.049	0.971	1.476

It was observed that the growth response of rubber trees due to the application of potash was negative. However, the negative response was significant for the girth recorded during 1964 only.

Interaction: None of the interactions was significant.

Girth increase: Main effects. The statistical analysis of annual girth increase at this location showed highly significant response

for the main effect P only from 1959-60 to 1961-62 and significant response during 1964-65. When girth increase in individual years was taken into consideration, it was noticed that nitrogen gave positive response in most of the years (Table 6). The rate of increase in any one year was not significant. The effect of applied potash showed negative response for the growth attribute studied during all the years excepting K₂ (1959-60) and K, and K, (1964-65). On the other hand, mean annual girth increase of trees showed positive response to the applied phosphate upto 1962 (5½ years) and after which negative values were obtained especially for P_a levels. It is interesting to note that the positive response obtained by way of absolute mean girth increase of trees for 1960, 1961 and 1962 was highly significant. Again the negative response recorded during 1965 was significant at five percent level. These results are indicative of slow build up of phosphate and suggests continued application of this fertiliser can suppress the girth increment after a period of time

Interaction. None of the interactions was significant.

Mundakayam

Girth: Main effects. The statistical analyses of the girth data, thus collected for individual years from 1958 to 1965, were undertaken. From the results of analysis the girth due to applied nitrogen was found to be significant only for the years 1959 and 1961. On further analysis, it was seen that linear component of nitrogen was significant in all the years studied.

The applied doses of phosphate contributed a positive effect in all the years. The effect was highly significant in all the years excepting 1958. Further, it is seen that the response to phosphate was significantly linear with no indication of curvature.

Table-6
Main Effect of Fertilizers on Girth (Inches per Tree)

Location: - Thodupuzha, Ernakulam District (Kerala State)

Years				M	ean girth	increase			Final
after plantin (1956			Before	tapping			After	tapping	Girth
	$-1\frac{1}{2}$		21-31	31 41	41-51	51-61	61-71	71-81	81
Levels	(1958	(1958-59	9) (1959-60)	(1960-61)	(1961-62)	(1962-63)	(1963-64)	(1964-65)	(1965)
No	2.449	2.151	2.703	4.175	3.626	2.565	2.821	2.174	22.664
N, ($\frac{2.512}{+0.063}$		2.326) (-0.377) (4.377	3.766	2.803	3.052	1.961	23.312
N ₂	2.419		2.472	4.247	3.651	2.887	2.897	2.093	23.062
Po	2.16	5 2.190		3.590	3.354	2.827	2.976	2.297	21.202
P, (2.62 (+0.455		2.663*		0.000		2.990 (+0.014)	2.107	24.078** +2.876)
P ₂	2.59 (+0.42)		3.037* (+1.235)	11000	-100	201110	2.804	1.824*	23.760** +2.567)
K	2.47		2.580	4.445	3.819	2.798	3.085	1.980	23.718
K,	2.40			4.143 (-0.302)	3.626 (-0.193)	2.713 (-0.085)	2.936 (-0.149)	2.078 (+0.098)	22.608* (-1.110)
K ₂ .	2.50 (+0.02		2.611	4.211 (-0.234)	3.598 (-0.221)	2.744 (-0.054)	2.749 (-0.336)	2.171 (+0.191)	22.714* (-1.004)

Note: 1. Figures in bracket indicate difference over control.

2. *-denotes significant difference at 5% level from control.

The growth of rubber trees due to applied potash was not significant in any one year. However, K₁ level contributed a positive effect, whereas application of potash at 80 lb/acre (K₂) resulted in the consistent suppression of stem girth of rubber trees.

Interaction None of the interactions was found significant except NPK in 1959.

Girth increase: Main effects The statistical analysis of the data revealed significant response to nitrogen for girth increases during 1958-59 and 1960-61 periods. Further a highly significant response was noticed for applied P from 1958-59 to 1960-61 for this growth attribute.

Examination of annual girth increases showed mostly positive response to nitrogen treatments and recorded statistical significance for 1958-59 and 1960-61 periods (Table 7). Applied phosphates showed positive and significant response for the three years from 1959 to 1961. From 1962 onwards, the response due to phosphate became negative. Like other locations, potash continued to have mainly suppressive effect on girth increases for both levels employed.

Interaction

There was significant NK interaction during 1960-61 and NP interaction during

Table-7

Main Effect of Fertilisers on Girth (Inches per Tree)

Location: Mundakayam, Kottayam District (Kerala State)

Yea				N	Mean girt	h increase			Final
afte plant 195	ing In	itial rth		Before 1	tapping			After tapping	Girth
	_ 1		21-31	31-41	41-51			71-81	81
Level	(1958	(1958-59	(1959-60)	(1960-61)	(1961-62) (1962-63	3) (1963-64	4) (1964-65	(1965)
No.	2.69	3.184	2.913	3.753	2 874	3.176	2.575	1.014	22.183
N,	2.705			3.845	3.004	3.122	2.590	1.025	22.724*
			(+0.072)			(-0.054)	(+0.015)	(+0.011)(+0.541)
N ₂	2.815			3.933*		3.059	2.593	0.868	22.652
	(+0.121)(+0.329)	(+0.118)	(+0.180)	(-0.034)	(-0.117)	(+0.018)	(-0.146) (+0.469)
Po	2.651	3.119	2.733	3.676	2.832	3.153	2.632	1.048	21.844
P,	2.749	3.476*				3.097	2,606	0.848	22.666**
	(+0.098)(+0.357)	(+0.349)(+0.232)	(+0.068)	(-0.056	(-0.026)	(-0.200) (+0.822)
P.	2.814	3.550*				3.107	2.522	1.011	23.051**
	(+0.163))(+0.431)	(+0.380)(+0.271)	(+0.155)	(-0.046)	(-0.110)	(-0.037)(+1.207)
Ko	2.695	3.433	3.008	3.823	2.925	3.164	2.609	0.942	22.599
K,	2.864	3.407	2.988	3.842	2.865	3.088	2,642	0.940	22,636
1	(+0.169)	(-0.026)	(-0.020) (-	+0.019) ((-0.060)	(-0.076) (+0.033)	(-0.002)	(0.037)
K,	2.654	3.307	2.930	3.866	2.929	3.105	2,507	1.026	22.324
W.	(-0.041)	(-0.126)	(-0.078) (-	+0.043)(+0.004)	(-0.059)	(-0.102 (-		-0.275)

Note: 1. Figures in bracket indicate difference over control.

2. * - denotes significant difference at 5% level from control.

3. ** - denotes significant difference at 1% level from control.

1963-64 and the relevant data are given in Table 7 (a).

 N_2 has given positive and significant response both in the absence of potash and in the presence of K_a . But this type of response was not found in the K_1 level for the same dose of applied nitrogen.

Response obtained for phosphate gets conditioned by the presence of nitrogen and thus N,P₀ has given the highest value of girth increase during 1963-64.

Palapilly

Growth measurements of individual trees were undertaken from 1958 to 1964 in this location.

Girth: Main effects The data collected were statistically analysed and it was found that the main effects were not significant. Interaction The first order interactions were also not significant for all the years except NK interaction in 1958 and PK interaction in 1961. Further, it was noticed that NPK interaction was significant during 1959, 1960 and 1961. The stray significant results obtained for certain interactions with available fragmentary data were considered to have limited practical application and hence left out in further discussions in this paper.

Girth increase

Table 8 indicated that mean increase in annual girth per tree did not show any

Table-7 (a)

Mean Girth Increments (Inches per Tree)

Location: Mundakayam

Nitrogen × Potash (1960/61)

L. S. D. at 5% level: ±0.208

Ko

Nitrogen

	-	Contract of the last of the la	-	
Phos- 1				
horus				

phorus	Po	P.	Py	
Nitrogen				
No 1	2.424	2,675	2.615	
N,	2.869	2,449	2.452	
N.	2.601	2.687	2.491	

L. S. D. at 5% level:

K.

appreciable response to the main effects. However, nitrogen gave positive response for all the years excepting 1958-59. The response to phosphate was inconsistent and that of potash was negative in most of the years studied.

Table-8

Main Effect of Fertilizers on Girth (Inches per Tree) Location: - Palappilly, Trichur District (Kerala State)

Years after			Mean girth increase			Final Girth		
plan- Initial ting Girth (1956)		l	Before tapping				7½ 1964	
Levels	$-\frac{1\frac{1}{2}}{(1958)}$	1½-2½ (1958-*	2½-3½ 59) (1959-	3½-4½ 60) (1960-	41-51			54)
No Ni	3.595 3.629	2.892 2.863 (-0.029)	2.630 2.687 (+0.057)	3.443 3.541 (±0.098)	1.995 2.026 (0.031)	1.980 1.984 (+0.004)		18.930 19.231 (+0.301)
N ₂	+0.034) 3.496 (-0.099)	2.874 (-0.018)	2.663 (+0.033)	3,543	2.019 (+0.024)	2.071	2.498 (+0.103) 2.404	19.164 (+0.234) 19.129
P _o P _i	3.605 3.490 (-0.115)	2.973 2.716 (-0.257)	2.541 2.664 (+0.123)	3.499 (-0.082)	2.078 (+0.087)	1.975 (-0.059)	2.457 (+0.053)	18.879 (-0.250)
P ₂	3.625 (+0.020)	2.941 (-0.032)	2.775 (+0.234)	3.447 (-0.134)	1.971 (-0.020) 2.085	2.026 (-0.008) 2.058	2.534 (+0.130) 2.353	(+0.190) 19.369
K ₀ K ₁	3.623	3.001 2.767 (-0.234)	2.725 2.676 (-0.049)	3.524 3.374 (-0.150)	2.098 (+0.013)	2.001 (-0.057)	2.551 (+0.198)	19.081 (-0.288)
K ₂	(-0.009) 3.484 (-0.139)	2.862 (-0.139)	2.580 (-0.145)	3.628 (+0.104)	1.858 (-0.227)	(-0.082)	2.490 (+0.137)	18.878 (-0.491)

Note:— Girth increase Not Analysed.
Figures in bracket indicate difference over control.
N. S.—Not Significant.

General Discussion

The results obtained from these experiments corroborated the findings of Malaysian workers ^{3, 4, 17, 18, 19} that rubber responds mainly to nitrogen and phosphate in most soils. However, all the soil types met with in different locations in the present study did not respond to potassium and this finding is at variance with the existing firtfiliser recommendations. ^{9, 10} The difference could be explained as due to the presence of adequate available potash in all the soil types experimented/upon as indicated in Table 2 under K₀ treatment.

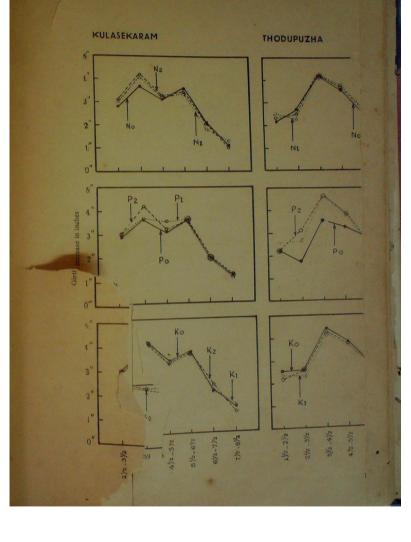
The nitrogen response as measured by annual girth increase was pronounced upto 41 years from planting/budding, in all the locations studied to some degree or other. After this period, response to the highest level of nitrogen was negative in some cases and less than N, in others. However, the initial gain in girth attained for nitrogen treatments was maintained and thus the cumulative girth data analysed showed significant response upto 1965 in the case of Kulasekaram and significant response in 1959 and 1961 at Mundakayam. Experiments run at Thodupuzha and Palapilly did not respond significantly to applied nitrogen. However, there was a general trend of suppression of girth at highest level of nitrogen employed in these two locations. Taking the over all picture as illustrated in Figs. 1 & 2, it may be stated that response to nitrogen, as measured by girth increase, was generally evident upto 41 years from budding or planting. Later falling off of response and in certain cases negative response were also recorded (Table 5, 6, 7 and 8). These results are in full agreement with the findings of Bolton, "Watson, "O Shorrocks " and Rubber Research Institute of Malaya, " As attributed by them, the cessation of the response to applied nitrogen might be due to the enormous release of nitrogen from the dying leguminous cover plants, which synchronises with this period.

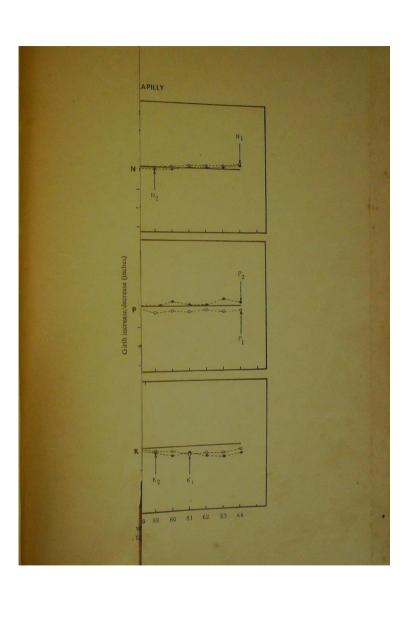
Experiments located at Kulasekaram Thodupuzha and Mundakayam registered significant response to the main effect due to P and the significant difference was continued to be maintained even at the last girth recording during 1965. However, as far as the annual girth increase was taken into consideration, a definite cessation of response to applied phosphate after 5½ years from planting/budding at Kulasekaram and Thodupuzha and $4\frac{1}{2}$ years at Munda-kayam was noticed. After this period, the response was generally negative and at P. level attained significance for the 12 months period between $7\frac{1}{2}$ to $8\frac{1}{2}$ years of age at Thodupuzha (Figs. 1 & 2). This seems to indicate annual application of rock-phosphate, from planting, slowly enriches the soil with phosphate and this fact is borne out by the analytical data of soil samples collected from phosphate treatments (Table 2). The residual effect of the built up phosphate may be expected to last longer and hence cessation of phosphate application to rubber after 41 to 51 years, as the case may be,

Experiment located at Palapilly did not show any response to applied phosphate and this may be attributable to the presence of fair amount of available phosphate in the soil (Table 2).

The main effect due to K did not register any significant response at Kulasekaram, Mundakayam and Palapilly. However, at Thodupuzha the growth response for applied K was negative and registered statistical significance for the year 1964 (Figs. 1 & 2). Since it is not possible to differentiate between direct and residual effects of applied potash we may conclude that the levels employed in these experiments were high with reference to the available K in the soil (Table 2).

Apart from the fertilisers, the beneficial feet of leguminous cover crops in improving the fertility status and physical condition of the soil and thereby improving the





growth of rubber plants were illustrated by numerous workers in Ceylon and Malaysia. The result obtained by one of the workers in Malaysia showed that rubber trees growing in association with legumes but not manured were found superior to trees manured but not grown in association with legumes. 22 The present results coupled with the above observations should be considered of special significance in understanding how the nutritional requirements of rubber may be modified by legumes and fertiliser interactions.

The importance of the inter-relationship of magnesium with potassium and phosphate was not taken into consideration at the commencement of the trial. In most of the trials magnesium deficiency occurred especially in plots treated with high levels of potash and phosphate. One cannot rule out the theoritical possibilities of magnesium and zinc being the limiting factors for the growth of rubber wherever high levels of phosphate and potash are employed.

Acknowledgments

We wish to acknowledge Dr. C. K. N. Nair, Ex-Agronomist of the Rubber Board, for planning and laying out the four experiments and carrying out the initial work for the first three years. Many workers have associated with these experiments since the commencement of the trial ten years ago. In this context particular mention should be made regarding the assistance of Shri P. K. Zachariah, Research Assistant, who collected soil samples and carried out much of the soil analytical work.

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Natural Rubber: Looking Ahead*

P. S. Habeeb Mohamed

Now that the Third Plan period is over, it will be appropriate to review our achievements during this period. The aim was to bring 3.6 lakhs of acres under rubber at the end of the Plan period. Against this, we have an area of 4,07,000 acres. The production target was 45,000 tonnes. Our actual production was 50,500 tonnes. Of course, there have been shortcomings in the replanting programme. However, there were encouraging signs during the planting season of 1965 and figures show that during the last year of the Plan, we replanted nearly 8,000 acres against the target of 10,000

Significant Trends

However, certain trends are significant, The consumption of synthetic rubber has recorded a considerable rise during the Third Plan period. Of course the consumption of natural rubber is also going up. The consumption figures of natural and synthetic rubber during the Third Plan period are shown below:

Year	Natural	Synthetic	Total
1961/62	48,410	10,186	58,596
1962/63	53,553	10,723	64,276
1963/64	61,155	11,959	73,114
1964/65	61,057	15,285	76,342
1965/66	63,765	21,553	85,318

We will notice from these figures that though the consumption of natural rubber has gone up, its share in the total consumption of rubber has gone down and Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 73rd UPASI Annual Conference held at Coonoor on August 27, 1966.

synthetic rubber has recorded an increase in consumption from 13% in 1960-61 to 25% in 1965-66. The rise of course is in keeping with the increasing consumption of synthetic rubber all over the world and due to the indigenous availability of synthetic rubber. However, in view of the poor productivity in the field of rubber plantations, this development has to be taken serious notice of. Our yield per acre during the year 1965 was 400 lb as against 560 lb in Ceylon and 817 lb for estates (1964) in Malaysia.

The production during the current year has shown some increase till June. The production of natural rubber for the period from April to June was 13,295 tonnes as against 11,670 tonnes for the corresponding period in 1965. However, in view of the present situation in the estates, the production of rubber will be affected. It would not be possible to measure actually the loss in production in the estates now. But, if the present situation continues, there will be an appreciable loss in production.

As it is, the prices of rubber are ruling high. There has been acute shortage of stocks in the country mainly due to the restrictions on import of natural rubber and at present, due to the stoppage of work in most of the big estates. The ruling prices are Rs. 325 per 50 Kg as against Rs. 180 in Singapore and 166 at Colombo.

Efficiency in Management

One way of measuring the efficiency in the management of plantations including estates and small holdings will be to consider the cost of production of rubber in the main

rubber producing countries and their selling price. It will be noticed that our price for rubber to-day is nearly double the international price. There is acute consciouscountries like Malaysia or Ceylon as they have to sell rubber in the face of keen competition from other natural rubber producing countries and synthetic rubber produced in industrially advanced countries, and they have been keeping the cost of production even and even reducing their cost of productivity. Though, this should also be our ideal, I am not sure whether the circumstances prevailing during the last one year or so have been conducive to maintain the cost consciousness in the case of small holdings particularly and even in the case of the large estates. First of all, there was the shortage of stocks due to increasing consumption and restriction on imports. With devaluation, the landed cost of rubber in India would be nearly Rs. 5 per Kg and it is unlikely even if imports are liberalised that the prices of indigenous natural rubber may go down below the cost of imported natural rubber. Synthetic rubber produced at Bareilly has been selling at Rs. 3.85 per Kg prior to devaluation, but it is now selling at 50 Ps. extra per Kg. As you are aware, into the cost structure of synthetic rubber enters, factors like imported raw materials, the cost of which has gone up and also re-payment of loans and interest charges which have been affected by devaluation. At the enhanced price of synthetic rubber and with the increased production in the factory, I should think it possible that the synthetic rubber factory can make up in a few years time. It can reduce its cost of production and its selling price in the future while the cost consciousness so far as natural rubber is concerned is getting confused. Now with the synthetic rubber price at Rs. 4.35 per Kg and imported cost of natural rubber at nearly Rs. 5 per Kg it is unlikely that rubber prices in this country will go down below a particular level. It is also clear that the

decisions of the Government on the Rubber Wage Board's recommendations will also have repercussions on the present cost structure of natural rubber though, it will take sometime to measure what exactly these effects will be. Therefore, it may seem odd in the circumstances to speak of reducing the cost of production and keeping the price level even, improving the quality of rubber etc. But it is, precisely this long term objective which we will have to keep in view even though, the conditions of today might give an impression that all is rosy with the future of natural rubber.

Fourth Plan Targets

The Fourth Plan target is to bring an additional 85,000 acres of plantations both in the public and private sectors. There has been some difficulty with the Government of Kerala to release 10,000 acres as programmed earlier for the Plantation Corporation of Kerala. In fact it is understood that they withdrew their offer of 5,000 acres given earlier to the Plantation Corporation of Kerala in favour of a new programme for cultivation of oil palm. This will definitely affect our programme for the expansion of natural rubber, But the State Governments of Mysore and Madras are going ahead with their programmes of rubber cultivation in the public sector and in Andam ans, under a programme for rehabilitation, we will have a substantial area for rubber cultivation. The present programme is to take up at least 6,000 acres in the public sector in the Andaman and Nicobar Islands.

As indicated earlier, the replanting programme had picked up in 1965. But we are not sure how far it is going to reach the target of 10,000 acres in 1966, even though we have received applications for replanting 16,000 acres. The present high prices have upset our calculation about replanting as far as the small holdings are concerned. We have now definite indications from the Government and the Planning Commission

that the programme of replanting will continue throughout the Fourth Plan period. We have also applied to the Government for release of foreign exchange to the tune of Rs. 20 lakhs for importing seeds and other planting material from Malaysia. On the small holders' side, we have implemented a number of programmes covering all aspects from planting to tapping and the marketing of rubber. In fact, during the year 1965-66 we spent more than Rs. 40 lakhs exclusively on small holders' rehabilitation, in addition to the amount spent from the General Fund for both small holders and large holders. In fact, with the end of the current financial year, there will be very little balance left in the Pool Fund for rehabilitation of the small growers but with the increase in production and the increased collection of cess, we may find it possible to finance all the programmes from the resources of the Board.

Progress in Research

Good progress has been achieved by the Rubber Research Institute in the research activities taken up. Series of nursery experiments undertaken during 1964-65 season showed that well manured old nursery sites may respond only to nitrogen, as levels of phosphates and potash are invariably high in such locations. Of the three nutrients, only nitrogen was found to increase the height as well as diameter of the seedlings.

Based on the research findings obtained so far from the NPK factorial experiments, started in 1956 in 4 different locations, the present recommendation is that young rubber grown in soils deficient in available phosphoric acid and potash, where covercops are not established or intercropped with other soil exhausting crops or badly croded should be fertilised with NPK 8: 12: 12 grade, at a revised schedule ranging from 40 to 80 Kg per acre per application. In soils where management practices were of high order especially when growing rubber in association with leguminous cover crops,

considerable reduction in fertiliser use could be effected especially by reducing the quantity of phosphoric acid and potash for a unit area. Under these conditions, the new recommendation would be, NPKMg 10:10:4:1.5. Likewise, additional fertiliser grades for old rubber hitherto not manured and regularly manured areas from immature stage are also being suggested.

Trials with different weedicides have indicated that for specific grass control in plantations, 'Tafapon' at the rate of 7.5 Kg per acre is the best. Treatment of Calopogonium cover crop seeds with sulphuric acid for 20 to 30 minutes gave 98 to 100% germination against 8 to 14 % in the untreated control. Bised on the first and the second year's yield of the clone; developed from them, 22 clones developed from the 1964 hand pollinated series performed better, with yield varying from 290 Kg to 690 Kg per acre per year, when compared to only 295 Kg per acre per year for the Tjir 1. The performance of some of the irradiated seedlings was also found to be promising, the estimated yield figures in one of the selections being 575 Kg per acre against 185 Kg for the control. Two more polyclonal seed-gardens have been established in the Madras Government Rubber Plantations, thereby increasing the total area under polyclonal grade to 136.5 acres. New tapping experiments have been initiated to find out the most effective methods of exploitation of the yield potential under the tapping conditions prevailing in our country. After extensive field trials, the use of Minimicron 77 Stretcher model was proved to be effective for spraying rubber upto 55 ft. Comparative studies on Micron and aerial spraying showed that invariably the former gave better disease control with uniform pattern of good leaf retention, while with the latter patches with poor retention was characteristic. However, there is the advantage that it is the most suited for extensive and continuous stretches of rubber areas due to quick coverage. Results of field experiments indicated that overhead shade reduced disease incidence appreciably.

Results of a series of experiments have shown that acetic acid can be used for coagulation of rubber in place of formic acid. The optimum concentration of acetic acid varied from 1.5 cc to 4.5 cc. and 0.5cc to 2.5cc for formic acid, for properly diluted latex weighing half Kg. Detailed technical studies to find out the quality under various concentrations of the acids are in progress. The cost of acetic acid for processing one sheet is found to be 95P whereas that of formic acid is 58 P.

A new experimental farm has been opened at Chethackal (Ranny) by the Board for conducting the various field experiments taken up by the Institute. An area of 7.4 acres has already been brought under a clonal trial. The area of the farm is proposed to be extended to 640 acres under a phased programme.

Four new regional nurseries started functioning during 1965-66 season. High yielding planting materials sufficient to plant an area of 2500 acres were distributed from the Central Nursery during the season. High yielding polyclonal seeds worth Rs. 8 lakhs were imported from Malaysia and supplied to growers. Two Micron 420, 56 Minimicrons, and 538 hand operated sprayers were made available to the growers for spraying. Rollers were supplied to the growers on hire purchase.

A Small Holders Advisory Service started functioning towards the end of May, 1966, As on date, the unit visited more than 150 holdings and several estates to investigate problems in rubber cultivation and technology. The visits were followed by confirmatory advisory letters.

The Publicity Section has started publication of a new Malayalam Magazine RUBBER which has attained wide popularity and readership among the planting community, which is evident from the present circulation of 12500 copies.

NEWS AND NOTES

Decentralisation of Development Activities

Taking into account the rapid pace in the progress of the Rubber Plantation Industry in recent years, the expansion of area under rubber envisaged during the Fourth Plan period and the role the developmental activities of the Board have to play in the implementation of various schemes, it was decided to decentralize the work of the Development Department of the Rubber Board Four regional offices of the Board were opened at Calicut, Ernakulam, Kottayam and Trivandrum from the 2nd May 1966. The regional offices began to function effectively from the 1st September 1966.

The Trivandrum regional office has jurisdiction over the area covered by the Board's sub-offices at Trivandrum, Punalur and Pathanamthitta; the Kottavam regional

office over the area covered by the Board's sub-offices at Kottayam, Kanjirapally and Palai; the Ernakulam regional office over the area covered by the Board's sub-offices at Ernakulam and Moovattupuzha; and the Calicut regional office over the area covered by the Board's sub-offices at Palghat, Calicut, Thaliparamba, Goa and Maharashtra.

The regional offices are under the charge of Assistant Development Officers who are empowered to issue planting licences, grant new, part and transfer of registrations and sanction 1st year subsidy upto 10 acres and subsequent years subsidy up to 20 acres.

This new set up is expected to facilitate the speedy disposal of the Board's work and to be convenient to the rubber growers.

New Branches for Meenachil Taluk Rubber Growers' Co-operative Society

The Meenachil Taluk Rubber Growers' Co-operative Society has opened four new branches at Thodanal, Pathampuzha, Poonjar and Erattupetta. All the four branches were inaugurated by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board on the 6th April, 1966.

At Thodanal the inaugural meeting was presided over by Shri A. N. Velayudhan Nair. Rev. Father Abraham Thottupuram welcomed the gathering. The Chairman, Rubber Board, formally declared open the branch by selling an aluminium pan to a small grower. Shri M. S. Gopalan Nair

and Shri K. P. Phalgunan, Dy. Registrar of Co-operative Societies, Rubber Board, spoke on the occasion.

The meeting at Pathampuzha was held under the presidentship of Rev. Father Thomas Kalathil. The new branch was opened by selling a bottle of formic acid to a small grower.

The third branch at Poonjar was inaugurated by the Chairman where also he opened the branch by selling an aluminium pan to a small grower. The last one at Erattupetta was opened by the Chairman



The Chairman inaugurating the Branch at Thodanal by selling an aluminium pan



The Chairman inaugurating the Branch at Pathampuzha by selling a bottle of acid



Inauguration of the Branch at Poonjar



Inauguration of the Erattupetta Branch

by selling a bottle of formic acid. The meeting held in the evening was presided over by Shri M. Fareed. Shri M. S. Gopalan Nair made a short speech. Shri T. V. Joseph welcomed the gathering and Shri P.J.Thomas proposed a vote of thanks.

Rubber Instructor's Office Opened

Dr. K. T. Jacob, Director of Research and Rubber Production Commissioner inaugurated the office of the Rubber Instructor at Ramapuram on the morning of the 18th April 1966. The office is functioning at the buildings of the Ramapuram Service Co-operative Society.

Those who spoke on the occasion included Shri M. M. Jacob and Shri K. N. G. Menon. In his inaugural speech Dr. Jacob expressed his concern over the growing tendency on the part of the rubber growers for intercultivation and intercropping among rubber in Meenachil taluk. He advised the growers to follow good cultural practices in rubber and set an example to others. Dr. Jacob concluded his speech with the request that every one should co-operate with the Board for the proper working of the new office at Ramapuram.

Mr. Shepeard's Visit to Rubber Research Institute

Mr. R. Shepeard, Research Officer of the Prang Besar Estate, Malaysia, paid a visit to the Indian Rubber Research Institute in April 1966 and held discussions with

the Chairman, Rubber Board, the Director, Rubber Research Institute of India and other officers.

Rubber Board Staff Association

The seventh anniversary of the Rubber Board Staff Association was celebrated on 14th May 1966 at the Mammen Mappillai Hall, Kottayam. Shri P. S. Habeeb



Dr A. T. Markose inaugurating the celebrations



Shri Viswanathan was awarded the Championship cup



Shri G. Ramachandran addressing the audience

Mohamed, Chairman, Rubber Board, presided. Dr. A. T. Markose, who inaugurated the function, briefly outlined how employees' organisations should function for their own prosperity. Sarvashree G. Ramachandran and K. P. Karunakara Pisharody spoke on the occasion. Shri V. I. Joseph, Vice-president of the Association welcomed and Shri P. S. Kuriakose proposed a vote of thanks. Sreemathy Visalakshi Sivaramakrishnan distributed prizes to those who won in the sports competitions.

Pension Benefits Extended to Rubber Board Employees

The pension benefits now enjoyed by the Central Government employees has been extended to the employees of the Rubber Board also with retrospective effect from

April 1, 1963. Necessary amendments have been made in the Rubber Board Employees' Provident Fund Rules in this

Cannanore District Marketing Society Inaugurated

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, formally inaugurated on 29th May, 1966, the Cannanore Rubber Marketing Co-operative Society by purchasing a rubber sheet from a rubber grower. The sheet was prepared in the smoke house constructed by the Nedianga Service Bank with the assistance given by the Rubber Board. In his inaugural address the Chairman stated that in the decentralised set up it was the endeavour of the Rubber Board to establish a co-operative society and a rubber nursery together with a sub-office of the Board in each area. Regarding Cannanore district, the Chairman expressed satisfaction that it could get all the aforesaid advantages. He recalled the words of the former Chuirman Dr. Rama Varma and said that there was ample scope for rubber development in Cannanore district. The Chairman concluded his speech with the request that the assistance extended by the Board should be



utilized to the fullest extent and that the small growers should join together on a co-operative basis. Shri Ramachandran Nair, District Collector, presided. The president of the Cannanore Rubber Marketing Society, Shri P. R. Rama Varma Raja, welcomed the gathering. Shri P. K. Narayanan, Information Officer, also spoke. Shri N. C. Varghese proposed a vote of thanks.

Shri P. R. Ramavarma Raja welcoming the guests

Fertilizer Workshop

The Agriculture Department of the Madras State organised a fertilizer workshop on 24th and 25th May, 1966, at the Agricultural College, Coimbatore. Sari K. C. Anenth, Dy. Director (Agronomy), attended the conference. The workshop was mainly intended to review the application of the

fertilizers recommended for the 1966 crop

The fourth group constituted to discuss about plantation crops fully endorsed the view that the fertilizer mixture now being recommended by the Rubber Board contained the correct proportions.

Dr. Sivaramakrishnan

The Institution of the Rubber Industry, London, at its meeting held on the 26th April 1966, has admitted Dr. N. H. Sivaramakrishnan, Dy. Director (Chemistry/ Rubber Technology), Rubber Research Institute of India., as an Associate Member.

Rubber Growers Seminar at Chadayamangalam

A one day seminar of rubber growers was rganised on 5th June 1966 at the Lower rimary School, Chadayamangalam. About 00 delegates from different parts of Kottarakara taluk attended the seminar. Discussions were held in the morning on scientific and technical aspects of rubber cultivation. 'Selection of seeds and seedlings', 'Application of fertilisers', 'Diseases and disease control' were some of the

subjects that came up for discussion. Discussions were led by Sarvashree K.M.Joseph, M. Mathew, P. N. Radhakrishna Pillay,

K. P. Phalgunan and P. K. Narayanan of the Rubber Board.

National Programme for Eradication of Pests and Disease

A two day conference of representatives of the Rubber, Coffee and Tea Boards was held on the 18th and 19th May, 1966, at the office of the Rubber Board, Kottayam. The meeting was mainly convened to formulate a uniform national policy for the control of pests and diseases that affect the plantation crops. Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, presided. Representing the Rubber Board Dr. K. T. Jacob, Director/ Rubber Production Commissioner and Sri K. V. George, Dy. Director (Pathology) attended the conference. Coffee and Tea Boards were represented by Dr. M. S. Sarma, Director, Coffee Research Institute, Sri Ranga Shetty, Senior Liaison Officer,

Coffee Board and Dr. K. K. Mithra, Liaison Officer, Tea Board. The Plant Pathologist, Dr. C. S. Venkita Ram represented the UPASI.

Among other things, the two day meeting discussed the implementation of disease control in plantations, uniform programmes in relation to different plantation crops and plant protection programme for each plantation crop. The meeting decided to give financial assistance to all types of growers for eradicating pests and diseases. The conference discussed the method of assistance to be allowed to the small growers in particular and suitable recommendations were made.

Conference to Discuss Programmes for Spraying in Rubber Plantations

A conference of representatives of rubber planters, pesticide manufacturers and suppliers, spraying agencies and spraying equipment manufacturers, co-operative societies and concerned officials of the

Government and the Rubber Board was held at the office of the Board on the 28th October, 1966. About 50 members representing the various interests attended the conference which was convened to discuss matters pertaining to the spraying of rubber plantations.

Welcoming the representatives the Chairman, Rubber Board, who presided, stated that the objectives of the conference were two fold viz. to review the progress achieved during the current year's spraying season and in the light of experiences, draw up plans for spraying of rubber, next year. He expressed concern over complaints received regarding the

poor results of spraying particularly in the case of Micron spraying. He requested the members to give their experiences and views in this regard.



Shri P. S. Habeeb Mohamed, Chairman, speaking at the conference



"A view of the conference

From the discussions that followed it came out that by and large, the results of spraying during 1966 were satisfactory, though some cases of poor results, particularly in Micron spraying, were encountered. Delayed disease incidence consequent on late rains and use of inadequate quantities of fungicide were mentioned to be the main factors responsible for the poor results obtained.

On the question of availability of pesticides and spraying equipments, the representatives of manufacturers assured that there would be no difficulty in meeting the full frequirements of the spraying season in 1967. They however expressed the fear that consequent on devaluation the cost of various items were likely to be higher compared to the previous season, but they assured that they would endeavour to keep the price level as low as possible.

It was estimated that about 1.5 to 1.6 lakh acres of rubber were likely to be sprayed with copper fungicides during April-May, 1967 employing the three different



The conference-another view

techniques of spraying in vogue viz. high volume Bordeaux spraying, low volume ground spraying and aerial spraying.

The conference concluded with a vote of thanks by Dr. K. T. Jacob, Director of Research.

Agricultural Production Seminar at Ernakulam

One of the important recommendations of the State Level Agricultural Seminar held at Trivandrum in October, 1965, was that district level seminars in which all sections of the agricultural community participated should be organised. The Agricultural Production Seminar organised by the district officials of the Agriculture Department at Ernakulam in July 1966 was the first of such

The Seminar which was held on July 7, 8, and 9, 1966, at the Town Hall. Ernakulam, was attended by the officers from various deparments including Agriculture, Co-operation, Community Development, Plant

Protection and Panchayat and leading agriculturists. About 300 delegates took part in the seminar. An executive committee with the District Agricultural Officer as convener was in charge of the proper conduct of the seminar.

Inauguration

The Minister for Defence Production Shri A.M. Thomas, formally inaugurated the seminar on July 7, 1966. The Minister stated that irrespective of the kind of the crop, the agriculturists should adopt a package approach. He suggested that production should be increased in all agricultural spheres and that all concerned should



Shri A. M. Thomas, Minister for Defence Production, inaugurating the seminar, On his right is Smt. Annie Thayyil, who presided,

show keen interest in raising production. The inaugural meeting was presided over by Smt. Annie Thayyii. Sri P. M. Joseph welcomed those present on the occasion and Shri Joseph George proposed a vote of thanks.

Papers and Discussions

After the inauguration papers were presented and discussions followed. Discussions were held in three separate groups at the seminar. Altogether 18 papers were presented in the seminar. The discussion on rubber was included in the third group. Shri P. A. Sreenivasan, Dy. Director of Agriculture, was the chairman of the group.

Representing the Rubber Board Shri P. K. Narayanan, Information Officer, attended the conference and presented a paper on "Expansion of Rubber Cultivation in Kerala" for discussion.

Most of the delegates actively participated in the discussion that followed. One of the important resolutions evolved after the discussion was to increase the replanting subsidy from Rs. 1000 to 1500 per acre. It was also recommended that all planters who replant should be given subsidy, that the seeds of cover crops should be distributed to small growers free of cost by the Rubber Board and that the required quantity of formic acid should be made available to all growers.

Conclusion

After discussions for three days the seminar concluded on 9th July. Shri Panampilly Govinda Menon, Dy. Minister, Government of India, attended the concluding session. The Minister announced that every effort would be made to reduce the interest on agricultural loan. He advised that there should be an efficient organisation to implement the various development schemes.

The meeting was presided over by Shri Janardhanan Nair, Director of Agriculture, Kerala. The seminar was very helpful in understanding the problems of Ernakulam district as a whole and preparing an outline of the development schemes there.

73rd Upasi Conference

The 73rd annual conference of the United Planters' Association of Southern India was held at Coonoor in the last week of August, 1966. The Union Finance Minister Shri Sachindra Chaudhury inaugurated the conference at 11 AM on the 27th August. Shri Chaudhury in his speech stated that the ultimate aim of all activities of the Government was social justice and he wanted the planters all over India to adopt a helpful and realistic approach. The Finance Minister said that the plantation industry had neither to lose nor suffer due to the recent devaluation of the rupee. The policy of increasing the country's exports was itself an unique incentive for the plantation industry. The Minister expressed satisfaction that the planters in South India were adopting modern scientific methods to Regarding plantation crops the Finance Minister wanted effective propaganda to be organised to fetch foreign markets. He pointed out the possibilities of increasing the export of Indian tea and claimed that devaluation would possibly help it. The Finance Minister concluded his address with a fervent appeal to the plantation industry in general to enhance productivity and production which according to him was consticuted processive.

Upasi Chairman's Address

The Chairman of the UPASI Shri M. M. Appaiya in his presidential address pleaded for a thorough enquiry into the affairs of the plantation industry by a high power body, to study the economic aspects of the industry. He described the present 'high'



The inaugural session—a view of the audience

price level of rubber in the domestic market as unhealthy. The rise according to him was the direct result of the Government's policy to maximise exports. The only way out he could suggest was to increase production and he said any artificial price control would lead only to malpractices.

Coffee Board Chairman's Speech

Shri A. S. E. Iyer, Chairman, Coffee Board, addressed the evening session of the conference. He suggested the creation of a special development fund and a price stabilisation fund for coffee growers and expressed the hope that the Government would consider the scheme favourably. The price stabilisation fund could be raised by the planters themselves and the development fund should be supplemented by the Government to encourage coffee growers. The

Chairman expressed confidence in the success of the Board's coffee replanting schemes, and other connected plans to enhance production.

Rubber Board Chairman's Speech

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, in his address outlined the developmental activities of the Board and the various schemes intended for the uplift of the small growers. After his address (published elsewhere in this Bulletin), the Chairman answered questions from the audience. He did not agree with a suggestion to convert a part of the newplanting loan as grant and replied that no further incentive was either necessary or practical for newplanting. Replying to another question the Chairman agreed to consider the relaxation of the replanting subsidy

rules to cover all the uneconomic and unselected areas irrespective of the entries in the registration records.

Scientific Conference

The UPASI Scientific conference was held on the 30th August. Papers on the plant protection schemes in Tea and Coffee plantations were presented and discussed at the conference.

Exhibition

The UPASI exhibition was opened at 9 AM

on 27th August. The Rubber Board had put up panels depicting the various schemes of the Board and statistics regarding production and acreage. Photographs were also exhibited at the side panels. The exhibitlon ended at 5 PM on the 20th August.

New President

Shri M. R. M. Poonja, General Manager of Kothari Estates, was elected as the new Chairman of the UPASI.

Inauguration of the Palghat District Rubber Marketing Society

While inaugurating the Palghat District Rubber Marketing Co-operative Society on the 16th July, 1966, Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, stated that rubber producers would get reasonable prices if the marketing of their production was done through co-operatives. He said that compared to the Travancore-Cochin area there was much scope for rubber cultivation in Malabar. He advised the growers to make use of the facilities provided by the Board to the fullest extent. Shri K. V. Raveendran Nair, District Collector, Palghat, presided. Shri P.K. Narayanan, Information Officer, Rubber Board, who spoke on the occasion, stated that the readiness on the part of the Board to implement the development schemes through cooperatives would mean that the Board was willing to decentralise powers to unofficial agencies.

The President of the Society, Shri Olappamanna, welcomed the guests and reviewed the progress made by the Society during the preceding 4 months. The Chairman inaugurated the Society by purchasing some rubber sheets from Shri K. C. Unni Nair.



The Chairman, Rubber Board, inaugurating the Palghat District Rubber Marketing Society

Shri George John Ancheril Elected Vice-chairman

Shri George John. Ancheril, has been elected Vice-chairman of the Rubber Board for a period of one year at the 54th meeting of the Board held on the 10th October, 1966, at Kottayam. He is a member of the Board representing large growers in the Kerala State. Shri George John is the second son of the late Shri A. V. George who was the Vice-chairman of the Board since its inception until his demise in 1959.

Shri George John joined his father's business in 1952 and he took keen interest in plantation affairs. Within a short period he became an expert planter. He has substantial stake in Messers. A. V. George and Co. Ltd. and is the managing director of Messrs. A. V. George and Co. (India) Private Ltd. Shri George John is also the managing partner of the Malayalam daily newspaper 'Kerala Bhooshanam.'



Shri George John Ancheril

Before he entered business, Shri George John had an extensive tour of the continent, the United Kingdom and the Scandinavian countries. Recently he undertook a business tour of Australia, Malaysia and Singapore. He was a member of the delegation sent by the Rubber Board to explore the possibilities of rubber cultivation in the Andaman and Nicobar Islands.

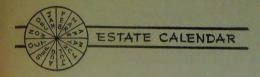
Shri George John has been intimately connected with the Rubber Board and the plantation industry in South India. He was first nominated to the Rubber Board in 1961 and was the Vice-chairman for a term. He is a member of the UPASI, the APK and the Mundakayam Planters' Association. He is also the Hony. Secretary and Treasurer of the Mundakayam Medical Trust.

All India Rubber Planters' Conference

The Mundakayam Planters' Association, in association with the Rubber Board organised an 'All India Rubber Planters' Conference at Mundakayam on the 27th and 28th December, 1966. Papers covering the different technical and administrative problems confronting the rubber plantation industry were presented by competent persons in the conference. A large assembly of delegates, including members and officials of the Rubber Board, representatives of various planters' association, in association, and the second planters' association, and the Rubber Board, representatives of various planters' association, in association, in

ations having interest in rubber, representatives of private concerns dealing in plantation supplies and top executives of the public sector plantation companies in Kerala, Madras and Mysore, participated in the conference in addition to a number of special invitees.

Shri Bhagwan Sahay, Governor of Kerala, inaugurated the conference on the 27th December 1966. Shri B.C. Sekhar, Director, Rubber Research Institute of Malaya, attended the conference and actively participated in the discussions.



For Rubber Growers

January

In the northern regions wintering may commence. This is the time when annual tapping rest is to be adopted and the panels protected with prowax or rubber kote-prowax mixture. Felling and clearing for newplanting or replanting is done at this time. This is also the time to start collection of *Purearia* seeds.

February

Wintering spreads effectively in most of the areas. The trees wintered earlier will start to refoliate. This is the time when sulphur dusting against powdery mildew has to be commenced. Many of the estates are allowed to enjoy tapping rest. Marking for the next season tapping can be done. Preparation of the land for planting is continued. Collection of cover crop seeds can also be continued.

March

Tapping rest can be discontinued and tapping commenced. Young areas are opened for tapping. Sulphur dusting rounds against powdery mildew is to be continued. Weeding is done in immature areas. Manuring can be started. In nurseries budding is done. Towards the end of the month spraying of fungicides against abnormal leaf-fall is started in large estates. In areas where planting has to be done, terracing, lining, pitting etc. should be done. Stimulants may be applied on trees 20 or more years old.

April

Weeding and manuring are continued. Spraying against leaf-fall also is continued. Budding in nursery and field is carried on. Preparation of land for planting is continued. The natural undergrowth is slashed. Dead woods are removed from the garden,

May

Spraying is continued. Treatment to prevent pink disease is done, Budding can be continued if necessary. Slashing of undergrowth is carried on. Sowing of cover crop seeds can be commenced.

lune

New flushes of young plants have to be given spraying. Nurseries are to be sprayed. The pits are filled and planting started. The tapping panels are disinfected with fungicides and water proofing with prowax or wax rex trescal done. If needed the beds for sowing seeds can be prepared. Cover crop seeds are sown or cuttings planted.

July

New flushes in nursery and young plants are sprayed. Planting is continued. If trees are tapped during this month panel protection should be given. Seed collection is done if available.

August

New flushes in nursery and young plants, in regions where shoot rot is prevalent, are sprayed. Treatment against pink disease is done. Seed collection is continued. Panel protection is given in areas where tapping is done. Rubber seeds are sown.

September

This is the time for weeding and manuring. Sowing of seeds can be continued. Repeated inspection and treatment of pink disease should be done. Young rubber buddings planted out during June-July should be given shade. Yield stimulants may be applied on trees 20 or more years old.

October

Weeding and manuring may be continued. Dead woods should be removed. Tapping panel should be given protective treatments.

November

Mulching should be done in nurseries and round young plants. Young plants should be guarded against sun scorch. Stems of young plants 2-7 years old and of older plants should be lime-washed if exposed to sun.

December

Lime-washing and mulching is continued if found necessary. Calopogonium seeds are collected during this month.

RUBBER STATISTICS

TABLE I

Area Under Rubber as at the End of Each Year

Year		Area in acres
950-51		170,506
1951-52		171,191
952-53		172,786
953-54		173,643
954-55		176,647
955-56		207,239
956-57		234,351
957-58		261,998
958-59		286,567
959-60		305,452
960-61		321,002
961-62		348,121
1962-63		361,142
963-64	***	377,938
964-65	***	383,813
1965-66		407,014

TABLE II

Planted Acreage Under Different Planting Materials as at the End of 1965-1966
(Area in acres)

Planting	. Newplanted area	Replanted area	Total area
Ordinary Budded	198,236 49,391 104,128	4,650 23,661 26,948	202,886 73,052 131,076
Clonal	251 755	55,259	407,014

TABLE III

Classification of Holdings and Estates According to Size as at the End of 1965-1966

		Groups			No.	of units	Area
4.	Small Holdings	(50 acres & below)					
	5 acres and belo	ow .			6	5,477	127,093
	Above 5 acres a	nd up to and inclu	ding 10	acres	. (5,175	45,099
	Above 10 acres					3,852	79,522
		Total			7.	5,504	251,714
3.	Estates (above 5	0 acres)					
	Above 50 and	up to & including	100	acres		325	23,612
	,, 100	,,	500	"		248	50,597
	,, 500	,	1000	,,		30	21,130
	,, 1000	,,	1500	,,		19	23,228
	,, 1500	,,	2000	,,		4	6,663
	,, 2000					10	30,070
		Total				636	155,300
		GRAND TOTAL			7	6,140	407,014

TABLE IV

Statewise Distribution of Area at the End of 1965-1966

(Area in acres)

	STATES	(50	HOLDINGS (50 acres & below)		ESTATES (Above 50 acres)		TOTAL	
		No. of units	Area	No. of units	Area	No. of units	Area	
1.	Kerala	74,445	244,614	581	138,096	75,026	382,710	
2.	Madras	1032	6,648	41	12,676	1,073	19,324	
3.	Mysore	25	392	11	3,945	36	4,337	
4.	Andamar	ıs		3	583	3	583	
5.	Tripura	1	20			1	20	
6.	Maharas	htra 1	40			1	40	
	Total	75,504	251,714	636	153,300	76,140	407,014	
		-		No. of Concession, Name of Street, or other Designation, or other	Children Control of the Control of t		-	

TABLE V
Statewise Production of Natural Rubber (In Metric Tonnes)

States	1960-61	1961-62	196263	1963-64	1964-65	1965-66
Kerala	23,175	24,954	29,057	33,792	41,391	46,953
Madras	2,040	2,060	2,695	3,176	3,724	3,195
Mysore	452	402	447	468	481	382
Andamans	30	30	40	51	20	
Total	25,697	27,446	32,239	37,487	45,616	50,530

TABLE VI

Production, Import and Consumption of Natural and Synthetic Rubber
(In Metric Tonnes)

Production			Import			Consumption			
Year	Natural	Synthetic	Total	Natural	Synthetic	Total	Natural	Synthetic	Total
1958-59	24,169		24,169	12,538	4,229	16,767	35,767	3,477	39,244
1959-60	24,173		24,173	15,287	5,718	21,005	40,491	4,964	45,455
1960-61	25.697		25,697	23,125	8,097	31,222	48,148	7,397	55,545
1961-62	27,446		27,446	22,528	10,121	32,649	48,410	10,186	58,596
1962-63	32,239		32,239	23,360	10,297	33,657	53,553	10,723	64,276
1963-64	37,487		45,562	26,275	8,812	35,087	61,155	11,959	73,114
1964-65	45,616		57,249	15,003	3,315	18,318		15,285	76,342
1965-66	50,530		65,271	16,357	2,735	19,092	63,765	21,553	83,518

TABLE VII

Reclaimed Rubber Acquired and Consumed by Manufacturers
(In Metric Tonnes)

Year	Acquired	Consumed
	3,973	4,102
1958-59	5,177	4,969
1959-60	5,183	5,453
1960–61	6,422	6,046
1961-62	6,839	6,850
1962-63	8,251	7,982
1963–64	9,349	9,369
1964–65	9,764	9,774
1965–66		

TABLE VIII

Stock of Natural Rubber at the End of Each Month (In Metric Tonnes)

Month	1959-60	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66
April	10,035	8,571	9,696	11,003	12,818	16,129	13,122
May	9,067	8,186	9,716	10,937	12,894	16,212	14,256
June	8,138	8,128	8,462	12,193	14,003	16,798	15,430
July	8,545	8,067	8,256	12,475	14,824	16,609	14,418
August	8,968	8,489	9,235	12,218	14,239	15,913	15,324
September	8,995	9,157	9,744	12,723	14,302	16,069	16,992
October	9,810	10,265	11,291	13,917	15,605	16,312	18,636
November	10,467	10,742	12.120	15,059	17,142	17,756	19,830
December	10,793	12,993	13,359	16,334	18,314	19,110	20,486
January	10,496	13,036	12,990	15,940	18,381	17,950	20,525
February	9,533	11,185	11,511	13,879	16,437	15,772	17,707
March	9,201	9,875	11,439	13,485	16,092	14,094	16,573

Rubber Position during April 1966 to September 1966

(M. Tonnes)

	April '66 to Sept. '66	April '65 to Sept. '65
Production		
Natural	24,715	24,293
Synthetic	8,481	8,897
Consumption		
Natural	33,524	33,142
Synthetic	9,645	10,320
Import		
Natural	4,525	13,744
Synthetic	2,041	1,933
Stock at the end		
Natural	11,935	16,992
Synthetic	4,827	8,734

The Rubber Board

Chairman: P. S. Habeeb Mohamed

Director of Research:

Dr. K. T. Jacob

Secretary: T. V. Joseph

Editor:

P. K. Narayanan

Asst. Editor:

T. N. V. Namboodiri

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The Better Choice

A rethinking on the utilisation of conventional type of materials in rubber planting has become inevitable in view of the advances made in the field of plant breeding. The intensity of interest shown towards making use of the progenies derived from seeds, needs to be diverted to going in for improved materials multiplied vegetatively, such as buddings. The superiority of budded materials over clonal seedlings has been established beyond doubt, so far as yield potential is concerned.

Budded plants are capable of withstanding tapping systems of higher intensities (alternate daily), with the exception of a few clones, while in clonal seedlings only 'once in three days system' is recommended to be followed. The number of 'yielding days in the latter case is thus less.

One school of thought against the use of buddings is said to be that budded plants have to be nurtured with greater care and attention. This mention of extreme care, in the case of buddings, is a little exaggerated for the reason that a budded plant needs careful treatment only during the initial period of its establishment. Whatever care exercised during this preliminary period will be felt more than justified when once such trees start bearing.

In hilly areas with steep slopes and tracts exposed to severe wind breaks budplants may not exhibit power of resistance as much as seedlings. For planting in such areas seedlings are the best suitable.

Mention has to be made, in this connection, of the undue popularity attained by the PBIG clonal varieties (GGI & GG2) in our country in recent years. Compared to Tjir I clonal seedlings, PBIG seedlings may fare a little better in production. This advantage is obviously due to the hybrid vigour inherent in polyclonal varieties. Hybrid seeds of this type will become available for distribution on commercial scale in India, with the commissioning of the polyclonal seed garden in Kanyakumari Dist. Import of seeds which results in considerable drainage of foreign exchange, will also be stopped as soon as polyclonal seeds are produced in India.

Of late, symptoms of realisation of the merits of budded material have been observed among the planters. This is a clear indication of the fact that the planters pay heed to what the Board advises.

The Director of the Indian Rubber Research Institute who visited Malaya last year has recommended in unequivocal terms that the planting policy has to be redesigned with a pronounced bias towards budded materials. A conference of rubber planters convened at Mundakayam in December, 1966, while discussing a paper on 'Planting materials and Planting' unanimously appealed for popularisation of budded strains.

The yield records maintained in Malaya also strongly support this change over. While budded trees of RRIM 600, 635 and PB 5/51 yield 1500 to 2400 lbs of rubber, the maximum yield registered by clonal seedlings like PBIG, GG!, GG2 is only 1350 lbs. At a time when a drive for improving the productivity in Indian plantations is being launched it is absolutely necessary to develop a "vegetative propagation oriented" outlook in the selection of materials for planting as this is the most vital basic factor deciding production potential.

Price Level and the Present Trends*

P. S. Habeeb Mohamed

The situation arising out of the steady fall in the price of natural rubber creates a serious situation for the rubber growers. It appears that for the last few months, the bigger consumers of natural rubber have practically kept off the market and there is considerable accumulation of stock with the estates and the dealers. The question of reviving the market and maintaining a teasonable level of price for the natural rubber gowers was discussed by the Chairman of the Board with the Dy. Minister of Commerce on 13—2—1967 and it was indicated that detailed proposals should be sent up by the Board. A copy of the Board's letter to Government has been circulated for information of the members of the Board from which it will be seen that there has been considerable accumulation of stock with the manufacturers on account of imported rubber and indigenous production of rubber purchased earlier.

Stock position and the market

It may be remembered that the Board has been consistent in its policy of recommending the quantity of imports to make up the requirements of the manufacturers. Even though the rubber growers are not happy about the Board's policy from 1956

onwards to recommend the gap to be met ption plus four months' stock requirements. so far the Board has been recommending the gap on the basis of the additional four months' stock. However in the proposals of the Board sent to Government from time to time it had been indicated that the import should be in a phased manner so that large quantities of import do not arrive particularly during the peak production period of natural rubber in the country. It has also been recommended that steps should be taken so that the large accumulation of stock with the manufacturers by imports and otherwise does not exercise a depressing effect on the market. It is noticed that the import of natural rubber for the period from September, 1965 to January, 1967 was 16,879 tonnes. This is higher than the total imports for the year 1965—'66 and also 1964—'65 and higher than imports for any corresponding period in any previous year. The stock position with the manufacturers, dealers and estates at the end of December, 1965 was 22,368 tonnes. It is also noticed that the level of purchase by the bigger consumers particularly the Tyre Companies has come down It is seen that for the period from September,

Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 56th meeting of the Board held at Kottayam on, the 3rd March 1967.

1966 to January, 1967 the total purchase of natural rubber by five big Tyre Companies was only to the extent of 5,707 tonnes, as against 14,091 tonnes in 1965—'66, 9,933

tonnes in 1964—'65, 6,681 tonnes in 1963—'64 and 6,231 tonnes in 1962—'63. The details of the monthwise purchase by these big Tyre Companies are indicated below:

Indigenous purchase of big Tyre Companies (M. Tonnes)

Months 1	1962—'63	1963—'64	1964—'65 4	1965—'66 5	1966—'67
September 1966	771	969	1,068	2,641	1,461
October 1966	1,156	907	1,766	2,363	656
November 1966	1,427	1,765	1,825	2,923	1,022
December 1966	1,245	1,486	2,879	3,623	1,558
January 1967	1,632	1,554	2,395	2,541	1,010
Total:	6,231	6,681	9,933	14,091	5,707
Percentage to tota production during the period		34%	42%	54%	20%

It is noteworthy that in spite of increase in consumption of natural rubber and increase in indigenous availability of both natural and synthetic rubbers, the level of purchase by the bigger Tyre Companies is going down and unless efforts are made to ensure that a considerable portion of the rubber produced in this country goes to the bigger manufacturers the depression in the market will continue.

The proposals which the Board had sent to the Government to maintain a steady level of price and the papers circulated for consideration of the Import & Export Committee could be usefully studied and recommendations made to the Government.

Members are aware that the enquiry of the Tariff Commission into the cost of production of natural rubber is still continuing and it may take some more time for the Government to fix the price of natural rubber. There is widespread apprehension among the planters that if the present depression in the market continues and the price falls, then this price may be misconstrued as the normal market price and the price of natural rubber fixed at this level for some more years, particularly at a time when the cost of planting and maintenance is going up steadily.

A welcome gesture

One noteworthy event during the period is the extending of statutory control over the price and distribution of synthetic rubber produced in this country. It has been reported that the Central Government has brought rayon cord, synthetic rubber, and carbon black within the purview of the Essential Commodities Act This is intended to enable the Government to control the price and distribution of these commodities which constitute important raw materials for the Tyre industry. We have requested the Government to send us a copy of the notification issued under the Essential Commodities Act as applicable to synthetic rubber and we will be able to study the implications, particularly whether this is a temporary or permanent arrangement. In

any case this is a welcome measure in the sense that so far when the price of natural rubber was under statutory control, there was no such statutory control on the production, distribution or the price of synthetic rubber though informal consultation with the Government used to take place and the price fixed by the manufacturers of synthetic rubber was with the knowledge of the Government. Since the same Ministry, i. e., the Commerce Ministry controls both natural rubber industry and also looks after the operation of the Essential Commodities Act through the Civil Supplies Commissioner (Ministry of Commerce) it is presumed that some uniformity will be maintained in future so far as the price level of natural and synthetic rubber produced in this country is concerned. The depression in the price of natural rubber will also affect the offtake of synthetic rubber had been revised consequent on devaluation. manufacturers have also represented to situation on the offtake of synthetic rubber.

Two Factors

There are two questions for consideration, assuming that the natural and synthetic rubber produced in this country is consumed inside the country itself. The main consideration is that considerable foreign exchange can be saved, if we can step up our production of both natural and synthetic rubber. Imports have to be arranged in such a fashion that they do not arrive in the peak production period of either natural or synthetic rubber and the excess stock built up by the manufacturers from all sources do not affect the market in any considerable way. At the same time restriction on imports may have the effect of suddenly boosting up the percentage of consumption of synthetic rubber which might bring in its wake expansion of synthetic rubber production and cutting down the price of synthetic rubber with its effect again on

natural rubber prices. Therefore modernisation of the plantation industry is to be carried out as early as possible. From this point of view the natural rubber industry may get a little time if the level of consumption of natural rubber is kept up as high as possible by adequate imports, because there is a limit to the natural rubber that we can produce within this country. There is also the question of expanding trade with neighbouring countries like Ceylon, Malaysia, which means that we might have to continue to import natural rubber for some more time. Since the problem of indigenous production of both natural rubber and synthetic rubber is peculiar to India, and Brazil the Board may seriously consider what exactly should be our future policy with regard to import, particularly when the Tyre and Tube Industries have been declared as priority industries and will be entitled to the benefit of the liberalised import policy. At the same time it is for consideration whether our difficulties of foreign exchange will ease in the near future. It might even mean that the priority industries may find it difficult to obtain their entire requirements of foreign ex-

Future expansion

Our production of natural rubber for the year 1966-'67 is expected to be 54,700 tonnes. Definitely the pace in the increase in production has been good, but the circumstances to-day are not congenial to the expansion of the area and increase in production. Investment in the industry has to be made sufficiently attractive to the planters and it should be the effort of the Board to revive the conditions which have been conducive to considerable expansion in area and increase in production during the last so many years. So far as the expansion of the area is concerned, we have not yet known about the decision of the Government of Kerala about making lands available in the Malabar region where private forests are available. It is hoped

that a liberal policy in this respect would be followed by the Government of Kerala. We had recently some discussion with the Managing Director of the Agricultural Reavailable for expansion of rubber area. But our past experience in availing of finance from the Refinance Corporation has not been very encouraging. This matter was discussed at a Common Meeting of the Commodity Boards' Chairmen at Bangalore in January. This meeting was also attended by the Special Secretary of the Commerce Ministry. It has been accepted in principle that the Rubber Board should prepare a scheme for loan finance to rubber planters in the large holding sector on the same lines as the Tea Board's finance scheme and the schemes available for expansion of the area under coffee. The discussions with the Special Secretary showed that the Government of India would be willing to consider favourably such a proposal from the Rubber Board. We have already sent up the proposals for a loan scheme to be operated by the Board on the basis of the decision taken at the Meeting of the Board in October 1966. This matter will have to be pursued.

Set-back in Replanting

It is disheartening to note that we have suffered set-back in the replanting programme for 1967. Last year against the target of 10,000 acres, we received applications for 16,000 acres. For the current year against the target of 10,000 acres, we have received applications only for about 3,500 acres. We have to intensify our publicity campaign and arrange to contact planters individually and make them replant the maximum area in 1967. High level of price is bad for replanting because people will be unwilling to cut down trees in uneconomic areas. A low level of price is equally bad because planters may reasonably have the apprehension that the low prices to-day may worsen 6 or 7 years after. This problem is

being looked into in detail and necessary corrective measures will be applied.

Proposals for the expansion of Research and Extension Services of the Board are being placed for approval. This is in accordance with the decision of the Board at its last Meeting on the basis of Dr. Jacob's report on his visit to Malaysia and also instructions received from the Ministry that a programme of expansion of area, increase in yield and research should be prepared for scrutiny by the Sivaraman Committee on Cash Crops.

The Pool Fund is getting depleted and we might have only Rs. 20 lakhs as opening balance for 1967-'68. The Government has not taken any decision about making from the General Fund to the Pool Fund for carrying on the existing schemes of the However, since the Government has given Rs. 70 lakhs for replanting in 1967-'68, perhaps we may scrape through 1967-'68 with the available balance in the Pool Fund. The collection from Excise Duty has been quite steady and we have collected by now from 1st April, 1966 Rs. 1,70,00,000/- In fact by steady increase in the collection of excise duty and by liquidating the Pool Fund we have built up a credit balance of nearly Rs. 3 crores with which we could make out a case for financing the large plantations and the small

Research Activities

Some advances have been made on the research side. Investigations on the latex flow pattern in relation to the brown bast affected trees have indicated that after the first phase of the flow, the fail in the flowrate was not gradual in brown bast affected trees. The flow rate, after a first rapid fall, remained constant for a considerable time. The phenomenon appeared to be associated with the initial stages of brown bast, i. e. the 'late dripping stage.' This condition is suggestive of some sort of failure in the

efficiency of flow blocking mechanism. Cyto-anatomical investigations on the depth of tapping and extent of exploitation of the trees have shown that about 54% of the latex vessels remain uncut as per the present tapping practices Studies have also proved that there is a positive significant correlation between yield and girth and girth and bark thickness in the same clone. There were indications to show that 'bark splitting'

recently reported from budwood nurseries, may not be a pathological problem. Creaming studies of skim latex have indicated that for creaming skim latex, the optimum concentration of Latcol HV both in powder form and swelled-up form, was the same viz. 0.2%. Studies on microbiological aspects in relation to rubber soils and latex have been initiated by the Rubber Research Institute.

Planting Materials and Planting*

Dr. K. T. Jacob

A. Introduction

Rubber planting in our country on a commercial scale is reported to have commenced in 1902, in an area of 500 acres. Since then, there has been a steady expansion in the area and during the last decade, the rate of increase has been very much marked i.e, from an area of 1,76,647 acres in 1945/55, it has now (1965/66) touched 407,014 acre mark and show signs of a much more rapid expansion in the near future. This rapid expansion has naturally resulted in the planting of rubber under a variety of soil and climatic conditions, some of them even marginal for a successful cultivation of rubber.

Rubber thrives well in a warm humid equable climate (20 to 30°C) with a fairly distributed annual rainfall of not less than 2000 mm and fairly deep and well drained soil. But it also grows under much wider soil and climatic conditions and it has even survived the adverse effects of drought extending from 4 to 5 months. Again, it can be successfully grown upto an altitude of 1500 ft. under Indian condition although it has established itself at much higher clevalent. But optimum results are obtained at lower elevations. Again, it is not nor-

Since a number of types to suit the particular climatic and soil conditions are available in rubber, as in other agricultural crops, it is essential that the best types suited for the specific soil and climatic conditions should be grown, for getting optimum results. This is particularly important in rubber, with a felling cycle of over 30 years, and a long gestation period from 5 to 7 years, where any initial mistake in the selection of the proper planting material for the specific area, will lead to far reaching adverse consequences. Therefore, in the present paper, it is proposed to examine the types of planting materials required under the varying conditions in the Indian Union.

B. Classification and Characteristics of Rubber Growing Regions

On the basis of the agro-climatic conditions, the rubber growing areas in the Indian Union can be broadly classified as follows:

1. Kanyakumari region— Characterised by very moderate and evenly distributed rainfall of about 1900 mm per year, which does not exceed 350 mm in any month. Both the South-west and North-east monsoons are equally important in this

mally grown in low lying areas where the water table is high, but several instances have recently been noticed where even these barriers have been overcome.

Paper presented by Dr. K. T. Jacob, Director/ Rubber Production Commissioner at the first All India Rubber Planters' Conference held at Mundakayam on 27th and 28th December 1966.

region. Temperature variations are not marked. Soils are found to be generally deep and comparatively more fertile, with good moisture holding capacity. However, strong winds are prevalent on the exposed situations.

- Kottayam, Ernakulam and Trichur (part) region: Under this region, Kottayam, Mundakayam, Kanjirappally, Meenachil, Thodupuzha and Mukundapuram Taluks are included. This is located at the centre of the rubber growing tracts, with an annual rainfall of 3000 to 4500 mm. The Southwest monsoon is very active, beginning in May, with peak period during June/July and may even extend to about 4 months. North-east monsoon is comparatively weak and ends normally by about November. Pre-monsoon showers are usually received during March and the diurnal variations in temperature are not much. Soils are mostly lateritic, highly acidic and comparatively poor in plant nutrient status. The conditions prevailing in this region are highly
- 3. Quilon and Trivandrum region: Comprising of the Pumalur, Pathanamthitta, Pathanapuram, Trivandrum and Nedumangad Taluks. Annual rainfall ranges from 2000 to 3300 mm. South-west monsoon is stronger than North-east, although comparatively weaker than in the previous area; the former commencing in April and continuing upto July/August, with June and July as the wettest months. However, January and February are normally dry months. The temperature fluctuations are of minor nature and soil conditions are better suited than in the heavy rainfall areas. Laterisation is not as much as the previous place.
- 4 Kozbikode and Canaanore region: With heavy rainfall varying from 3200 to 3400 mm annually. The South-west monsoon is the predominant one, contributing nearly 80 to 90 per cent of the total rain.

June/July are the wettest months, with about 1000 mm fall in each month, and therefore conditions are conducive to *Phytophihora* incidence. Drought period is longest in this area, with about 4 to 5 months. Soils are mostly lateritie, highly acidic and poor in plant nutrient status.

- 5. Palghat and Trichur (part) region: Characterised by uneven distribution of rainfall which is also the lowest when compared to other regions, and having pronounced wet and dry seasons. Drought period is the longest, extending 4 to 5 months. Summer temperature is comparatively high. Most of the areas are swept by strong dry winds. The soils are slightly acidic and comparatively well supplied with plant nutrients.
- 6. Mysore region: Located in the northermost part of the rubber tract of South India, characterised by comparatively extreme winter and summer seasons. Annual rainfall varies from 2100 to 2600 mm approximately. South-west monsoon contributes the major part of the rainfall with July as the wettest month, having nearly 1000 mm fall. North-east monsoon is very weak and ends in November. Drought period is also very pronounced. Conditions favourable to Phytophthora and Oldium leaf fall diseases are prevalent.
- 7. Andaman and Nichobar region: Climatic conditions in this region are more or less similar to those of Malaysia, with a moderate and evenly distributed rainfall, having no pronounced wet and dry seasons Both the monsoons are equally important and with little temperature fluctuations, but with much wider soil variations.
- 8. Regions with specific problems:
 (i) High elevation areas—found in most of
 the planting districts in South India, especially in the Mundakayam, Moovattupuzha,
 Kozhikode and Mysore regions, where
 distinct seasonal variations prevail, with fall

in temperature and prevalence of overhanging mist during winter months. Conditions here are therefore favourable to incidence of powdery mildew.

- (ii) Wind exposed areas—depending upon the locations of mountain ranges, areas which are exposed to strong winds are found scattered all over the rubber growing regions in the country.
- (iii) Low lying areas where water table is comparatively high.—In areas where land is formed of hills, ridges and valleys, patches of low lying valley areas having high water table may be encountered. Such low lying patches are found in all regions, especially in Andamam and Nicobar regions. In addition, low lying areas on river banks and raised paddy fields are met with

C. Planting Cycle

Being a sturdy tree crop, rubber can continue to be in the field for indefinite periods, even though the yield may considerably go down with advancing age, with the decline setting in after the peak periods of production. The tendency for maintaining old and obsolete plantations which have outlived their economic utility, is still prevalent among the planting public, especially the Small Holders. Therefore, it is imperative that a definite planting cycle should be accepted at the time of planting itself, which from experience and data available elsewhere, is considered to be about 30 years including immaturity period, so that tapping is done only on the virgin bark and first renewal. Usually, tapping on the second renewal bark may not be economic.

D. Planting

Selection of land and other preliminary operations like clearing, lining, pitting, refilling etc. have not undergone much change. In clearing a jungle area for rubber plantation, after removing all trees of

economic value, the undergrowth is slashed and burnt. Excessive clearing and burning will result in soil erosion and destruction of humus. Lining is carried out according to the terrain of the land. In flat areas, square or rectangular planting is adopted, while on a slopy land, contour planting is most advantageous. Planting pits are necessary, for the successful establishment and satisfactory growth of young plants. ×3 ft. may become necessary, but in loose ×2½ ft. or wide shallow pits with central alavango' hole can be tried. Mechanisation for pitting is feasible, especially in polythene bag planting, using a Post Hole-Borer machine, to effect economy. Filling of pits should be done with top soil as far as possible. Planting may be carried out during favourable season, after settling of the soil in the pit. The plants should firmly be planted in the pits without air spaces

E. Planting Season

The optimum climatic condition is the main factor in fixing the planting season, In our country, best results are obtained when rubber is planted along with the onset of South-west monsoon, usually in June. Success of late planting in August/September, depends on the occurrence of North-east monsoon. Planting of already established materials in polythene bags, at periods other than the conventional season, or at least for early or late planting can be explored.

F. Planting Density

Fixation of planting density depends on the type of planting materials to be used-seedlings or buddings. In a tree crop like rubber, there is an optimum stand a unit area can support to produce the maximum economic yield. Planting at a higher initial population for subsequent selective thinning is a sound scientific proposition. In doing

so, the higher initial cost will have to he taken into consideration, especially in view of the urgent need to reduce the cost of production of natural rubber, to enable it to compete successfully with synthetic rubber, on price factor. But in the case of planting materials like clonal seedlings with its inherent wider variability, higher initial stand is necessary, to permit thinning out of weaklings. But in actual practice, after planting a higher initial density, planters especially the Small Holders, are reluctant to carry out selective thinning even though it has been established that maximum yields could be obtained from an optimum stand. Another factor is that a major part of the area under rubber in our country is heavily interplanted with other trees of economic importance. The practice of planting a higher density in such intercropped areas aggravates the illeffects still further. It is known that closely planted rubber exhibits a tendency to grow taller, without proportionate girth. Similarly, the thickness of the bark and standard of bark regeneration are likely to be adversely affected in close plantings. Moreover, in our country, under will remain wet for long periods, after a rain, in closely planted areas, thereby reducing the number of tapping days in an year. However, the initial per acre yield may be higher in a closely planted area for sometime, which will not be maintained for long. A consideration of all the factors mentioned in respect of close planting therefore suggests the importance of ensuring an optimum initial planting density. On the basis of data available and from experience gained elsewhere, an initial planting of 200 plants per acre in the case of clonal seedlings and 180 buddings per acre are considered to be

G. Planting of Supplies

Vacancy supplying even in a mature stand, is not uncommon among Smallgrowers. But in technically advanced countries like Malaysia, vacancy supplying after

the first or second year of planting is not practised. Even in such cases, vacancies in patches are generally supplied and individual vacancy filling is not considered desirable. For vacancy supplying, polythene bag plants are the most ideal.

H. Planting Materials

Planting materials used in rubber cultivation can be broadly divided into high yielding clonal seeds and vegetatively propagated clones.

1. Clonal seeds: Clonal seed is obtained either from monoclonal or polyclonal area. Among the monoclonal seeds, Tjir I is the only suitable material for planting. This, with a moderate yield has gained wide popularity in our country and is the most favoured planting material even now, especially among the Small-growers But in technically advanced countries, monoclonal seeds are not favoured, instead, polyclonal hybrid seeds of proved parents are used to exploit its inherent hybrid vigour, moderately high yielding character and comparatively low cost. For the production of such seeds, polyclonal seed gardens were established and reputed polyclonal hybrid seeds like the GG series are being produced in Malaysia. In India also, polyclonal seed gardens have been established and are expected to produce seeds by 1970/71.

For reasons stated earlier, a higher initial stand of about 200 plants per aere is necessary in the case of all seedling materials, which increases the initial cost, to facilitate progressive thinning of the weaklings. Again Clonal seedlings give only moderate yield, and at the same time, are highly susceptible to brown bast under alternate daily system of tapping. Hence for a higher production, it is essential that preference is to be given to high yielding budgrafts. It may be noted that in Malaysia recording the highest annual per acre yield, about 80% of the total planted area, is under budgrafts and probably the reverse may be the case in our country.

2. Clones: A clone is a group of plants from the original Wickham collection from Brazil in 1876 was comparatively poor. Selection of mother trees was made from this seedling progeny, basing on high yield and other desirable secondary characters. The selected plants were multiplied vegetatively by budgrafting and thus the primary clones were evolved-eg, PB 86, Tjir I etc., Crossing among the proved primary clones, known to produce high yielding progeny and by selection and multiplication of promising hybrids from this group, produced secondary clones like RRIM series and PB fractional clones. There is a high degree of genetic uniformity among individuals of a clone. Hence an optimum stand could be initially planted, avoiding the necessity of planting a higher stand per acre and later thinning out, as in the case of seedlings. Moreover, most of the buddings could be tapped on an alternate daily system--S/2 D/2 100% intensity, excepting a few clones like GL I, which are highly susceptible to

The phenomenal increase in the per acreyided of rubber achieved in the Far East is mainly due to the evolution of high yielding clones. Some of the clones RRIM 600, 623 and 628 have produced over 3000 lb per acre and many others have crossed the 2000 lb mark. In addition, clones are also available to suit specific agro-climatic requirements and resistant or tolerant to prevailing diseases. A high yielding clone RRIM 605, which has produced over 2000 lb per acre in Malaya is reported to be suitable for planting, in drier regions. The following general recommendations are made in the choice of planting materials for the different regions in our country.

(1) In the Kanyakumari region, with a moderate climate approximating to the ideal conditions for the growth of rubber, any of the modern high yielding planting materials, excepting clones highly susceptible to the incidence of Oidium—the problem disease in the locality—could be cultivated. Buddings are to be preferred to clonal seedlings in this area.

- (2) For the Kottayam, Ernakulam, Trichur Region, with very heavy rainfall and the consequent widespread of abnormal leaf fall disease, clones like PB 86, Tjir I which are highly susceptible, should be avoided. Modern high yielding RRIM series and PB fractional material may be tried.
- (3) Punalur region—though with slightly lower rainfall than Mundakayam area—also has virulent Phytophthora attack, especially in Punalur, Pathanamthitta and Pathanapuram, and hence clones like PB 86, Tjir I etc which are highly susceptible to this disease, may be avoided. But clones showing slight tolerance to this disease like Gl 1 and GT 1 and other high yielding clones could be tried.
- (4) Kozhikode-Cannanore region, with heavy seasonal rainfall, provides congenial climatic conditions for heavy abnormal leaf fall incidence. Also due to the prolonged and pronounced drought period and comparatively poor soil conditions, the average growth of plants may be poor. Therefore clones highly susceptible to abnormal leaf fall disease like Tjir I and PB 86 and slow growers like GL 1 and PB 86 may not be preferred. Moreover, Tjir I may also show considerable depression in yield during hot dry period. Therefore, other vigorously growing budgrafts and clonal seedlings are to be preferred. RRIM 605 which is reported to be slightly drought resistant, may prove to be a good planting material for this region.
- (5) In Palghat region, with low rainfall, pronounced drought period, highly wind spect conditions and with comparatively good soils, clones which are susceptible to wind damage like Tjir 1, LCB 1320, RRIM

600 and those highly sensitive to dry conditions like GL I etc may not prove to be very satisfactory. Clones which are resistant to wind damage and not much affected by dry conditions like RRIM 605 and clonal seedlings may be cultivated in this region.

- (6) For Mysore region, with pronounced drought period and at the same time having seasonal variations conducive to Phytophthora and Oidium diseases, clones sensitive to dry conditions and highly susceptible to the above diseases may not be grown. Clonal seedlings and other clones which are not sensitive to dry conditions will be more suitable in this area.
- (7) In the Andaman Nicobar region, the climatic conditions are almost similar to that of Malaysia, especially in Nicobar islands and hence all the modern high yielding budgrafts and clonal seedlings are suitable for this region. But due to the peculiar land formation in this region, problem pockets like highly wind swept areas and low lying places with high water table constitute a considerable portion in this region. In such areas, suitable planting materials are recommended separately.
- (8) Regions of specific problems—(i) High elevation, where the important problems are fall in temperature, seasonal variations of climate and prevalence of overhanging mists during winter months. Such conditions are very congenial for Oidium, incidences and therefore the ravages of this disease may invariably become a limiting factor. Therefore, clones resistant to this are to be grown in this region. In this connection it may be mentioned that PB 86 is reported to grow better than other clones and clonal seedlings in Wynad area.
- (ii) Wind exposed areas. Here clones highly susceptible to wind damage like Tjir 1, LCB 1320, RRIM 600 etc should not

be planted. Clonal seedlings and other high yielding wind resistant budgrafts suitable to the prevailing agro-climatic conditions may be chosen.

(iii) Low lying areas with high water table. It has been found that Gl l is a suitable planting material for such areas.

I. Conventional Planting Materials

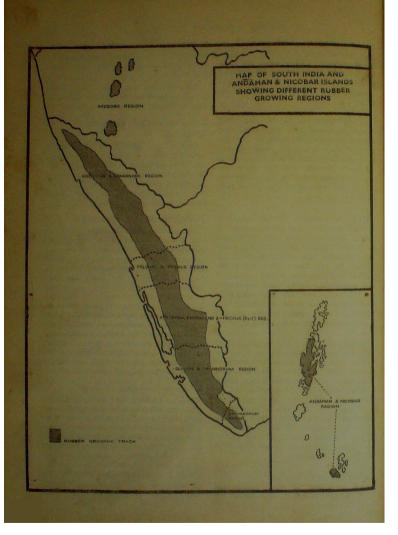
Seed at stake planting is an accepted method in rubber cultivation, but climatic conditions prevailing in our country make this undependable. Planting of seedlings, and stumps previously raised in the nurseries, is most common in our areas. Field budding is sometimes practised.

J. Polythene Bag Planting

Though the method of raising seedlings and budded stumps in the nursery and trans-planting them in the field is a generally accepted method, raising plants in polythene bags and planting them in the field as such, without disturbing the shoot and root systems, is becoming popular. In the case of seedlings, polythene bags of 12" diameter, 24" height and 250 to 300 gauge thickness, filled with made up soil, is found to be satisfactory. The plants are retained for 8 to 10 months in the bags and transplanted during favourable season. This method has an added advantage that undisturbed plants are being put into the field, and thereby reduce the percentage of casualties.

K. Greenbudding

In green budding, the buds stripped from green terminal shoots of the desired clone are budded on seedlings in the nursery or on seedlings raised in polythene bags. But a better method is to budgraft the plants in the nursery, cut them back and transplant the stumps in polythene bags after sufficient root pruning. This will overcome the disadvantage of the root system becoming long and elongated, as in the case of seedlings raised straight in polythene bags. Such



green budded stumps planted in polythene bags could be planted in the field during favourable season. When polythene bag plants are used, the pit size may be reduced.

L. Maintenance

Maintenance of a plantation, especially during its immaturity period, has great influence on its future yield and performance. The guiding principles in maintenance should be to effect economy and at the same time adopt the necessary techniques to reduce the immaturity period. It has been conclusively proved that establishment of a legumi-

nous ground cover reduces the immaturity period of rubber. This will also reduce the cost of weeding, effectively check soil crosion and retain soil moisture. In addition, by raising a leguminous ground cover from the very beginning, substantial saving on manuring cost could be achieved. Judicious fertiliser application according to requirements of the plants, based on the soil fertility level and tissue analysis, will produce optimum growth and yield. Other items of maintenance like timely weeding, corrective pruning and proper disease control operations are also necessary for successful rubber cultivation.



Observations on the Floral Biology of and Fruit Set in Hevea brasiliensis Mull-Arg*

P. J. George, A. O. N. Panikkar, V. K. Bhaskaran Nair I

Introduction

Although much work had been done in the improvement of the Para Rubber Tree (Hevea brasiliensis Mull-Arg) through breeding and selection, our knowledge of the floral biology of the plant is very limited. A precise knowledge of the morphology of the flower, sex distribution, rate and time of anthesis and anther dehiscence and extent of fruit set in the various clones of Hevea would be a very useful prerequisite for programmes of work relating to breeding and establishment of seed gardens. The present studies were initiated with these in view.

Earlier workers have however mentioned about the morphology of the flowers in *Hevea*. Mention may, in this connection, be made to Edgar (1958), Djikman (1951) and Planter's Bulletin (1953).

Hevea brasiliensis is monoecious. The flowers are arranged in panicles, both male and female flowers being found on the same panicle. The panicles are either axillary or terminal and appear usually during refoliation after wintering. The female flowers are found to be limited in number.

The male flowers are typically pentamerous, with a bell-shaped perianth, of five lobes, which is yellow in colour. The stamens are ten in number, arranged in two whorls of five each, attached to a central column. They are smaller than the female flowers and are found on the minor and the major branches.

The female flowers are restricted to the terminal position on the main inforescence stalk and on the major branches. They are bigger than the male flowers in size and have a green disc below the perianth and the ovary. The perianth is yellow in colour with five lobes. The ovary is generally trilocular with a single ovule in each locule. Rarely, however, ovaries with two, four, five or even six locules with one ovule in each of them, are met with.

The present studies had been carried out on trees growing at the Experiment Station of the Rubber Research Institute of India at Puthupally, Kottayam. The relevant details of the materials and of the methods followed, are mentioned appropriately.

Wintering and flowering

Hevea brasiliensis being deciduous, sheds the leaves, the phenomenon being termed as 'wintering.' Wintering in South India is normally from December to February. The trees may shed its leaves either completely or partially, during this period. The new

^{*} Contribution from the Division of Botany, Rubber Research Institute of India, Kottayam-9.

Senior Research Assistant, Cyto Anatomist, Dy. Director, Botany Division, R. R. I. of India, Kottayam-9.

flushes of leaves appear sooner or later and inflorescences also appear along with them.

Wintering and flowering in H. brasiliensis had been studied with respect to the following clones:

1.	Tjir 1	2.	GL 1
	AVROS 255	4.	PB 6/9
	PB 86	6.	PB 5/139

9. RRIM 501 10. RRII 14

For the observations, four trees from each clone and five healthy branches from each tree were chosen. These trees and the selected branches were properly tagged and the first count of leaves on each of them was taken during the first week of December, Observations with regard to the rate of defoliation, appearance of inflorescence and period of profuse flowering were made at weekly intervals thereafter. A summary of the observations made during 1965–1966 is given in Table I.

Table—I
Wintering and flowering (1965—66) of Hevea

SI. No.	Clone	50% Winter- ing	100% Winter- ing	First Flower- ing	50% Flower- ing	100% Flower- ing	Remarks
1	Tjir 1	27-1-66	23-2-66	19-2-66	3-3-66	16-3-66	
2	Gl I	27-1-66	8-2-66	8-2-66	19-2-66	3-3-66	
3	AVROS 255	27-1-66	9-2-66	19-2-66	23-2-66	3-3-66	* Winter-
4	PB 6/9	31-1-66	*	19-2-66	23-2-66	3-3-66	ing had
5	PB 86	27-1-66	8-2-66	3-3-66	16-3-66	16-3-66	been fou-
6	PB 5/139	31-1-66	19-2-66	3-3-66	16-3-66	16-3-66	nd to be
7	RRIM 501	27-1-66	22-2-66	19-2-66	3-3-66	16-3-66	partial
8	RRIM 5	9-2-66	19-2-66	19-2-66	3-3-66	16-3-66	with reg-
9	RRII 12	17-1-66	28-1-66	17-1-66	31-1-66	10-2-66	ard to
10	RRII 14	5-1-66	25-1-66	31-1-66	9-2-66	3-3-66	PB 6/9.

The date of 50 percent wintering corresponds to the date of observation on whi habout 50 percent of the total number of old leaves had been shed, and that of 100 percent wintering to the date on which all the old leaves had been shed, with regard to the respective clone. The date of first flowering corresponds to the date of observation on which a flower, either male of remale, has opened on any panicle of any of the branches under observations in the particular clone; that of 50 percent and 100 percent flowering to the date on which 50 percent of or all the branches under observation bear open flowers, respectively.

All the clones, except PB 6/9, have been found to winter completely. In the case of PB 6/9 wintering had been found to be partial, some of the old leaves being retained on some of the branches.

Refoliation, however, had been found to start even before all the old leaves of a branch are shed off. Along with the new flush of leaves, panieles also appear. Panicles initially appear on the basal parts of the newly formed portions of the stem subtended by the scale leaves; but later, they arise in the axils of the leaves or on the top portions of these branches.

Wintering and flowering had been found to be early in the case of RRII 12 and RRII 14. Wintering was complete by about the third week of February. Profuse flowering was noted from the middle of February to the middle of March, in general.

As mentioned earlier, the observations had been carried out from the first week of

December 1965 to the third week of March 1966. A summary of the meteorological data for this period is furnished in Table II. It may be noted that no rainfall was recorded during the months of January and February. These months also recorded the maximum mean temperature, 31.19°C in January and 32.00°C in February.

Table—II
Climatological data (weekly summary) at the RRII Experiment
Station (December 1965 to March 1966)

Period	Total rainfall (Cm)	No. of rainy days	Max. temp. (mean °C)	Min. temp. (mean °C)	Relative humidity (%)
Nov. 28 to Dec. 4	1.13	2	29.14	22.00	86.29
Dec. 5 to Dec. 11	12.31	4	27.00	21.14	92.00
Dec. 12 to Dec. 18	0.76	1	30.00	20.00	86.29
Dec. 19 to 25	00.00	0	30.00	20.71	83.43
Dec. 26 to Jan. 1	0.00	0	31.14	22.00	82.57
Jan. 2 to 8	0.00	0	31.71	21.14	90.29
Jan. 9 to 15	0.00	0	32.14	. 22.14	86.71
Jan. 16 to 22	0.00	0	32.00	22.00	86.14
Jan. 23 to 29	0.00	0	31.71	21.71	
Jan. 30 to Feb. 5	0.00	0	32.00	22.00	85.14 87.00
Feb. 6 to 12	0.00	0	32.0	22.00	87.00
Feb. 13 to 19	0.00	0	32.00	22.29	
Feb. 20 to 26	0.00	0	32.00		89.86
Feb. 27 to Mar. 5	3.30	2	31.43	22.00	89.71
Mar. 6 to 12	2.79	2	30.00	21.71	90.43
Mar. 13 to 19	1.27	1	31.00	20.57	89.14
Mar. 20 to 26	0.65	1	30.29	21.71	93.57
Mar. 27 to Apr. 2	4.57	i	30.86	22.00 22.57	94.57 93.00

Sex ratio

It had already been mentioned that the male flowers are much greater in number than the female flowers. Detailed observations were made with respect to the distribution of the male and the female flowers in the following clones;

- 1. Tjir 1 2. Gl 1 3. AVROS 255 4. PB 6/9
- 5. PB 5/139 6. PB 5/60 7. PB 6/50 8. BD 10
- 9. RRII 6 10. RRII 12
- 11. PB 86

For these observations five trees were chosen from each clone and ten panicles from each tree. Fully developed panicles were collected, before any of the opened flowers fell off, and the numbers of male and female flowers or flower buds were counted in each.

A brief summary of the observations is given in Table III.

Table—III

Distribution of male and female flowers in Hevea

SI.	Clone	Mean No. flowers per panicle male	flow	of male ers for female flower
1.	Tiir 1	240.24	4.32	55.61
2.	Gl 1	225.64	2.36	95.61
3.	AVROS 25		5.62	36.93
4.	PB 6/9	143,68	1.32	108.85
5.	PB 5/139	268.70	2.24	119.96
6.	PB 5/60	151.50	7.26	20.87
7.	PB 6/50	153.56	3.38	45.43
8.	BD 10	263.04	1.36	193.41
9.	RRII 6	258.46	8.26	31.29
10.	RRII 12	139.88	2.12	65.98
11.	PB 86	200.98	2.70	74.44

The number of flowers in a paniele varied from clone to clone. The mean number of male flowers per paniele varied from 139.88 in RRII 12 to 268.70 in PB 5/139. The mean number of female flowers in a paniele ranged from 1.32 in PB 6/9 to 8.26 in the case of RRII 6. The sex ratio consequently was also found to vary for the different clones studied. The proportion of male flowers for each female flower was found to

be the lowest in PB 5/60, and highest in the case of BD 10, the values being 20.89 and 193.41 respectively. Speaking in general of all the clones, it was found that a mean number of 77.13 male flowers are present for each female flower.

Anther dehiscence

Anther dehiscence was studied in the following clones of:

- 1. Fx 516 2. AVROS 255
- 3. Gl 1 4. PB 6/9
- 5. RRII 12 and 6. RRII 6

A preliminary observation was made with regard to all the above clones, throughout day and night, at intervals of two hours. Flower buds were examined for the presence of dehisced anthers, if any, while they were still attached to the tree. This has shown that no anther dehiscence takes place during the night hours and that the anthers dehisce generally between 6.00 Hrs and 12 00 Hrs. Detailed observations were undertaken during this period.

For the detailed investigations, observations were made at 30 minutes intervals from 5.30 Hrs to 12.00 Hrs. Each time 25 flower buds expected to open the same day, were chosen on the panicles attached to the trees and the anthers were observed on the spot, after separating the perianth carefully. The flower buds thus studied were clipped off every time to ensure that no bud is examined more than once. Another 25 buds were chosen, examined and removed for the next observation and the process was repeated. This procedure was adopted separately for each clone.

A summary of the observations is given in Table IV.

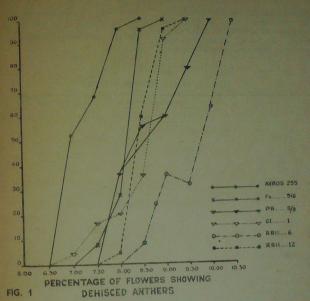
Table—IV

Anther dehiscence in Hevea

SI. No.		Time of observation									
				Fx 516	AVROS 255						
1.	5.30	Hrs.	25	nil	nil	nil	nil	nil	nil		
2.	6.00	**		,,	**	,,	,,	,,	,,		
3.	6.30	,,		,,	,,	,,	,,	,,	,,		
4.	7.00	,,		,,	13	1	,,	,,	,,		
5.	7.30	31		2	17	4	,,	,,	,,		
6.	8.00	,,		7	24	5	9	1	,,		
7.	8.30	,,		24	25	9	14	15	2		
8.	9.00	,,		25	25	23	15	24	9		
9.	9.30	,,		25	25	25	20	25	8		
10.	10.00	,,		25	25	25	25	25	16		
11.	10.30	,,		25	25	25	25	25	25		
12.	11.00	"		25	25	25	25	25	25		
13.	11.30	"		25	25	25	25	25	25		
14.	12.00	,,		25	25	25	25	25	25		
	1	Maximu	ım Temp	°C 32	32	32	30	32	30		
	I	Minimu	m Temp	°C 22	22	22	23	22	22		
	F	Relative	Humi-								
			dity	% 83	91	91	91	86	96		

It had been found that anther dehiscence start from 6.30 Hrs and continues upto 10.00 Hrs. though individual clones have shown some difference in the range of time. In AVROS 255 dehiscence started at 6.30 Hrs. and is completed by 8.30 Hrs. The corresponding period is 6.30 to 9.30 Hrs;

7.30 to 9.00 Hrs; 7.30 to 10.00 Hrs; 7.30 to 9.30 Hrs. and 8.00 to 10.30 Hrs. for Gl I, Fx 516, PB 6/9, RRII 12 and RRII 6 respectively. All the flower buds examined after 10.30 am had dehisced anthers, in the case of all the clones. The details are graphically represented in Figure 1.



Once the anthers start dehiscing, it was noted, that the time, required to complete the process vary a little with respect to the different clones. It is completed in two hours in the case of Fx 516, AVROS 255 and RRII 12, PB 6/9 and RRII 6 took 2½ hours and in Gl 1 the process was extended over a period of 3 hours.

Anthesis

A preliminary observation, throughout day and night has shown that neither male nor female flowers open during the night hours and that the flowers generally open between 10,00 to 14,00 Hours. Detailed

observations with regard to the time of opening have been carried out at 30 minutes intervals with regard to all the clones studied for anther dehiscence, from 9.00 Hrs to 16.00 Hrs.

100 to 200 male flower buds and 50 to 100 female flower buds, in each clone, expected to open during the day of observation, were studied, their exact number depending on the availability of flower buds. The buds found to be opened were clipped off after each observation and the number of buds opening at every interval of 30 minutes was recorded separately for the male and the female flower buds.

It was found that the male flowers generally open at least an hour earlier than the female flowers, with regard to the clones studied. The time of opening of the male and female flowers was also found to vary

in the different clones. The observations on the time of anthesis of male and female flowers are summarised in Table V and VI respectively.

Table—V
Opening of male flowers in Hevea

SI.	Time		Perce	entage of	male flo	wers oper	ned in each	ch clone
No			Fx 516	AVROS 2	255 GI 1	PB 6/9	RRII 12	RRII 6
1	9.00- 9.30	Hrs.	nil	nil	nil	nil	nil	nil
2	9,30—10.00	,,	"	,	,,	,,	,,	,,
3	10.00—10.30	,,	19	,,	37	,,	,,	7
4	10.30-11.00	,,	28	"	,,	3	1	21
5	11.00-11.30	- 17	24	,,	",	10	2	52
6	11.30—12.00		20	,,	1	50	19	20
7	12.00-12.30	33	5	1	8	21	29	
8	12.30—13.00	,,	4	27	53	11	20	
9	13.00-13.30	"		46	31	5	23	
10	13.30-14.00	,,		20	7		4	
11	14.00—14.30	"		6			2	
12	14.30-15.00	"						
13	15.00-15.30	2,						
14	15.30—16.00	"						
N	Maximum Temp.	°C	32	32	32	30	32	30
N	Minimum Temp.	°C	22	22.5	23	20	22	23
F	Relative Humidit	y %	84.5	83	83	95	84.5	91

With regard to the opening of the male flowers Fx 516 and RRII 6 had been found to be earlier, the flowers opening from 10.00 Hours onwards. In the latter the duration of opening is short extending from 10.00 to 12.00 Hrs. Only whereas in the former it is from 10.00 to 13 00 Hrs. In RRII 12 and AVROS 255 the male flower buds open upto 14.30 Hrs. after which no flower buds were found to open in any of the closes studied.

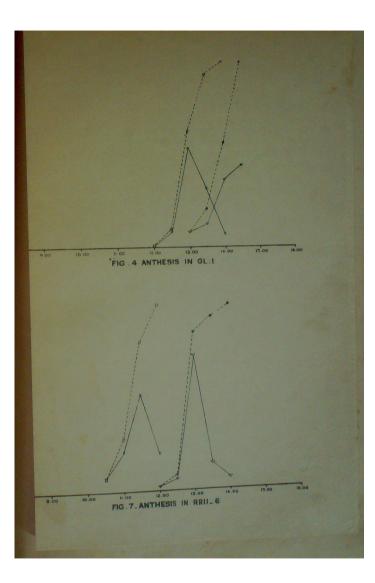
The female flower buds start opening from 11.00 Hrs. in the case of Fx 516 the process extending up to .4.30 Hrs. In the case of PB 6/9 the corresponding period

is from 13.30 to 15.30 Hrs., whereas the other four clones studied are found to be intermediate between the above two. After 15.30 Hrs. no female flower bud expanded.

To get a clearer idea of the time of opening of the male and female flowers in each of the clones studied, the observations are graphically represented in figures 2 to 7.

Fruit set

Fruit set in *Herea* had been studied with regared to all the eleven clones in which the distribution of male and female flowers had been studied. Two trees were chosen from





Table—VI
Opening of female flowers in Hevea

		Percentage of female flowers opened in each clone							
SI. No	. Time	Fx 516	AVROS 255	Gl 1	PB 6/9	RRII 12	RRII 6		
1.	9.00- 9.30 Hrs	nil	nil	nil	nil	nil	nil		
2.	9.30-10.00 ,,	21	"	,,	,,	,,	"		
3.	10.00-10.30 ,,	>>	,,	"	"	57	29		
4.	10.30-11.00 ,,	3	"	"	99	"	25		
4. 5. 6.	11.00-11.30 ,,		"	"	,,,	"	2		
6.	11.30-12.00 ,,	41	33	25	"	22			
7.	12.00-12.30 ,,	13	"	8	"	37	6		
8.	12.30-13.00 ,,	24	"		"	"	72		
9.	13.00-13.30 ,,	9	6	12	"	2	14		
10.	13.30-14.00 ,,	8	20	36	4	20	6		
11.	14.00–14.30 ,,	2	74	44	18	78	***		
12.	14.30-15.00 ,,	***	***	***	68		***		
13.	15.00-15.30 ,,		***	***	10	***	***		
14.	15.30-16.00 ,,								
	Maximum Temp °C	32	32	32	30	32	30		
	Minimum Temp °C	22	23	22	20	22	23		
	Relative Humidity%	83	83	87	95	91	91		

each clone and 75 female flowers in each tree distributed on five branches, chosen at random, were tagged. From each clone 150 Female flowers were observed. Counts of

the female flowers which developed into fruits were taken at intervals of ten to fifteen days till these fruits became mature. The results are summarised in table VII.

Table VII Fruitset in Hevea

SI. No.		No. of	Number of fruits observed after							
	Clone	female flowers	2 weeks	1 month	2 months	3 months	4 months	Remarks		
1	Tür 1	150	45	9	8	8	6			
2	GLI	150	1	1				None of the 150		
3.	AVROS 255							female flowers		
		150	55	9	4	1	1	observed, deve-		
4.	PB 6/9		82	8	4	3	3	loped to		
5.	PB 5/139	150	23	8	6	6	5	produce mature		
6.	PB 5/60	150		17	4	3	3	fruits in the		
7.	PB 6/50	150	83	3	2	1	1	case of Gl I and		
8.	PB 86	150	64	2	3	2	2	AVROS 255.		
9.	BD 10	150	57	3	2	2	1			
10.	RRII 6	150	9	3	20	20	20			
11.	RRII 12	150	68	27	20	20				

Mentioning all the clones in general, 2.545 percent of the female flowers observed set fruits which developed into mature stage. The observations taken after two weeks showed that 70.48 per cent of the female flowers observed had dropped off during this period. This could be due to drop of the female flowers which were unfertilised as well as due to the fruit drop during the initial stages of development. Of the fruits recorded after two weeks, \$1.52 per cent dropped off within the next two weeks. Of the fruits observed after one month, two months and three months 58.8, 86.8 and 91.3 per cent respectively developed into mature fruits. In other words, fruit drop decreased when the fruits approached maturity.

Discussion and summary

The present paper gives a brief account of studies on wintering and flowering in ten clones, anther dehiscence and opening of the male and female flowers in six clones and sex ratio and fruit set in eleven clones of Hevea brasiliensis Mull Arg. under natural conditions, at the Experiment Station of the RRII.

In general, the period of wintering had been found to be January to February. The exact time of wintering, however, may vary in the different regions according to the climate of the particular region. Of the ten clones studied, nine showed complete wintering by the third week of February. Wintering started early in the case of two clones, RRII 12 and RRII 14 and complete wintering was noted by the end of January. Partial wintering was noted in the case of PB 6,9 in which case, all the old leaves were not shed off and some of them were retained along with the new ones. It was noted that in this clone only 95.68 percent of the leaves were shed off during wintering.

In all the clones, refoliation started before all the old leaves dropped, the panicles also appearing along with the new flushes. First flowering was recorded before complete wintering in the case of Tjirl, RRIM 501 RRII 12 and PB 6/9 and after complete wintering in AVROS 255, PB 86, PB 5/139 and RRII 14. With regard to Gl 1 and RRII 5 first flowering was noted on the date on which complete wintering was also observed.

The mean number of flowers per panicle had been found to vary from 142.00 in RRII 12 to 270.94 in PB 5/139. The mean number of female flowers per panicle varied from 1.32 in PB 6.9 to 8.26 in RRII 6. The proportion of male flowers to each female flower varied from 20.89 in the case of PB 5/60 to 193.41 in BD 10.

The anthers usually dehisce before the male flowers open. The time lapse between anther dehiscence and opening of the male fllowers was found to vary with regard to the different clones. Anther dehiscence started at least two hours before flower expansion in RRII 6 whereas it was 5 hours 30 minutes ahead in the case of AVROS 255. It may be mentioned in this connection that the time of anther dehiscence and flower expassion may vary in different species. For different leguminous species a time lapse, between anther dehiscence and flower opening, of 3 to 8 hours has been reported by different authors (Bolhius etal 1965; Chakravarty & Choudhiri1965). Majumdar (1964) cited that in Hevea, anthers dehisce by 8.00 Hrs. The present studies have shown that anthers usually start dehiscing by 6.30 Hrs. and continues upto 10.30 Hrs., under natural conditions, the exact time varying with respect to the different clones as may be seen from Table IV

The male flower buds expand earlier than the female flower buds of the same clone, as may be noted from Figure 2 to 7.

Though Hevea flowers profusely, only a small percentage of the female fllowers develop into fruits. Even in hand pollination programmes only 2 to 8 percent of the pollinated female flowers develop to fruits

and an average of 5 percent fruit set is considered a fair success (Edgar 1958), though the final success depends on the clones pollinated (Dijkman 1951). Under natural conditions, the percentage of fruit set is considerably lesser.

In the present studies, under natural conditions, 2.545 percent of the female flowers had developed into fruits. The individual clones, however, varied with regard to the extent of fruit set. None of the female flowers observed, set fruit in the case of GI I and AVROS 255. In three clones, the fruit set was only 0. 67 percent and 13.33 percent of fruit set was recorded in RRII12. Tjir I showed a fruitset of 4.00 per cent. It may also be mentioned that only 0.67 per cent fruit set had been observed in the case of PB 86, which is reported to be a prolific seeder (Paardekooper 1965). It may be mentioned here that there was heavy incidence of Oidhum during the season. This could be an additional factor for the low fruit set, observed in the present studies.

It does not appear that there is any relation between the number of female flowers in a panicle and the extent of fruit set. The preportion of male flowers to female flowers also does not appear to have any influence on the fruit set, as may be recalled from Table III and VII. In RRII 6, wherein the maximum number of female flowers per panicle had been noted, fruit set was only 0.67 per cent. In BD 10, which showed 193.41 male flowers for each female flower, the fruit set was only 1.33 per cent. RRII 12, which recorded the maximum fruit set of 13.33 per cent, had 2.12 female flowers on an average per panicle and 74.44 male flowers for each female flowers.

Fruit drop during the early stages of development is considerably high. Ross (1960) had reported that fruit drop is heavy during the first half between pollination and harvest in the case of hand pollination. During the the first month, fruit drop was

recorded to be 94.5 percent. However, rate of fruit drop decreased considerably with the advancement of maturity.

Acknowledgement

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The Versatility of Natural Rubber*

B. C. Sekhar

Natural Rubber is unique in its properties and there is no synthetic rubber which can completely match the qualities of natural rubber. When the synthetic industry came in, they tried to develop materials having basic strength and properties equivalent to natural rubber, to fit in, with the requirements of the consumer. Styrene-butadine (SBR) and other synthetic rubbers could not compete with natural rubber, instead that could be considered complementary to the natural rubber industry. For example, in the tyre manufacture, for better tread wear, SBR should be used for tread, for better ozone resistance, neoprene should be used for the side walls and for better tack properties, natural rubber should be used for the carcas. Thus there are specialised areas of use for different polymers. Though natural rubber enjoyed an unique position, presently, it is being used largely for the special requirements of the consuming industry. It is only countries like India which can develop in a realistic manner industries of natural and synthetic polymers which will complement each other.

In developing synthetic rubbers, it would not be advantageous to go in for a polyisoprene unit. Polyisoprene is a very poor polymer and if one goes in for its production, it would not be wise. The latex is usually coagulated and the coagulation formed are sheeted out in thin sheets for easy drying. The moisture in rubber caused fungal growth. The smoking of rubber was introduced to prevent this, since smoke offers protection against fungal attack. The sheets thus produced were visually graded, depending upon the colour, dirt, bubbles and blisters. Since the presence of bubbles and blisters downgrade rubber, the dilution of latex before coagulation became a necessity. The RSSI sheets thus produced, in a large measure, can be said to be a good rubber.

Quality a must

In rubber technology, several ingredients such as sulphur, accelerators, activators, etc. are used. No scientific basis was adopted to develop this technology until synthetic rubber came into prominence. Synthetic rubber came up and it wanted to find out properties which will replace the element in natural rubber and then came the necessity for natural rubber producer to ensure the quality and give the product the best properties, especially uniformity and consistency, which the consumers were looking for. This was the position when scientists in Malaysia felt that unless something is done to improve the properties of natural rubber, synthetic polymers would establish domain in the rubber world.

In Malaysia they started up with the tree, to find out what is the position of rubber

Speech delivered by Sri. S. C. Sekhar, Director, Rubber Research Institute of Malaya at the first All India Rubber Planters' Conference held at Mundakayam on 27th and 28th December 1966.

molecule in the latex and found out that when latex comes out, it is a balanced polymer and no synthetic rubber can stand to its qualities. The presentation of synthetic rubber in the market in attractive forms, necessitated some standards to be set for natural rubber. The first thing thought of, was to develop some technological specifications.

Salient aspects

In setting up standards, three aspects were given utmost consideration, from the consumers point of view:

- 1. the consumer has a right to get from the producer what he cannot get from the factory;
- 2. there is no room for any dirt to exist in rubber; and
- 3. the producers should ensure the required standard in the product.

Rubber undergoes in the consuming, factory many operations at temperatures of 150 to 160°C. Nature has given natural rubber the anti-oxidants to stand to these high temperatures—it has got built in quali-

Methods in Malaysia

In Malaysia there are different methods of converting latex into rubber. With the advent of synthetic rubber, the rubber technology, which was until then an art, became more scientific. Synthetic rubber lacked certain qualities which natural rubber has. A thorough search for these qualities or the substances that impart these qualities to natural rubber was initiated. As already mentioned it was found that the natural rubber latex contains a balanced proportion of antioxidants, prooxidants, accelerators and activators of vulcanisation. Most of these substances are lost when latex is diluted and coagulated since they are water soluble, where as in natural coagulation these substances are retained in the cuplump Which improved technological qualities.

Thus it became apparent that coagulation without dilution of latex is most desirable for retaining the good properties.

In view of this, a private Company in Malaysia has laid down that rubber latex should be processed as per their specifications. Sheets are to be prepared from latex without dilution, at a pH of 5 to 5·2 with acetic acid. Sheets are allowed to drip in shade and then smoked. This will cause bubbles and blisters, but it is of no technological consequences.

Pre-requisites for NR

Thus, the pre-requisites for preparation of natural rubber are (1) latex should be coagulated at field dre to retain all or most of the non-rubber constitutents; (2) it should be prepared in a form for easy and quick drying; (3) the product should have uniformity; and (4) it should be presented in an attractive form.

'Heveacrumb process'

To achieve these ends, a model technique was developed in Malaysia. namely the 'Heveacrumb process,' in which the latex is mixed with 0.7% castor oil and coagulated with acid. This coagulum is cut into small crumb, by passing through crumbling machines. The castor oil forms a thin film over these small crumbs or pellets and prevents the adhesion of crumbs together, thereby increasing the surface area and facilitating drying. Several machines used in the plastic and such other in Justries were tried in crumbling, but it has been found that the existing creping machinery can be used with minimum modifications, The main consideration in choosing machinery was that it should not be too sophisticated requiring the services of technical personnel to operate them but should be simple to deal with, so that the producer himself can operate it. Crumbs are dried in hot air at a temperature of 100°C and then pressed together with mechanical device, to form

bales of 112 lb., and are covered in polythene material, so that dirt may not pick up in the course of transit. This system has been found cheaper than sheeting and the process is quicker. There is a great demand for Heveacrumb in the world market. One American firm even went to the extent of extolling it by saying that instead of 'Heveacrumb,' it should be named as 'Heavenly-crumb.' They found that only 2% rejects are there in Heveacrumb, while the rejects in RSSI came to 24% in their factory operation.

The cuplumps and other scrap rubbers can also be made into crumb incorporating castor oil after thorough washing of these scraps. Then they are dried and made into bales.

The Visual Grading and Heveacrumb

The visual grading system cannot be applied to Heveacrumb. Therefore a new type of grading system was adopted which throws light on the technological properties of rubber. This is known as Standard Malaysian Rubber (SMR) grading system. In this system, nitrogen, dirt, volatile matter, copper and manganese are specified. There are three grades depending upon the variations on these constituents, (1) SMR 5 with 0.05% dirt content; (2) SMR 20 with 0.2% dirt content; and (3) SMR 50 with 0.5% dirt content. There is a sub-division, viz, SMR 5L, which is meant for consumers rubber. In all these grades, copper content is 8 ppm, Nitrogen 0.7% (wt) and volatile matter 1% (wt). Manganese content comes to 10 ppm each for the first two and 20 ppm for the third. Ash content (wt) comes to 0.5% in the first, 1% in the second, and 1.5% in the third.

If plasticity retention index can be ensured, copper content and manganese can be drawn out of the specifications,

There is no extra difficulty involved in production of SMR. What is wanted is some extra care, to see that contaminators are avoided to the maximum in the process of production and packing, whether it is latex, cuplump or scrap. This grading system can comprise of all types of rubbers, viz, sheet rubber, crepe and Heveacrumb By this grading system and heveacrumb process, more uniformity of the product can be achieved.

In India, introduction of standards is equally important because if rubber is allowed to remain out in the sun before selling to the consumer, the buyer does not know whether it has been exposed to the sun. When exposed to sun, rubber gets degraded.

Oil Extension of Natural Rubber

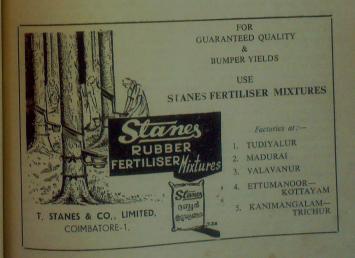
Oil extension of natural rubber is particularly pertinent to India, in view of shortage in production. Actually this is not the problem of the producer, but that of the consumer in the sense that consumer can easily oil extend rubber in his factory, itself. By oil extending rubber in his factory, the manufacturer gets an increased capacity for his tyres. Oil extended natural rubber improves the tread-wear and it also gives a better road grip for the tyres. There is no reason why the consuming industry in this country should not oil-extend the rubber. If the producer oil-extends, it will be cheaper, because it will be easy for him to oil extend natural rubber as he can put oil into the rubber at the field itself, when it can take in oil more effectively. In Heveacramb process also, oil can be added to rubber upto 40%.

The time to invest is when one is strong, and not when he is facing a threat. If India was going in for newer Synthetic Rubber Units, then definitely technical specification scheme should be adopted. India is enjoying three times the

price of natural rubber in Malaysia and hence it is the opportune time for investment. There is no justifiable reason on the part of the producer, even with the yield that he is getting at present in India, that he is not making a reasonable profit. The basic necessity of the country is to ensure that there is a good supply of this strategic

material. If this is done, any synthetic polymer can be replaced.

The labour charges will go up when the country becomes prosperous. When cost of labour is going up, cost of production will also increase. The only answer to this is the use of less labour by giving more wages for efficient labour.



A Rapid Method for the Estimation of Volatile Fatty Acid in Ammoniated Concentrated Latex*

P. John Jacob, E. V. Thomas, & K. Kochappan Nair §

Introduction

The volatile fatty acid content of ammoniated latex is an index of putrefactive degradation taken place in latex; and it is expressed as the number of grams of potassium hydroxide equivalent to the volatile fatty acids present in latex containing 100 gms. of total solids. (1) For good quality latex the VFA No. should be less than 0.1 (2) The main volatile fatty acids in latex are formic, acetic and propionic acids.

The present standard method for the estimation of VFA No. in latex is based on steam distillation of a sample of acidified serum under controlled conditions and titrating the distillate with barium hydroxide (1). The method is tedious, time consuming and requires careful attention in avoiding carbon dioxide for obtaining reasonable accuracy. A rapid method developed by Cook and Sekar (3) is also not free from some of the above mentioned defects. Ether extraction and chromatographic methods have the disadvantage of being cumbersome and lack precision.

similar methods were being used for the estimation of volatile fatty acids. But recently, a colorimetric method was developed, (4) which is as accurate as the conventional distillation method while rapid and much simpler in nature. A sample containing the salts of the volatile fatty acids were esterified with ethylene glycol in presence of sulphuric acid. The esters formed were converted to hydroxamic acid with sodium hydroxide and hydroxylamine. The mixture was added to acidic ferric chloride and the colour of the ferric hydroxamate, which is proportional to the VFA, was measured.

In sewage sludge, for quality control,

Due to the simplicity and rapidity of the colorimetric method, the authors thought of adopting this technique for the estimation of VFA in latex and accordingly experiments were eatried out.

Experimental

VFA of a number of samples were estimated by the colorimetric and the British Standard methods. The method followed in the colorimetric estimation is given below:

Reagents used (1) and (4)

- 1. Ammonium sulphate 30% (w/v)
- 2. Sulphuric acid 50% (v/v)

^{*} Contribution from the Chemistry and Rubber Technology division, Rubber Research Institute of India, Rubber Board, Kottayam-9.

[§] Assistant Rubber Chemist, Senior Research Assistants, Chemistry and Rubber Technology division, Rubber Research Institute of India.

 Acidic ethylene glycol: Mix 30 ml of ethylene glycol and 4 ml of 50% sulphuric acid. Prepare this reagent freshly each day.

- 4. Sodium hydroxide: 4.5N. Dissolve 180 gms of sodium hydroxide in water and dilute to 1 litre.
- 5. Hydroxylamine sulphate: 10% solution in water.
- 6. Hydroxylamine reagent: Mix 20 ml of 4.5N sodium hydroxide with 5 ml of hydroxylamine sulphate solution just before
- Acidic ferric chloride reagent: Dissolve 20 gms of ferric chloride hexahydrate in 500 ml of water and add exactly 20 ml of concentrated sulphuric acid and dilute to 1 litre.

Preparation of the sample

50 ± 0.1 gm of latex was weighed, coagulated with 50 ml of 30%, ammonium sulphate solution and collected as much serum as possible (1). The serum was filtered through a dry filter paper into a dry conical flask. Aliquotes of 10 ml and 1 ml were taken for the BS method and the colorimetric method respectively.

Procedure

I ml of the serum was mixed in a test tube with 2 ml of acidic ethylene glycol and heated in a boiling water bath for 3 minutes. The mixture was chilled in ice cold water immediately after heating. 2.5 ml of hydroxylamine sodium hydroxide reagent was added to the test tube and mixed well. The solution was kept aside for one minute and poured into 10 ml of ferric chloride solution contained in a 25 ml standard flask. The solution was made upto 25 ml, shaken well and kept aside for 5 minutes without the stopper for the gases to escape. A blank was also run with 1 ml of a mixture of 5 ml of ammonium sulphate solution and 2 ml of distilled water. The colour intensity was

measured in a photo-electric colorimeter at 490 mu.

A standard solution of acetic acid was prepared and neutralised with standard sodium bicarbonate solution. The neutralised acetic acid solution was suitably diluted to give 200 ppm to 1000 ppm solutions. From each solution ! ml alequotes were taken, the colour developed as above, the colour intensity measured at 490 mu and a standard graph was drawn.

Calculations

Let W be the weight of the latex taken, dre the percentage of dry rubber content, TS the percentage of total solids, V the volume of ammonium sulphate solution used for coagulation of latex and X be the acetic acid content in 1 ml of serum expressed in gms × 10⁻⁶, then

VFA No. =

$$\frac{X \times \left[\begin{array}{c}V + W \times & \frac{100 - drc}{100 \times 1.02}\end{array}\right] \times 56.1}{W \times TS \times 100 \times 60}$$

 $\frac{56.1}{60}$ is the factor for converting the acetic acid concentration into potassium hydroxide

The values obtained by both the methods are tabulated in Table 1.

Discussion

There is fairly good agreement between the V. F. A. Nos. estimated by the standard and the present methods. However, it is yet to be tested whether the method holds good for V. F. A. Nos in ranges other than those tested. It should be cautioned that for reasonable accuracy in the proposed method, the serum should be absolutely clear, since turbidity if any, affects the transmission of light and will lead to a high VFA No. Standard graph should be drawn at least with three concentrations of acetic acid with each series of estimation for better accuracy. The amino acids may possibly

interfere with the test (4) and methods of overcoming this and more detailed study of the interfering materials are under way.

In spite of the above limitations, the method has a definite advantage of speed and simplicity and is most suitable when large number of latex samples are to be analysed and compared.

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Comparison of VFA Nos. Determined by the
BS and Present Methods

Sample No.	VFA No. by the BS Method	Average	VFA No. by the Present Method	Average
1.	0.13420 0.12770 0.12750	0.12980	0.14330 0.14330 0.10530	0.13063
2.	0.06282 0.06352	0.06317	0.06680 0.05753	0.06216
3.	0.17660 0.19080 0.19790	0.18843	0.12470 0.13430 0.18280	0.13726
4.	0.09618 0.09618	0.09618	0.09450 0.09450	0.09450
5.	0.08646 0.08646 0.09212 0.10490 0.08504	0.09100	0.09469 0.08523 0.11890 0.12310 0.09469	0.10332
6.	0.11660 0.11660 0.11800 0.12060	0.11795	0.10490 0.10490 0.15110 0.14610	0,12675
7.	0.21740 0.21450 0.21361 0.22490	0.21760	0.18130 0.17300 0.21380 0.21910	0.19680
8.	0.14900 0.14340 0.15460 0.15460	0.15040	0.13870 0.12310 0.18990 0.18990	0.16040

Marketing of Natural Rubber

T. V. Joseph*

In the early days of this century the price of natural rubber in the world market was excessively high. In the London market it was 12 sh. 8 d. per lb. in 1910 (Rs. 13.38 at the current rate of exchange). The tremendous increase in price was due to two important inventions, which took place at the close of the 19th century. The first one was by Good Year in America and Hancook in England on the process of vulcanisation of rubber which opened up a wide range of use for natural rubber. The second one was the invention of pneumatic tyre by Dunlep in 1880, which ushered in a new era in transportation.

Early History

In the beginning of the century the main source of supply of natural rubber was the Latin American countries, particularly Brazil which accounted for about 28,000 tons at the time. The production of rubber in these countries was not sufficient to meet the growing demand. Hence, rubber plantations were gradually developed in the East also. The average price of rubber per pound in 1925 was 2 sh. 103d. Even at this price the cultivation of rubber was still the most remunerative agricultural operation However, the great slump of the thirties changed the advantageous position of rubber and price fell sharply to the lowest level so far recorded. As a recovery measure, leaders of the main rubber growing countries conceded to the setting up of an International Agreement in 1934 to restrict

export of rubber. As a producer of natural rubber, India also joined this Agreement. For the implementation of the agreement a local committee was appointed in our country. This committee gave permits to individual producers to export. It should be remembered here that in those years the rubber produced in the country was mainly exported and there was practically no internal rubber manufacturing industry worth mentioning.

The commencement of the Second World War changed the course of history of this industry. In the early years of war the main producing countries of this vital raw material in the East were overrun by Japan and the Allied Nations were forced to fall upon India, Ceylon, Brazil and certain African countries for natural rubber.

Government Control

Government control for this industry in India was started with the joining of the International Agreement. This control continued during the Second World War as the Government was forced to extract whatever quantity of rubber available within the country. For this purpose, the Government issued certain rules under the Defence of India Regulation. The Government also set up a Purchase Depot at Cochin to channelise the supply of rubber to the consumers. For the war effort, the rubber trees were exploited to the maximum and after the war it was necessary to replace the old trees with new ones. The regulation promulgated under the Defence of India

Secretary, Rubber Board, Kottayam

Rules also ceased after the war. Hence, the Government passed the Rubber Act in 1947 and the present Rubber Board was set up with a view to developing the industry.

The Korean War boom of 1950 changed the situation radically. The price of rubber went up in the world market. There was great demand for rubber in India also. But by 1953 the boom collapsed and there was less demand. This hit the small producers mostly.

The appointment of the Plantation Enquiry Commission to study the conditions of plantation industry including rubber is an important event in the history of this industry. The Commission submitted its report in December, 1956. It must also be mentioned in this connection that the Tariff Commission had also conducted certain enquiries during the last 16 years. The first enquiry was made in 1951, and another in 1952. The last one was completed in 1960. Consequent on the recommendations of the Tariff Commission, the Government had frequently reviewed and revised the price of natural rubber.

As far as marketing of natural rubber is concerned, the continuance of protection to this industry is an important point. The price of natural rubber has been under control since 1943 with a short break in 1946-47. In 1943, the maximum price was fixed at Rs. 77 as. 5 per 100 lbs. The price was steadily increased according to the increase in cost of production and the world market price. By 1963, the maximum price was Rs. 162.60 per 50 kg. for the top grade. During this period, the Government had fixed a minimum and maximum. However, the Government removed the maximum price in December, 1963 and later fixed a minimum only. This was made because the Government wanted to give incentive to certain industries including rubber. As only the minimum was fixed, it was possible for the producers to sell their product at

any rate above minimum without violating any provision of the Rubber Act. Since the removal of maximum price, there has been substantial increase in price. It is true that during 1964 there has been practically no increase in rubber price. The price of rubber has been considerably high in 1965 and 1966. The all-time record of Rs. 342.50 per 50 kg. has been reached in April, 1966. The increase is due to certain reasons. In the first place, we have to encounter difficulties at the border, and the rubber manufacturing industry being a strategic one has to step up production. As a result, the demand for natural rubber also increased so rapidly that its production within the country failed to keep pace with the increased demand without increase in import. Since 1963 we have been meeting part of the demand from synthetic rubber produced in a factory located in Bareilly. There was a breakdown in the plant due to an explosion in December 1965 and the production had to be stopped for more than three months. These reasons accentuated the situation and sent the price of natural rubber high.

It is necessary to examine the production and consumption of natural rubber in India. At the end of 1965/66, the country produced 50,530 M. Tonnes of rubber. The consumption of rubber during the same period was 63,765 M. Tonnes. The gap in production and consumption is being filled in by import. During the year 1965/66, we imported 16,357 M. Tonnes of natural rubber as against 15,003 M. Tonnes in the year 1964/65

Manufacturers and Dealers

It is necessary to examine here the structure of rubber manufacturing industry in India. At the end of 1965-66, there were 839 manufacturers. Out of this, 20 have been purchasing 66 per cent of the total production. By their method of purchasing they are able to influence the market. Out of the 839 manufacturers, about 190 have

been exclusively purchasing latex. As far as manufacturers are concerned, West Bengal stands first followed by Punjab, Maharashtra and Delhi. The number of manufacturers in West Bengal is 175, while the other states and centrally administered area have the following respectively: 172, 162 and 110. In Kerala, there are 54 manufacturers. They account for about 5 per cent of total consumption of rubber.

At the end of 1965-66 there were 608 dealers in India; of this 21 dealers handled more than 1,000 tonnes of rubber during the year. Nearly 160 dealers are very small and handle an average of 5 tonnes or below per year, while 159 dealers handle between 5 to 5 tonnes and 135 dealers between 25 to 100 tonnes. The dealers who handle between 100 to 500 are 106. There are 27 dealers handling between 500 and 1,000 tonnes. From the distribution of dealers, it is seen that Kottayam district occupies the first place followed by Ernakulam and Quilon districts. The number of dealers in the 3 districts are 235, 106 and 77 respectively. Out of the total of 608 dealers, 103 are outside the state. Here, Delhi stands first; others are West Bengal, Maharashtra and Punjab according to importance.

Different Grades of Rubber

The Government of India has fixed the minimum price of different grades of rubber. The classification of grades in India follows the classification abroad with small changes. This has been originally set up by the Rubber Goods Manufacturers Association of New York. At present, there are 7 groups consisting of 22 grades. In addition to the above, latex concentrates grouped into 3 types are also being marketed. The grading of rubber can be broadly classified into 3 sections—(1) smoked sheets, (2) crepe rubber and (3) latex. Under smoked sheets, there are three groups. The difference is mainly on the percentage of mould growth, bark, sand and other contaminations which distinguish one grade from the other. As

far as crepe rubber is concerned, there are two distinct parts, pale latex crepe and estate brown crepe. Pale latex crepe is produced from pure latex and is priced higher than smoked sheets in the market, while estate brown crepe is produced from scrap rubber which is of 3 kinds--curly scrap, shell scrap and earth scrap. The brown crepe is produced after milling the scrap rubber. In Kottayam, there is a concentration of crepe mills having 17 mills out of the total 20 mills in Kerala.

Of the total production of rubber in India during 1965-66, 40% was produced as Group 1 rubber followed by 24% of Group 2 and the rest other grades. In the case of small growers, production of higher grade is lower than this. They are able to produce mainly lower grades of rubber. At the end of the period of 1965/66, there were 636 estates of above 50 acres and 76,000 smallholdings of 50 acres and below in extent. The estates produced about 60% of rubber, the rest was by smallholdings. The interesting aspect in this case is that the tappable area of estates under rubber is only 38% of total while 62% is contributed by the smallholdings. The average yield per acre of estates at the end of 1965/66 was 624 lb while that of small holdings was only 262 lb. The above picture gives a background of the general pattern of production and marketing of rubber in India.

Foreign Markets

So far, we have examined in brief the development of marketing in India. It is necessary to consider our position in relation to the situation abroad. As far as natural rubber is concerned, Malaysia accounts for nearly 40 per cent of production. Naturally, she has a decisive influence in the world market. In fact, Singapore is the most important market for rubber. The economy of Malaysia is mainly dependent on the sales of rubber abroad. There is very little manufacturing concerns in that state.

Apart from Singapore, other important markets are New York and London. London has a long association with Malaysia as most of the main planting companies have their headquarters in London The dealers in New York have their branches in Canada and Latin America and offlees in the maintand of Malaysia. Kuala Lumpur is also growing as an important market of natural rubber. At present, Malaysia is vigorously attempting to improve her marketing of rubber in Eastern European countries particularly in Soviet Russia and during the last few months she has been able to receive substantial orders from these countries.

The main consumer of rubber is U.S. A But in recent years the share of U.S. consumption of natural rubber in her total has fallen sharply. In fact, it has reached about 25 per cent in 1965. U.S. A. started production during the war and is now able and also to supply substantial quantities to other consuming countries like Canada, Western Europe etc. The decline of U. S. A's consumption of natural rubber is due to her fear that in a contingency like war, she might be cut off from the sources of natural rubber supply and she has to In U. S. A. natural rubber has been wiped off from a number of uses where it had a To-day, natural rubber is not being used to an appreciable extent in the field of car

It is also necessary to consider the position of Ceylon which is a neighbour of our country and an important producer of natural rubber. Her trade is mainly with China and is covered by a long term agreement, By this, Ceylon Government is selling rubber in return for rice. Recently, she has come to an agreement with Rumania for the supply of natural rubber. At present, Malaysia and Ceylon have surplus natural rubber. In Malaysia the surplus is confined to higher grades of rubber.

In the field of production, Indonesia had an important place prior to 1958. Her position as the most important producer has fallen since then and Malaysia has taken it over. Indonesia generally produces lower grades of rubber and a large quantity of rubber is shipped to Singapore for milling. Recent confrontation with Malaysia has disrupted this trade. With the cessation of hostility, this trade is expected to improve.

In the world market, the price of natural rubber is decided by a number of factors. The price of synthetic rubber is an important factor. Recently, the U S Stock Pile the rise or fall in natural rubber price. In the discussion held in 1962 on the future prospects of natural and synthetic rubber at the instance of the International Rubber Study Group, it was mentioned that natural rubber producers would be able to increase their marketing in U.S.A. if they are able to supply natural rubber at about 20 U.S. cents (about Rs. 1.50 per 1b). The present U. S. cents. At present, synthetic manufacturers are able to supply rubber at lower rates. The problem with synthetic producers in the world to-day is the over capacity of the industry.

Competition and Recent Advances

As far as rubber produced in India is concerned the quality and presentation do not affect its sales much. But in the case of other countries, it is a different story. Malaysia has to face keen competition from other rubber producing countries and also from synthetic rubber producers. The synthetic rubber is at present available in neat packages and its producers are always willing to give technical advice to consumers. This is weakening the competitive strength

of natural rubber. Hence natural rubber producers in Malaysia are seriously making efforts for improving their grading and packing. The grading of natural rubber is visual in nature. The unreasonableness of this system can be clearly gauged from the following quotation:—"...is based on fine shades of colour distinction when most of the rubber is later mixed with carbon black; is concerned with bubbles as a defect when an essential processing operation for all yulcanised products is the churning-up of the rubber with air; is unable to detect the one particular contaminate, sand, which is positively deleterious in vulcanisates; pays attention to minor mould growth when almost all the rubber is later mixed with sulphur and sulphur compounds which are among the best anti-fungal agents known."*

In recent years there has been great advance in grading of natural rubber in many countries. The technically classified

based on the curing rate of rubber. The very recent form is the Standard Malaysian Rubber. The SMR has been popular in manufacturing countries, as will be seen from the production of this variety. In February, 1966, Malaysia produced only 200 tons of SMR, while production in June, 1966 amounted to 700 tons. As far as India is concerned, we have to go a long way. The Rubber Board has been giving subsidies to co-operative societies for putting up smoke-houses and thereby improving the quality of subber, but the progress of the scheme remains unchanged during the last two years. Perhaps, the attractive price of rubber may be the reason for this. It is high time to think in lines of improving the quality and presentation of natural rubber. Natural Rubber producers should think in terms of building up a strong marketing wing of their own to take better quality rubber to the manufacturers' doors, and to convince them of the advantages and superiority of natural rubber over synthetic

^{*} Dr. L. C. Bateman in Future of Natural and Synthetic Rubbers, 1962, P. 62.

A Rapid Method of Wet Ashing Rubber

P. K. Zachariah*

The importance of accuracy and rapidity in analysis need not be emphasised. In the analysis of rubber, the removal of the organic material is the most cumbersome and time consuming operation. Unless extra care is not taken in this process, the analytical results would be erratic. Two methods, namely, wet ashing and dry ashing are followed for effecting the destruction of organic matter. The advantage in time of the latter method over the former is undisputed. But dry ashing has the drawbacks such as the loss of certain mineral constituents prone to volatilization at high temperatures and difficulty of achieving complete combustion, which result in low analytical results. Low analytical values are also said to occur due to the absorption of the materials by the hot glaze of the crucibles when porcelain crucibles are used.1 The method is expensive because the costly crucibles are consumed by a few number of ashings. Wet ashing is superior to dry ashing as far as the accuracy is concerned because there is no possibility for the loss of elements to be determined by volatilization. But the method is very cumbersome and time consuming and requires very large quantities of acids. The use of large quantities of acids is not only expensive but also leads to some error in analytical results due to the introduction of impurities present in the acids to the test solution. Considering the comparative rapidity and less tedious nature of

dry ashing procedure, this method is generally adopted for the estimation of inorganic constituents in rubber. Since different dry ashing procedures have to be followed for the estimation of different elements in rubber, quite a large quantity of rubber is required and total time required for the preparation of test solutions is too much, when a number of mineral constituents have to be assayed9. For certain studies on latex physiology, we have to subject comparatively small quantities of rubber for analysis for the accurate determination of various inorganic constituents. Hence the need for a rapid wet digestion procedure suitable for determination of a number of elements from single test solution was felt.

From the experiments carried out in the laboratory the following method has emerged out.

Reagents:

- (1) Concentrated nitric acid AR
- (2) HNO, H2SO, HCIO,
 - (10:1:4) mixture

Procedure:

Weigh out 5 grams of rubber sample into a 150 ml pyrex beaker and place the beaker on a heater covered with an asbestos centred wire gauze or on a hot plate. Heat the beaker with its contents till a dry carbonaceous residue is left behind. Cool the beaker, and add 5 ml of concentrated nitric acid. The beaker is covered with a watch

^{*} Senior Research Assistant, Agronomy division, Rubber Research Institute of India.

glass and is placed again on the heater for about 10 minutes. Before the nitric acid is completely evaporated away, add 10 ml of HNO₃ - H₂SO₄ - HClO₄ (10:1:4) mixture and continue heating for about 10 minutes. Again add 10 ml of the ternary mixture and continue the digestion. Within 15-20 minutes a clear digest would be obtained. Even after the digest is turned clear, continue the digestion for 15-20 minutes more. The digest is used for analysis. Total time required for ashing will be about 60 to 75 minutes only.

10g of sample may also be ashed by the same procedure, but the initial volatilization of organic matter would require a longer duration. For ashing more than 10g of sample a squat shaped pyrex beaker of 250 ml capacity may be used.

Considering the easiness and rapidity of ashing, a 5g sample is the most suitable quantity.

Summary

A rapid wet ashing procedure for ashing rubber is described. While the conventional methods are time consuming, the total time required for the present method would be only 60 to 75 minutes. Since there is no possibility for the loss of volatile inorganic components during ashing, and there is less chance of contamination either from the reagents used (since small quantity of reagents being used) or from the containers (containers being pyrex glass wares) the analytical results obtained by the procedure may be more reliable.

Acknowledgement

The author is greatly indebted to Dr. K. T. Jacob, Director/Rubber Production Commissioner of the Rubber Research Institute of India for the facilities provided for conducting this work.

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Development of Rubber Plantations in Andaman and Nicobar Islands

P. P. Cherian*

some ten islands are marked in respect of



Rubber trees brought under tapping 5½ years after field planting at Manglutan Estate

Andaman and Nicobar Islands. Actually there are 223 small and large islands covering 3215 square miles equivalent to approximately 20,57,000 acres or just above one fifth of Kerala State. Only 29 islands are inhabited and the current population estimated as 75,000 slightly exceeds that of Kottayam town. The density works to 27 per square mile against 387 and 1,126 respectively for the whole of India and Kerala State.

The northern 204 islands, with an extreme length of 290 miles and maximum width of 32 miles form the Andaman group. The Nicobar group comprises 19 islands, the northernmost and southernmost of which are situated 75 and 100 miles away from the nearest Andaman group and Sumatra respectively. The main islands in the northern group are North Andaman, Middle Andaman, Little Andaman and South Andaman, Little Andaman. Port Blair in South Andaman. the seat of the Administration, lies about 750 miles from Calcutta and Madras from where shipping communication is maintained during intervals of 2 to 3 weeks. The I. A. C. now provides a weekly direct flight service between Calcutta and Port Blair. Nancowry in Nicobar group about midway between Madras and Singapore almost along the regular sea route to the Far Fast is reputed to be a fine natural harbour, though unconnected with continent by shipping communication.

Dy. Rubber Production Commissioner, Rubber Board, Kottayam.

Land Tenure

As all land being owned by the State, the problem of ceiling does not arise. Land lease usually runs for a period of 30 years with the option of renewal. Land t.x or rent works out to 12 paise per acre for the first eight years and Rs. 3/- for the next 22 years. Agricultural income tax is not levied, but a Royalty of 2 per cent of the net market value of the crop exported out of the islands is collected.

Only less than one per cent of land falls under paddy cultivation while 72 per cent accounts for forest. The current rice import amounts to about 28 per cent of the total requirement. Strangely, the staple food of the majority of sturdy Nicobarese, the Secondary School Football Champions of the Indian Union, is neither rice nor other cereals but occounts.

Wild life

Wild boars abound in Andamans. It is stated that most of them are progenies of European breeds introduced by the Dutch over two centuries ago. Import of different species of deer took place only recently. Of these, barking deer and especially spotted deer multiplied themselves so rapidly that they have now become serious pests with no carnivorous forest animals to control them. Elephants are imported from the mainland for timber hauling. Among birds, parrots are reckoned to be the most serious pests. They swoop in thousands to devour and destroy maturing paddy, plantain and other fruits within incredibly short time.

For the rubber plantation, cattle and soats from the villages have been the main problems. Barbed wire fencing was erected completely around the plantation. Deer and pigs are controlled by trapping and hunting.

Labour

Limited labour from Ranchi, Madras, Andhra and Kerala as well as locals are available. Recruitment of contract labour from the main land has waned. There are no statutory minimum wages and service conditions for estate workers under the Plantation Act. The Home Ministry and the Administration have, however, promulgated uniform minimum wages and service



Manglutan Estate-Background very good growth and frost poor growth, both 5½ years after planting.

conditions for their workers in the P. W. D., saw mills, forest department etc based on Factory and Industrial Acts and Rules which though not applicable to the private sector nor to plantation labourers coming under scheduled employment, indirectly industrial to the prevailing wage pattern.

Estate workers in Andaman, unlike their counterparts in the mainland enjoy weekly

paid holiday and an 8-hour work per day. After permanency, they become eligible for service conditions accorded to Class IV Central Government servants, if the existing labour rules relating to Andaman Administration workers are extended to rubber plantation labourers.

Old Rubber Plantation

Plantation crops are not new to the islands. Hardly seven miles away from Port Blair and scattered in five villages exists probably the oldest State-owned rubber estate in the Indian Union, got planted by convicts. The remnants of a tea estate said to have opened up before the first world war along with rubber still remain in Shoal Bay. Scattered oil palms introduced during presecond world war period have been located around Port Blair.

The early history and management of the old rubber estate have passed into oblivion. The extent currently under old rubber appears to be much less than 422 acres registered with the Rubber Board and 586 acres recorded in the land settlement. The State is not known to have managed the property directly after maturity but leased it from time to time. Following a court case between the lessee and the Administration the estate was closed in December, 1964.

Recent Developments

The Development Scheme introduced by the Rubber Board of India from 1949 onwards in the mass scale supply of selected seeds as a result of which over one lakh of acres were brought under high yielding rubber costing less than Rs. 3.00 per acre to the Board had reached the far-flung Andamans during 1955–756. Two large nurseries were established in South Middle Andamans, but planting carried out was abandoned later, owing to lack of interest and financial inducements. Some of the rubber trees still survive amidst secondary iungle growth.

Planting of 70 acres during 1960-'61 at Manglutan, 14 miles from Port Blair in the private sector, under a Superintendent trained by the Board in the mainland constituted the subsequent development. Against the normal maturity period of seven years, rubber trees in 15 out of 70 acres in Manglutan estate attained the standard growth for production by 5½ years and tapping commenced from June, 1966.

The attempt to plant 2,000 acres in Katchal, Nicobar, by a private company during 1962 to 1964 fizzled out, after spending over ten lakhs of rupees and without planting even a single rubber seedling.

Public Sector

Out of ten lakhs of rupees provided in the Third Five Year Plan for rubber, a Pilot Project is being implemented. The scheme brought under the Ministry of Rehabilitation from the Home Ministry and executed by the Rubber Board functioning under the Ministry of Commerce envisages the planting of 500 acres in South Andaman to serve primarily as a Rubber Research Cum Development Station for the accelerated development of the Islands.

Of the target, 100 acres of forest allotted in 1965 were clear-felled departmentally and planting completed during the year itself. Another 150 acres out of 200 acres released for 1966 in February, were also planted and felling completed in the remaining 50 acres in the same year.

According to the Report of the Sub-Group on Rubber of the Plantation Crops Working Group of the Planning Commission, the extent of land available for rubber planting during the Fourth Five Year Plan is envisaged as 1,500 acres in South Andaman, 3,000 acres in Rutland and 10,500 acres in Katchal. The Inter-Departmental Team on Accelerated Development Programme for Andaman and Nicobar Islands on the basis of previous surveys estimates

a total area of 30,000 acres available for rubber. Large scale planting in Katchal, Little Andaman and Rutland is now being clanned.

Suitability of islands for rubber plantation

The suitability of the Islands for rubber plantation has been studied from various angles from time to time. According to distribution of rainfall and climate, the Nicobar Islands are considered to be the best, followed by Little Andaman, Rutland and South Andaman while Middle and North Andaman are less congenial. Wide variaman soil. Generally speaking the plant nutrient contents as revealed by chemical geously with those of leading rubber estates in South India and even better than in Malaysia. However, the influences of physical factors including the comparatively higher clay content and underlying stiff soil impeding water percolation and wide variation of soil texture from place to place as well as prevailing wind on high hills remain to be studied with regard to rubber growth and correlated.

The position of Manglutan estate illustrates this aspect vividly. While rubber trees in about 15 acres attained tapping girth of over 22 inches at 20 inches from the ground in 5½ years, there are other plots where trees of the same age average below five inches in girth at the same level. Chemical soil analyses reveal better soil nutrients in poor growing area and vice-versa, indirectly confirming the impact of other factors. Similar results have been noticed in the old estate as well as in the Research Cum Development Station where the height of plants 10 to 12 months after planting of stumps varied from 4 to over 15 feet in different fields, against normal height of 61 feet in Indonesia quoted by Dijkman.

All lands with luxuriant tropical forest before felling need not necessarily be satisfactory for rubber nor for any particular agricultural crop, as there are other factors influencing growth and success.

The causes for heterogeneous growth in the same region can be found out only by experiments and observations for which the Rubber Research Cum Development Station in South Andaman being organised.



Development Station, Ferrargunj, 10 months after planting stump; over 15 feet height indicating excellent growth,

Technical questions presented

Early trials and observations were therefore aimed at to elucidate the following:

(a) To account for the most outstanding as well as retarded rubber growth in parts of the old estate and subsequent plantings.

- (b) How far the defects can be remedied.
- (e) Demarcation of most satisfactory area for rubber cultivation by easily distinguishable physical and other factors so that unsuitable portion can be left uncleared or utilised for other crops.

Of the four types of Andaman forests, i. e., deciduous, evergueen, mangrove and tidal, the latter two are obviously unsuitable for rubber planting. The first covering mostly flat and undulating terrain comprising the slushy area occupies some 45 per cent of the total forest. The slushy land need not be the basal area, but includes undulating hills. The second comprises hillslopes and infrequently level areas. Distinct belts of the two types become easily discernible during February/March. Land previously under evergreen forest has so far shown the best rubber growth and that under deciduous forest, the worst, while the position of the intermediate region remains to be elucidated. Incidentally, in Nicobar group of Islands the main forest type is reported as evergreen.

The demarcation of Andaman land for rubber cultivation in accordance with the nature of forest before felling and correlation of planting success may have practical possibilities.

Unlike hillslopes, the soils in slushy portion are comparatively poorly drained and more clay. Top soils in these areas are formed as a result of accumulation of fine soil particles brought by water from higher levels or from surrounding hills. This may account for the formation of very thin layer of black soil blended with organic matters and for the comparatively better soil nutrients as disclosed by chemical analysis and for the unusually heavy growth of Pueraria cover. Thorough burning after felling of forest, clearance of planting rows for removing stumps and refilling pits with stiff clay soil devoid of plant food—the thin layer of top black soil hardly pareable for

refilling—may partly be responsible for earlier retardation of growth.

Rubber plantation in other countries

The drawbacks, some redeemable in the light of experience, need not be viewed seriously though indicating the necessity for research trials. So far known, no rubber producing country enjoys the optimum conditions for rubber planting. Each has its own drawbacks complicated by interaction of many factors. Malaysia in spite of its even distribution of an ideal rainfall is very seriously affected by root diseases in regard to both old and young rubber. Plantations in South India are practically free from root diseases, but consequent upon a heavy and uneven pattern of rain distribution, suffer from equally damaging leaf disease problems. Despite the general poverty of the Malaysian soils in comparison with those in India, the average yield is greater. Viet Nam although not situated within the latitude considered for successful rubber cultivation and in spite of drought and low rainfall, produced the highest yield per acre before the present political conflict. The history and expansion of rubber plantation in South East Asia, Viet Nam, Africa, South America etc. under widely varying conditions have been the results of successful attempts made in overcoming unfavourable factors prevailing in each country. In South India itself, under varying intensity of rainfall and difference of climatic conditions from district to district yields upto and above 1,000 lbs, per acre have been realised from well managed estates under high yielding material in all regions. The yields in Andaman from part of the old estate and from the small area now brought under tapping in Manglutan estate are quite satis-

Current problem

The main problem appears to be the evolution of planting techniques suitable to

the peculiar conditions in the Island. This may necessitate radical modifications from the standard practices followed in the other rubber producing countries. The following were therefore tried during the first two years.

- (a) Apart from the normal contour terracing, pitting and planting, regardless of soil type and slope, rectangular planting in flat and undulating slushy area with rows as far apart and plants as near as possible but within the maximum stand prescribed. The possible technical and economical advantages of the latter planting in the particular soil conditions and the theoretical aspect for tows towards South-West become apparent from observations recorded elsewhere.
- (b) Reduced and staggered application of fertiliser mixtures in exposed areas and for oversized plants.
- (c) On steep hillslopes exposed to South-West, the prevailing wind from May to August caused ultimate defoliation of young plants, which until then showed most encouraging growth. But in 1966, neither cyclone nor wind, damaged plants on hillslopes protected by adjoining forest belts. Patches of forest had been left uncleared on very steep slopes and along both sides of ravines and adjoining perennial and possible sources of water during dry season. The 100-feet forest belt along over a mile boundary of the plantation reserved for future road development may also provide some protection at the early stages.
- In some regions of Kerala, inhibited initial rubber growth due to wind is made up after a period of few years, while in other parts the retardation persists longer.
- (d) Reduction in the size of pitting and adopting 'alavang' planting in slushy areas owing to peculiar soil conditions compared with standard planting.

Planting in standard pits of $3\times3\times3$ and $2\frac{1}{2}\times2\frac{1}{2}\times2\frac{1}{2}$ feet during 1965 in slushy area presented a disappointing spectacle in the beginning, in contrast to most encouraging growth on hillslopes. Limited experimental 'alavang' planting and that on slightly raised bed indicated that in stiff clayish underlying soil of slushy area, the plantseregardless of sprouted seeds or stumps—could be more easily established with the



Development Station, Ferrargunj, 12 months after planting stump; below 4 feet, unsatisfactory initial growth.

least soil disturbance than by conventional pitting, followed by refilling and planting, in the processing of which soil becomes puddled up. Subsequent growth remained unaffected whether pitted or not. After liberal manuring reinforced by frequent mulching with Pueraria cuttings, plants in the slushy portion improved considerably but not yet to the size of planting on hillslopes.

Basing on this experience pitting, was reduced to $2\times2\times2$ and again to $1\frac{1}{2}\times1\frac{1}{2}\times1\frac{1}{2}$ feet as well as to $1\frac{1}{2}\times1\frac{1}{2}\times1\frac{1}{2}$ feet cube during 1966, apart from continuation of limited trials without pitting on terracing with many variations and 'alavang' planting in slushy area. Earlier growth on loose hillslopes appeared to follow the same pattern as in slushy area, i. e. variation in the size of pitting and even non-pitting hardly affects growth in the peculiar Andaman soil types under normal manuting.

Deep rooted jungle trees seem to be exceptions in Andaman especially in slushy areas. The lateral roots of old rubber trees on hillslope could be traced to over 100 feet from the collar indicating typical rooting pattern, possibly influenced by soil factors.

(e) Use of 1 year, 2 year clonal stump, stumped clonal and seed at stake planting to find out the cheapest and quickest planting technique.

Sprouted seed at stake planting on a hillock during late October 1965 could survive the Andaman drought without watering and after 14 years attained very satisfactory growth compared with the same year earlier planting of 10 month clonal stump. The trial indicates encouraging possibilities of seed at stake planting for later field budding or for establishing clonal rubber in commercial scale even under Andaman conditions.

- (f) Thorough, light and "no" burn methods of opening up jungle for rubber planting.
- (g) Removal of stumps from the planting rows as well as retention to find out the impact of disease and pest.
- (h) Use of various types of leguminous creeping and bush covers for soil conservation and rejuvenation of stiff soil by mulching. Besides Pueraria, covers planted include Calopogonium mucunoides, Centrosema pubescens, Crotalaria anagyroides, Crotalaria usaramoensis, Tephrosia candida and Tephrosia vogellii.

(i) Different methods of physical soil conservations.

Terracing in undulating and flat slushy area stagnates water preventing natural drainage in spite of lateral drains cut. Planting after the main rains during October/ November was tried with minimum soil interference. Contour lining in slushy land followed by terracing for soil conservation and normal pitting seem to be incompatible with cutting costly drains in the same area to prevent water stagnation.

(j) Use of high yielding clonal seedlings from Malaysia and S. India and introduction of budded planting materials of foreign origin for comparative yield studies.

Some of the aforesaid methods indicate many possibilities, but final assessment can be made only after many years.

Economy of rubber cultivation

The rubber tree normally starting production from 6 to 7th year after planting The present practice is to replant after some 25 to 30 years with the latest high yielding planting materials. The yield per acre for ordinary material averages upto 400 lbs. against 800 to 1,000 lbs. for high yielding clonal or budding. The average annual yield of 8,65,238 acres of clonal and budded rubber under tapping in Malaysian large estates works out to 1,009 lbs, per acre. Higher yields upto 2,000 lbs. or more are realisable with latest improved planting materials but the current average of the largest rubber producing country may be a safer commercial basis for comparison. While the minimum price per pound is controlled to Rs. 1.50, the maximum which is left unfixed, recently soared to over Rs. 3.00 and again dwindled to Rs. 2/-. The net income of high vielding rubber plantation may be roughly estimated as up to 30 percent of the gross income during a tapping period of 20 years or so excluding land

Of 4,07,014 acres under rubber cultivation in the Indian Union, South Andaman accounts for three units comprising 583 acres exclusive of 150 acres planted during 1966. Our current annaual production of natural and synthetic rubber totals 50,500 and 16,400 tonnes respectively against 100,000 tonnes consumption; the deficit being made up by import costing crores of

rubber in part of dry land allotted to them. fluancial assistance. Five acres of dry land provided for each family are mostly left unutilised. Tapping, collection of latex and processing take only 4 or 5 hours work daily. Women tappers generally excel men and adolescents as well as children can be provided with light paid employment even under the Plantation Act labour Rules.



Seed at stake-9 months after planting

Out of 76,140 units, only 636 exceed 50 acres while the remaining are small holdings. Units less than 5 acres number over 65,000 averaging about two acres each indicating the popularity of rubber planting among small holders in South India and possibilities of development in the Islands as a part of

The rubber plantation on the small holding point of view offers some unique features. The small grower with rubber plantation background, unfettered by labour codes, animated by personal interest and with the coveted ownership of a viable unit looming large becomes an enthusiastic proprietary worker requiring neither rigid control nor enforcement but only technical guidance along with Ilmited financial assistance. During 1965-'66, nearly 200 Andaman settlers came forward to plant



Budded stump-1 year after planting

No other crop gives continuous employment throughout the year for all members of family with regular income as rubber. This may explain the extraordinary increases of rubber small holdings in South India and in all rubber producing countries in South

Acknowledgement

I am much obliged to Shri P. S. Habeeb Mohamed, I. A. S., Chairman, Rubber Board and to Dr. K. T. Jacob, Director, Rubber Research Institute of India / Rubber Production Commissioner for the opportunity kindly given to embody my short Andaman experience in this paper for publication. To the latter I am indebted for permission to initiate a number of interesting trials to find out the most suitable planting methods under Andaman conditions.

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NEWS AND NOTES

All India Rubber Planters' Conference

The first All India Rubber Planters' Conference held at Mundakayam in December 1966, under the joint auspices of the Mundakayam Planters' Association and the Rubber Board marked a new era in the history of the rubber plantation industry in India. Never before had the entrepreneurs in the plantation sector gathered in such a large number to discuss problems affecting the industry. The common forum evolved at the conference thus marked the bezinning of a concerted effort to cradicate the mala dies afflicting productivity in plantations.

The Conference, scheduled for two days, was inaugurated at 10 A. M. on 27-12-'66 by Shri Bhagawan Sahay, the then Governor of Kerala. Declaring open the Conference, the Governor commented the vast potentialities of the plantation industry. Shri P. S. Habeeb Mohammed, Chairman, Rubber Board, who presided over the occasion, called for better productivity at lesser cost. Shri B. C. Sekhar, Director of the Malayan Rubber Research Institute, who spoke on the occasion felt honoured in getting associated with the planting community of his homeland. Shri Sekhar came to India specially to attend this Conference. Shri M. P. Alexander, Chairman of Cardamom Board, Who addressed the gathering wished all success to the conference on behalf of the particular section of planters he represented.

Shri A. V. John Ancheril, Chairman of the Conference Committee and the Mundakayam Planters' Association, while welcoming the chief guests dealt at length

the significance of convening the first Conference of this type at Mundakayam and the elaborate arrangements made by the committee for the conduct of such a conference at the national level.

Shri P. K. Narayanan, Information officer of the Rubber Board read out the messages received, wishing success to the function from eminent persons. Shri S. Sreenivasan, Convener of the Conference: Committee, thanked the guests. The inaugural session concluded at 11.30 A. M.

The Plenary sessions started soon after the inaugural session. Shri B. C. Sekhar, Director of RRIM, acted as the Director of the discussions.

The first session started with a paper on "Planting materials and Planting" by Dr. K. T. Jacob, Director of the Rubber Research Institute of India. Dr. Jacob in his learned paper appealed for a bias towards the use of budded materials for planting. Shri Sekhar appreciated the value of the contents of the paper presented by Dr. Jacob,

The second session started with the presentation of a paper by Shri Chacko A. Kallivayalil a leading planter on "the Commercial exploitation of rubber."

The third session on the first day ended with the presentation and discussion, of a paper on 'Manuring of rubber,' by Shri K, C. Ananth Dy. Director of the Rubber Research Institute of India.



Shri Bhogawan Sahay inaugurates the conference. Shri P. S. Habeeb Mohamed, Shri A. V. John, Shri B. C. Sekhar, and Shri M. P. Alexander are also seen in the picture.

The film NATURALLY IT'S RUBBER was shown to the delegates after the third session.

The fourth session started the next day at 10 A. M. with a paper by Shri K. V. George, Dy. Director, Rubber Research Institute of India on "Control of diseases and pests of rubber." Shri B. C. Sekhar presided.

Shri D. S. Kulkarni, Editor of "RUBBER NEWS" in the fifth session, viewed the 'Natural Rubber Industry' as a third man. His paper, on "Natural rubber—A third man's point of view" was subjected to prolonged and heated discussions.

The development schemes of the Rubber Board were discussed at length by Shri A. K. Raja Padmanabhan, Development Officer in his paper presented at the sixth session. Shri A. V. John, Chairman of the Mundakayam Planters' Association gave a detailed account of the "Problems confronting the rubber plantation industry" from a planters' point of view in the seventh and the last session.

Concluding session

After the plenary sessions, the valedictory address was delivered by His Grace, Benedict Mar Gregorios, Archbishop of Trivandrum. The Archbishop reminded of the great task ahead of the planting community in increasing the productivity by moving with the times.

Shri George John, Vice-chairman of the Rubber Board welcomed the guests. Shri B. C. Sekhar, Director of the Conference, reviewed the highlights of the recommendations emerged as a result of the discussions



Dr. K. T. Jacob, Director, Rubber Research Institute of India presenting his paper on

* Planting materials and planting.' From left:—Dr. K. T. Jacob, Shri B. C. Sekha, Shri A. V. John and Shri Habeeb Mohamed.

at the plenary sessions. Shri Abraham Lukose, Convener of the Conference Committee proposed a vote of thanks.

Representing the delegates attended the conference, Shri K. C. Sankara Narayanan, Managing Director of the Plantation Corporation of Kerala expressed appreciation for the fine arrangements made by the organisers of the conference. He announced on behalf of the Plantation Corporation his willingness to play host to the Planters' Conference next year. His announcement was received with cheers by the delegates.

Exhibition

As a part of the conference a two day exhibition had been arranged at the premises

of the Mundakayam club. Leading concerns in the field of Plantation supplies had put up stalls at the exhibition.

Souvenir

To mark the first A. I. R. P. C., the committee published a souvenir including the contributions from eminent men in the field of R. P. Industry.

The Conference has been able to create indelible impressions in the minds of those who attended it. The many a present they received from well-wishers of the conference in the form of kit, key chain, pen ete added to the charm of the assembly. The Coffce Board's gesture of offering free coffee to the delegates was praised by all. The facilities

arranged for Boarding and lodging of delegates were also well appreciated.

The assembly was acclaimed unique in many respects by the participants.

International Symposium on plant pathology

The Indian Phytopathological Society had organized an international Symposium on Plant Pathology from December 27, 1966 to January 1, 1967 which was held at the Indian Agricultural Research Institute campus, New Delhi, with one session at Agra for a day. An exhibition had been organized at I. A. R. I. campus during the symposium to give a complete plant disease picture of the country to visiting scientists

from abroad as well as participants from other states. Rubber Board also took part in the exhibition.

The then Union Minister Shri C. Subramanyam visited the stall. Shri K. N. G. Menon, Board's Liaison officer at Delhi took him round the stall and explained the exhibits.

Industrial Seminar at Kanyakumari

About 200 delegates attended the Industrial Seminar held at Nagercoil in Kanyakumari District on 28th and 29th November 1966. The then Chief Minister of Madras Shri Bhakthavalsalam inaugurated the Seminar. Shri Venkitaraman, the then Minister

for Industries also spoke. Shri P. B. Krishna Swamy, District Collector welcomed the gathering. Dr. N. H. Sivaramakrishnan. Dy. Director, Rubber Board participated in the discussions that followed.

Loan Schemes for Plantation Development

The Agricultural Refinance Corporation had set apart Rs. 6 crores in the current financial year for the development of plantation industries and Agriculture. This was disclosed by Shri K. C. Cheriyan, Managing Director, Agricultural Refinance Corporation. He stated that the success of the scheme depended on how people utilize the oppertunity opened to them and added that the experience so far had shown that the incentive in this direction was insufficient. He was addressing a Conference at the Rubber Board office on January 31st convened to discuss the matters pertaining to the loan schemes by the Refinance Corporation. Shri A. K. Rajapadmanabhan, Development Officer, Rubber Board presided. The Senior officers of the Rubber Board attended. The representatives of

the Banks as well as the representatives of the plantation industry took part in the discussion. Shri Cheriyan had refuted the criticism that the commercial Banks were disinterested in the proposed schemes of the Corporation. He stated that in accordance with the provisions of the constitution, the corporation could not pay the loans direct to the growers and hence if such a provision was necessary, the existing laws had to be amended by the Central Government. However he promised to do whatever needed to help the growers within the present limitations.

Speaking on the occasion Shri A .K.. Rajapadmanabhan said that the rubber growers should be educated the advantage of the loan schemes thereby installing confidence and belief among them.

Municipal Exhibition at Kottayam

Shri A. M. Thomas, the then Minister for Defence production inaugurated the 10th Industrial and Agricultural fair at Kottayam. Shri Kurian Uthup, Municipal Chairman presided. Speaking on the occasion the Minister stressed the importance of org nising such exhibitions which in every respect imparts knowledge about the developmental

activities taking place around the country. Among others, Industries Department, Medical College, Agriculture Department and Rubber Board participated in the exhibition. The exhibition ended on January 21st 1967. Shri R. Prasad distributed prizes at the concluding day. He also visited the Board's pavilion.

Crepe Milling Factory at Cheruvannoor

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, had laid the foundation stone for the Cheruvannoor Crepe Milling Factory at Cheruvannoor near Faroke on February 11, 1967. Shri A. D. Boland presided over the meeting. Speaking on the occasion the Chairman explained the immense possibilities of developing rubber plantations in Malabar area. In this connection he mentioned about the Crepe Milling Factory proposed to be constructed at Palai in the Co-operative sector with the assistance of

the Rubber Board. He also pointed out the possibilities of starting more Crepe Milling Factories in Malabar, Shri G. K. Panikker of Rural Industries Project, Calicut, welcomed the gathering.

The Rural Industries Project with its headquarters at Calicut is financing the Factory. The Crepe Mill is to be constructed at a cost of Rs. 3 lakhs. The Cheruvannoor Crepe Milling factory is the first of its kind in Malabar area to be constructed on an industrial basis.

Research Centres at Calcutta and Bombay

indian Rubber Manufacturers' Association had decided to set up two research centres at Calcutta and Bombay to do research on problems relating to the manufacturing of rubber products and rubber made goods. A decision to this effect had been taken at the council meeting of the IRMRA at New Delhi on March 7 1967. Dr. K. f. Jacob, Director/Rubber Production Commissioner attended the meeting.

Board's Liaison Office at Delhi

Rubber Board's Liaison office has started functioning at New Delhi. The address of the new office at Delhi is Liaison officer, Rubber Board Liaison office, F—27, Green

Park Main New Delhi—16. The Field officer of the Rubber Board Shri K, N, G, Menon is in charge of the New Delhi office.

Rubber Growers Co-operative Conference at Palai

The first rubber Growers co-operative conference at Palai marked the beginning of closer contact among growers giving a new outlook with an urge to discuss their common problems in a congenial atmosphere. The objective of such conferences

by and large is to classify the problems confronting them in a bid to make a common solution. The conference at Palai proved to be worthy of its objectives for more than one reasons. It was held at Palai on 4th and 5th of March 1967 under



Shri P. S. Habeeb Mohamed, Chairman, Rubber Board inaugurates the conference.
Shri K. M. Chaedy, Shri Thomas Joseph Kottukapally, and Shri P. O. Kuriakose are also seen.

the joint auspices of the Rubber Board and the Meenachil Taluk Rubber Planters Co-operative Society.

Over 200 delegates from different rubber growing districts of Kerala representing cooperative institutions participated in the conference.

Inauguration

Inaugurating the two day conference, Shri P. S. Habeeb Mohamed, Chairman Rubber Board observed that a conference of delegates representing co-operative societies was being held for the first time and that it clearly showed the progress won by the societies in this sphere. The Chairman further said that the Rubber Board always aimed at enlarging the working of co-operatives. He exhorted the Rubber Marketing Societies to come forward and study the problems facing the growers more closely than confining in their own realms of activity viz., marketing.

Price decline and its Effects

Commenting on the decline in prices, the Chairman detailed the factors that led to the decline in price levels and revealed the steps taken by the Board. He informed the delegates that the Board had taken up the problem with all its seriousness. Shri Thomas Joseph Kottukapally presided. The Secretary of the conference Shri P. K. Narayanan welcomed the gathering. Shri P. J. Thomas proposed a vote of thanks.

Papers presented

The following 6 papers were presented in wo days.

two days.			
Paper	Author		
Necessity for Rubber Growers co-operatives	Dr. V. R. Narayanar Nai		
Co-operative Rubber Marketing	Shri K. V. Joseph		
Co-operatives and Industrialisation	Shri J. Y. Joseph		
Co-operative Credit	Shri M. S. Gopalan Nai		
Rubber Development Schemes	Shri K. P. Phalgunar		
Modernisation of	Shri P. Mukundan		

Each paper elicited lively discussions. Sarvasree P. S. Habeeb Mohamed, T. V. Joseph, A. K. Rajapadmanabhan, Dr. K. A. Jose and Prof. P. J. Mathai presided over the respective sessions.

Elaborate arrangements had been made for the Boarding and lodging of delegates. On the first day "Film Naturally It's Rubber" was projected. The concluding session was presided over by Shri K. M.

Chandy. Shri Chandy discussed in detail the difficulties experienced by the growers and suggested the steps to be taken up to uphold the price line.

Shri T. P. Seetharaman, of the Trichur Rubber Marketing Society suggested that the next co-operative conference should be held at Trichur. This met with the approval of the delegates.

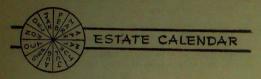
Orissa Plants Rubber

The State of Orissa has taken up rubber planting in an area of 20 acres. This enterprise manned by the Soil Conservation Dept. of Orissa is in unison with the programme of the Rubber Board for bringing additional area under rubber in the country.

The 'Rubber Farm,' as they call it is, situated on the Baripada-Midnapur Road in Mayurbhanj district. The planted area is 400 ft, above mean sea level. It enjoys an annual rainfall of 60-65 inches with a

dry spell for three months. 70 per cent of the rains occurs during middle June-middle August. The soil of the area is red loam, with a PH of 5.5 to 6.

The material used for planting here is Tjir-1 seedlings. The performance of the plant appears to be satisfactory. Encouraged by this experience the Government of Orissa has decided to plant rubber in an additional area of 20 acres this year.



For Rubber Growers

January

In the northern regions wintering may commence. This is the time when annual tapping rest is to be adopted and the panels protested with prowax or rubber kote-prowax mixture. Felling and clearing for newplanting or replanting is done at this time. This is also the time to start collection of *Purearia* seeds.

February

Wintering spreads effectively in most of the areas. The trees wintered earlier will start to refoliate. This is the time when sulphur dusting against powdery mildew has to be commenced. Many of the estates are allowed to enjoy tapping rest. Marking for the next season tapping can be done. Preparation of the land for planting is continued. Collection of cover crop seeds can also be continued.

March

Tapping rest can be discontinued and tapping commenced. Young areas are opened for tapping. Sulphur dusting rounds against powdery mildew is to be continued. Weeding is done in immature areas. Manuring can be started. In nurseries budding is done. Towards the end of the month spraying of fungicides against abnormal leal-fall is started in large estates. In areas where planting has to be done, terracing, lining, pitting etc. should be done. Stimulants may be applied on trees 20 or more years old.

April

Weeding and manuring are continued. Spraying against leaf-fall also is continued. Budding in nursery and field is carried on. Preparation of land for planting is continued. The natural undergrowth is slashed. Dead woods are removed from the garden.

May

Spraying is continued. Treatment to prevent pink disease is done. Budding can be continued if necessary. Slashing of undergrowth is carried on. Sowing of cover crop seeds can be commenced.

New flushes of young plants have to be given spraying. Nurseries are to be sprayed. The pits are filled and planting started. The tapping panels are disinfected with fungicides and water proofing with prowax or wax rex treseal done. If needed the beds for sowing seeds can be prepared. Cover crop seeds are sown or cuttings planted.

July

New flushes in nursery and young plants are sprayed. Planting is continued. If trees are tapped during this month panel protection should be given. Seed collection is done if available.

New flushes in nursery and young plants, in regions where shoot rot is prevalent, are sprayed. Treatment against pink disease is done. Seed collection, is continued. Panel protection is given in areas where tapping is done. Rubber seeds are sown.

September

This is the time for weeding and manuring. Sowing of seeds can be continued. Repeated inspection and treatment of pink disease should be done. Young rubber buddings planted out during June-July should be given shade. Yield stimulants may be applied on trees 20 or more years old.

October

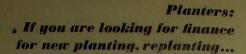
Weeding and manuring may be continued. Dead woods should be removed. Tapping panel should be given protective treatments.

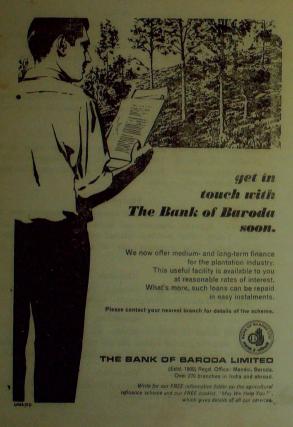
November

Mulching should be done in nurseries and round young plants. Young plants should be guarded against sun-scorch. Stems of young plants 2-7 years old and of older plants should be lime-washed if exposed to sun.

December

Lime-washing and mulching is continued if found necessary. Calopogonium seeds are collected during this month.





The Rubber Board

mtor of Research:
Dr. K. T. Jacob

T. V. Joseph

tor: P. K. Narayanan

Asst. Editor:

T. N. V. Namboodiri

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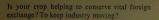
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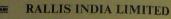
State and snails feed on tender leaves

Cover: Slugs and snails feed on tender leaves and buds of rubber plants and drink latex. An affected plant.

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Make sure of this today. Produce more and more rubber—with the use of scientifically formulated Rallis "Tree Brand" Fertilizers and Tata Fison Pesticides.



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Rubber Prices

The price of natural rubber had been under control in India upto the 16th December, 1963, on which day the Government of India lifted the control and removed the maximum and minimum prices then in force. Following certain representations and taking into account the disquiet caused by the lifting of the control, the Government reimposed a minimum price on the 19th December, 1963, which was actually the minimum price that existed before decontrol.

In fact, neither the removal of the control on price nor the removal on a minimum price had any appreciable impact on the market situation upto the middle of 1965. The price remained steady as before for about one and a half years since removal of control and it began to rise only from June, 1965. During April, 1966, the price of rubber touched the peak level and thereafter it began to decline. And that trend has been continuing ever since.

It may be mentioned here that the quantity of rubber sold at the peak price level was very limited. The steep rise in price could be attributed mainly to the restriction on imports. Other contributory factors were the fire accident in the Synthetic Rubber Factory at Bareilly leading to stoppage in production for about four months, the increased requirements of the Government and the labour strike in the rubber plantations.

It was at the time when the price of natural rubber was ruling high, that the rubber goods manufacturers approached the Government of India for reimposition of the maximum price of natural rubber and thereupon, in October, 1966, the Government asked the Tariff Commission to undertake an enquiry into the cost of production of natural rubber and submit its recommendations regarding a fair price for rubber. The Commission started its work connected with the enquiry in November, 1966 and submitted its report to the Government on the 31st May, 1967.

After considering the report of the Commission, the Govern nent announced its decision on the 18th August, 1967. The Government accepted the recommendation of the Tariff Commission that Rs. 415/per quintal of RMA grade I rubber f. o, b. Cochin would be a fair price. On the 20th October, 1967, the Government of India, by notification published in the Gazette of India, brougut the price of natural rubber under control and reimposed maximum and minimum prices, the minimum price being the same as the fair price recommended by the Tariff Commission.

Along with its decision on the price of rubber, the Government have also announced the introduction of a Cash Subsidy Scheme for one year for the benefit of small rubber growers owning upto four hectares, as the Government have found that the small rubber growers are in need of some immediate support to improve their productive efficiency. The Government have appointed a committee to enquire into the economics of small holdings and to suggest such measures as may be necessary to improve the efficiency and to contribute to the stability of the small holding sector. When it is remembered that 63 percent of the rubber area in India is owned by small holders, the importance to the industry of the steps to be recommended by this committee will be clear. The committee has already commenced its work. It may be hoped that the recommendations to be made by the committee after going in depth into the economics of the small holdings would help stabilise the position of the small holders.

Though there may be difference of opinion whether the price fixed by the Government is fair and reasonable, now that the maximum and minimum prices have been statutorily fixed, it should be the endeavour of all concerned to stabilise the market and to help the producer get the minimum price fixed by the Government, for his product. It may be mentioned in this connection that as per section 13 of the Rubber Act, 1947, it is an offence to buy or sell natural rubber at a price higher than the maximum price or lower than the minimum price fixed by the Government.

It is reported that the Government of India have decided to stop all imports of natural rubber during the current year. There are now adequate stocks of rubber with manufacturers, dealers and estates sufficient for more than four months' consumption. This is also the peak period of production of natural rubber in the country. The glut in the rubber market has been continuing even after fixation of the price of rubber. But the decision of the Government not to allow any more imports may have some effect on the market and the situation may improve to the benefit of the rubber growers.

The decline in the price of natural rubber is not a problem peculiar to India. The international price of natural rubber has been at an all time low level and the major rubber producing countries are considering of taking concerted action to face the grim situation. In fact, the minimum price now fixed by the Government of India is very much higher than the ruling international price. All these factors point to the necessity of reducing the cost of production of natural rubber by adopting improved methods of cultivation and processing, so that it can successfully compete with the synthetic product when occasion demands. The rubber planters in India should no longer be complacent in the matter of modernisation of the plantation, under the belief that they will continue to enjoy a protected market for a long time to come, as the situation is changing. They also have to move with the times.

Rubber Prices and Import Policy

P. S. Habeeb Mohamed

The prices of natural rubber have marked a sharp decline in the market recently from the high levels reached about the middle of 1965. This steady fall in price has created a serious situation as far as the rubber plantation industry is concerned and the Rubber Board has expressed its apprehension that it would adversely affect the future of the industry. The Board at a meeting held at Kottayam in March, 1967 was of the opinion that the present situation is the result of indiscriminate imports of natural rubber and hence imports should be stopped immediately. It is the Board's view that unless prices are stabilised, expansion in rubber cultivation and pro-

Manufacturers' View

The spokesmen of the rubber goods manufacturing industry, obviously do not agree with the Board's analysis of the situation that it is the imports that are depressing the prices of indigenous natural ruber. In their view higher imports were necessitated by the high prices of indigenous rubber which hindered the expansion programmes of the manufacturing industry. The manufacturing industry. The manufacturing industry has felt that the Rubber Board was taking a partisan attitude in the matter of prices of natural rubber in favour of the plantation industry and that the planters could not be expected

to take interest in reducing the cost of production of rubber if the Board itself was constantly harping on higher prices fortubber. The apprehension has also been voiced that if the industry's estimated import requirements are not fully met, all its manufacturing and export programmes would be seriously affected.

The manufacturing industry also contends that even the present market price of rubber is much higher than the controlled minimum price of Rs. 323/- and much better than the international market price. It has expressed surprise at the statement by the Board that the rubber goods manufacturers were reluctant to buy rubber from the Indian surprise.

Growers Unhappy

It is interesting to note that the rubber growers also have not been happy over the policy of the Board regarding the price of natural rubber. They feel that the Board has not helped them to obtain the best prices for their product and that it has been harping on the necessity for keeping the price level even and reducing the cost of production of rubber.

Obviously the policy of the Board has not been seen in its true perspective either by the manufacturers or by the producers. It will be appropriate in this context to

This article was written before the Government of India announced minimum and maximum prices for natural rubber on the recommendations of the Tariff Commission.

² Chairman, Rubber Board.

recall the background of the problem of prices of natural rubber in India and to enunciate the guide lines to be followed for the future.

History of Price Control

The price of natural rubber in India has been under control since 1943 with a short break in 1946-'47. In 1943 the price of natural rubber was fixed on the basis of the price prevailing in Ceylon. The prices were reviewed and revised in 1951, 1952 and 1961, on the recommendations of the Tariff Board and the Tariff Commission which enquired into the cost of production of rubber. The maximum and minimum prices of rubber were fixed by the Government upto 1963. On 16th December, 1963, the Government relaxed the prices of rubber from control and as a result there was some confusion in the market. The Rubber Board brought the matter to the notice of the Government and on the 19th December the Government fixed a minimum price which was actually the minimum price

Though the maximum price of natural rubber was thus removed, the price in the local rubber market remained steady upto May, 1965. It was more or less around the minimum price. However, by the middle of 1965, the price of natural rubber began to increase and this trend continued upto the middle of 1966. Since then it started to decline.

Spurt in Prices

Many reasons can be attributed for the spurt in the price of natural rubber. In the first place, the country had to encounter difficulties at the border and the rubber manufacturing industry, being a strategic one, had to step up production. As a result, the demand for natural rubber increased rapidly and indigenous production could not keep pace with the increased demand. Some curtailment in imports of

natural rubber also occurred during the same period. In addition to this, the Synthetic Rubber Factory at Bareilly, which started production in 1963, and which was supplementing part of the country's requirements of rubber, had to stop production for a few months in 1966 due to a fire accident. Further, the strike in the rubber plantations during the period July to September, 1966, also contributed to depleting the stocks of rubber and consequent increase in prices.

Imports

As a result of the increase in price, Government issued licences for import of 2,700 tonnes in July, 1965 and further imports amounting to 10,000 tonnes were also allowed in 1965-'66, which were expected to be imported into the country during 1966-'67. The Government decided on 26 8-1966 to allow an additional import of 7,500 tonnes of natural rubber for the first half of 1966-'67. It may be remembered that the tyre industry was declared as a priority industry following devaluation and that imports for the tyre industry were liberalised. It was also decided to allow further imports during the second half of the year.

It can be seen from the facts mentioned above that Government have allowed a considerable quantity of imports of natural rubber during 1966-'67. The import of natural rubber for the period September, 1966, to June, 1967, was 26,388 tonnes. This is higher than the imports for any corresponding period in the previous years and even the total imports for the years 1965-'66 and 1964-'65. The bulk of the imports during 1966-'67 has been made in the period from September, 1966, to January. 1967, which is the peak period of production of natural rubber in the country. This resulted in a glut in the market, as the total rubber available in the country exceeded the demand. During the period April, 1966, to June, 1967, indigenous production of rubber was 64,524 tonnes and the import for the same period was 28,477 tonnes. Thus the

total quantity available would be 98,001 tonnes whereas consumption during that period was only 86,524 tonnes.

Stock of Rubber

To look at the problem from another aggle, it would be admitted that the stock of abber with dealers and estates will be an indication of the availability of rubber in the country. At the end of June, 1967, the stock with estates and dealers was 11,675 tonnes as against 7,204 tonnes at the end of fune, 1966. This does not include the stock with small growers numbering about 82,000 and sharing more than 40% of the total production of natural rubber.

Another important point to be remembered is that even though natural rubber is produced by about 82,000 growers, the big consumers are few in number and their purchase policy will have an effective impact on the market. During the period from tyre manufacturers in the country purchased only 28% of the total production as against 63% during the period from September, 1965, to June, 1966. Whereas they lifted 19,247 tonnes during the period September, 1965, to March, 1966, during the same period in 1966—67, they purchased only 7,702 tonnes. This is another reason for the decline in the

To summarise, the present decline in the prices of natural rubber has been due to (1) the utimely import of natural rubber during the peak period of production in the country, (2) the decline in the offtake of rubber by big manufacturers, (3) the higher quantity of imports than what was actually required, and (4) the increase in stocks of natural rubber with dealers and estates as a result of increase in production.

Import Policy

To get over the present confusing situation, the Rubber Board has suggested to the Government that imports should be restficted to the gap estimated by the Board

between production and consumption of natural and synthetic rubbers and that they should be made in a phased manner rather than allow imports in a particular period in an year. Earlier the Board had recommended the gap to be met by imports on the basis of actual consumption plus four month's stock requirements. But on a further review of the situation arising out of the glut in the market, the Board decided at its last meeting to recommend the gap on the basis of actual consumption plus three months' stock requirements. This revised recommendation has been made on the basis of three facts, viz. (1) indigenous availability of natural and synthetic rubbers has increased, (2) the tyre and tube industries have been declared priority industries entitled to the benefit of the liberalised import policy, and (3) the actual stocks with manufacturers, estates and dealers do not average more than three months' stock at a time. The Board has also requested the Government not to allow any import of natural rubber during the peak period of production and that further licensing of imports should be stopped and those licences watch are in the stage of being processed should be suspended.

Price Difference

The manufacturing industry has taken the stand that even the present market price of natural rubber of about Rs. 4/- per kg is much higher than the notified minimum price of Rs. 3.23 and it is not able to get supplies of rubber either from the producers or the dealers at the correct price. But when complaining about the high prices that it has to pay now, it is forgetting about an important arrangement which has been in force since 1955. According to this arrangement, the manufacturers have to pay the difference between the notified price of indigenous natural rubber and the landed cost of imported natural rubber. It would appear that the idea behind the Government's decision was to equalise the rubber prices in the internal market when the imported price went below the controlled price and thus recall the background of the problem of prices of natural rubber in India and to enunciate the guide lines to be followed for the future.

History of Price Control

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To look at the problem from another angle, it would be admitted that the stock of rubber with dealers and estates will be an indication of the availability of rubber in the country. At the end of June, 1967, the stock with estates and dealers was 11,675 tonnes as against 7,204 tonnes at the end of June, 1966. This does not include the stock with small growers numbering about 82,030 and sharing more than 40% of the total production of natural rubber.

Another important point to be remembered is that even though natural rubber is produced by about 82,000 growers, the big consumers are few in number and their purchase policy will have an effective impact on During the period from the market. September, 1966, to June, 1967, the five major tyre manufacturers in the country purchased only 28% of the total production as against 63% during the period from September, 1965, to June, 1966. Whereas they lifted 19,24) tonnes during the period September, 1965, to March, 1966, during the same period in 1966-'67, they purchased only 7,702 tonnes. This is another reason for the decline in the

To summarise, the present decline in the prices of natural rubber has been due to (1) the utimely import of natural rubber during the peak period of production in the country. (2) the decline in the offtake of rubber by big manufacturers, (3) the higher quantity of imports than what was actually required, and (4) the increase in stocks of natural rubber with dealers and estates as a result of increase in production.

Import Policy

To get over the present confusing situation, the Rubber Board has suggested to the Government that imports should be restricted to the gap estimated by the Board between production and consumption of natural and synthetic rubbers and that they should be made in a phased manner rather than allow imports in a particular period in an year. Earlier the Board had recommended the gap to be met by imports on the basis of actual consumption plus four month's stock requirements. But on a further review of the situation arising out of the glut in the market, the Board decided at its last meeting to recommend the gap on the basis of actual consumption plus three months' stock requirements. This revised recommendation has been made on the basis of three facts. viz. (1) indigenous availability of natural and synthetic rubbers has increased, (2) the tyre and tube industries have been declared priority industries entitled to the benefit of the liberalised import policy, and (3) the actual stocks with manufacturers, estates and dealers do not average more than three months' stock at a time. The Board has also requested the Government not to allow any import of natural rubber during the peak period of production and that further licensing of imports should be stopped and those licences which are in the stage of being processed should be suspended.

Price Difference

The manufacturing industry has taken the stand that even the present market price of natural rubber of about Rs. 4/- per kg is much higher than the notified minimum price of Rs. 3.23 and it is not able to get supplies of rubber either from the producers or the dealers at the correct price. But when complaining about the high prices that it has to pay now, it is forgetting about an important arrangement which has been in force since 1956. According to this arrangement, the manufacturers have to pay the difference between the notified price of indigenous natural rubber and the landed cost of imported natural rubber. It would appear that the idea behind the Government's decision was to equalise the rubber prices in the internal market when the imported price went below the controlled price and thus place the manufacturers who import rubber and those who purchase locally on an equal footing. In other words, the Government have accepted the principle that the manufacturers should pay the same price for rubber irrespective of its source.

This arrangement was working fairly satisfactorily till the devaluation of the Indian Rupee in 1966. But since devaluation, the cost of imported rubber has gone up and the notified price of indigenous rubber has not been revised. Hence the Board is not able to collect any amount as price difference. Yet the principle which has been enforced by the Government since 1956 has to continue. If this principle is enforced, the difference between the price of imported rubber and the Indian notified price has to be paid to the rubber planters so as to equalise the prices of indigenous and imported rubber. Some manufacturers have, of course, taken this factor into account and calculating that the landed cost of imported rubber would be Rs. 4.50 to Rs. 5.00 per kg, are prepared to purchase rubber at Rs. 4.10 per kg f. o. b. Cochin. But even this arrangement does not work because as the manufacturers are having sufficient stock, they would not be willing to purchase rubber from the market and even when higher grades of rubber are offered to them they are in a position to reject them or purchase them as lower grades thus forcing producers or dealers to under-

Board's Views

The Rubber Board had all along been holding the view that natural rubber produced in the country should fetch a reasonable and steady price giving a fair return to the producer. In fact the Board was of opinion that any excessively high price would not be good for the future of the plantation industry. Such high prices would also adversely affect the major rehabilitation scheme of the Board, viz. the Replanting Scheme, as the producers would be unwilling to cut down low yielding trees and plant

afresh, because if very high prices prevail even the low yield would be fairly remunerative. Besides, the Board's programmes for improving the quality of rubber sheets would also suffer because when the prices soar, neither the dealers nor the manufacturers would be interested in quality but only in acquiring as much rubber as possible.

Again we have to consider the impact of synthetic rubber produced in the country and the price of imported rubber. Since the SBR produced by M/s. Synthetics and Chemieals Limited, is sold at Rs. 4.35 per kg. natural rubber prices would have some relation to the price of SBR. This is necessary for the future of natural rubber. In fact, during the period when natural rubber was scarce, synthetic rubber manufacturers in India were able to make serious inroads into the consumption pattern of rubber in this country. Therefore the natural rubber industry has to be watchful about the impact of synthetic rubber and asking for an excessively high price for natural rubber would be harmful to the long term interests of the

Reasonable Price

Now the question will naturally be asked as to why the Rubber Board has taken such serious note of the recent fall in the prices of natural rubber. The answer will revolve round the definition of a reasonable price for rubber. The circumstances of today are not the same as those of ten years ago. The manufacturers have been pressing for the reimposition of the maximum price of rubber. The maximum price was removed in December, 1963, and this has worked to the advantage of the plantation industry in the sense that fresh investment on a considerable scale is flowing into the industry. If the maximum price is reimposed, the flow of investment which would have otherwise come to rubber, would be diverted to other fields particularly because the prices of other ing at a faster pace. It is interesting to note in

this connection that the index number of natural rubber prices has been the lowest among the important agricultural commodities. Natural rubber and tea are two commodities which have not benefited from increase in prices that has been characteristic of the Indian economy in the last few years.

Stabilising the prices of natural rubber is particularly necessary at a time when the natural rubber in the country is not soficient to meet the growing demand. This will give confidence to the planters who would like to expand their area under rubber.

The Board has all along been advocating the view that a maximum price should not be enforced in the case of natural rubber. The intention behind removing the maximum price in 1963 was to give intentive for the industry's development. The conditions which necessitated the removal of the maximum price still exist.

Minimum Price

In regard to the minimum price to be fixed by the Tariff Commission after its present enquiry, the Board has been of the view that it should have some relation to the price of synthetic rubber prevailing in the country and the cost of imported natural rubber. Of course, cess to be paid by the manufacturers to the Board would be outside the purview of the price difference. The price of natural rubber should not be a cost plus profit price alone. It should be an incentive price. This point is particularly

important as natural rubber is in short supply in the country and the producer will have to be given incentives for some more years. Entrepreneurs should be brought into the industry for further expansion and this can be achieved only if an incentive prize is guaranteed. This is all the more necessary, as a considerable extent of the acreage under rubber belongs to the small growers.

The cost of production of natural rubber has increased considerably during the last few years especially since the last enquiry by the Tariff Commission. In this connection the award by the Wage Board for the Rubber Plantation Industry is worth mentioning. The cost of other items other than labour charges has also increased in the last few years. Again during the last ten years, the number of small growers has increased considerably which is a new situation to be taken note of.

The Board has been consistent in its view regarding the prices of natural rubber and it has been pleading for a steady and reasonable price for rubber. Fluctuations in price would be advantageous neither for the plantation industry nor for the manufacturing industry. The Board feels that a steady price level could be achieved by regulating the imports of natural rubber into the country and recent developments justify the views held by the Board. It is for the concerned interests to sit together and arrive at a policy that would be beneficial to all and conducive to the balanced development of all sectors of the rubber industry.

A Review of the Progress of the Natural Rubber Industry in the Various Rubber Producing Countries

R. Gangadharan Unni *

Introduction

Major Producers

The major producers of natural rubber according to their rank in production in 1966 are Malaysia, Indonesia, Thailand, Ceylon, Nigeria, India, Liberia, Cambodia, Vietnam, Congo and Brazil. The above countries account for about 98% of the world rubber output. The individual share of these countries in world production and area is given in Table 1.

From Table 1, it is clear that Malaysia together with Indonesia and Thailand shares about 80% of the world area and 79% of the world production. India

covers only 2.2% of the world production. But she holds the sixth rank, both in respect of area and production.

Importance of Natural Rubber

Almost all the producers of natural rubber are exporting practically their entire rubber output to other countries. The only three exceptions are India, Brazil and Philippines. In fact, the former two countries are importing rubber to meet the gap between their domestic production and demand. Natural rubber is one of the main pillars of the economy of the developing countries. Table 2 gives the percentage value of rubber exports to total exports for some of the major producting countries.

Table 1

Major Producers of Natural Rubber and Their Share in World Area and Production

Country	Area at the end of 1965 ('000 acres)	Percentage to total area	Production during 1966 ('000 tonnes)	Percentage to total production
Malaysia†	4,790	33.3	1,003	41.2
Indonesia	4,910	34.2	711	29.1
Thailand	1,816	12.6	207	8.5
Ceylon	567	3.9	131	5.4
Nigeria	592	4.1	77	3.2
India	407	2.9	53	2.2
Vietnam	250	1.7	49	2.0
Cambodia	118	0.8	51	2.1
Liberia	265	1.8	54	2.2
Brazil	26	0.3	24	0.9
Congo	230	1.6	25	1.1
Others	394	2.8	51	2.1
Total:	14,365	100.0	2,436	100.0

(† Includes Singapore also)

^{*} Statistical Officer, Rubber Board, Kottayam-9, Kerala State, India.

Table 2

Country	Value of rubber exports as a percentage to total exports
Malaysia	40%
Indonesia	44%
Vietnam	69%
Thailand	17%
Ceylon	16%
Nigeria	6%
Liberia	40%

It can be seen that for most of these countries natural rubber is a major foreign exchange earner.

Rubber in Indian Economy

Rubber occupies only a very insignificant position in Indian economy. It covers only about 0.12% of the total cultivated area. The corresponding percentages in Malaysia and Ceylon are reported to be as high as 60 and 10, respectively. Other big producers too have a good proportion of their cultivated area under rubber.

History

Rubber cultivation in India, on a commercial scale, is reported to have commenced in 1902, in an area of 500 acres. Since then, the industry steadily developed passing, of course, through ups and downs. On account of the high price for rubber in the early

years of planting, more and more area was brought under rubber. By 1910, the area under rubber increased to 29,500 acres with a production of about 80 tonnes. The area under rubber in 1925 stood at 76,295 acres yielding about 6,400 tonnes. During the early periods, practically all rubber produced was exported. The industry received a severe set-back during the slump of 1929-'30 but recovered during World War II. Excessive exploitation during the war and the pegging down of the price at a low level took their toll. Plantations were damaged and replanting came to be neglected. In the year 1947, the Rubber (Production and Marketing) Act came into force and the Indian Rubber Board was set up to look

During the 10 year period from 1946 to 1956, the acreage under rubber in India increased from 1,69,923 acres to 2,34,351 acres and the production from 15,000 tonnes to 24,000 tonnes. In other words, an additional area of 61,428 acres was brought under rubber, during the period. More than three-fourth of this area was contributed by small holdings, below 50 acres in size. As a result, the structure of the rubber industry had undergone some changes. In 1946, the share of small holdings of 50 acres and below was slightly above 30%. By 1956, it increased to 49%. The number of rubber growers at the end of 1956 increased to 35,614. Their size-wise distribution was as given in Table 3.

Table 3

Classification of Rubber Growers According to Their Size in 1956

CHADDING			THE REAL PROPERTY.	A common particular
Size of	No. of units	Area in acres	Percentage to total	Average size
Below 5 acres 5 to 10 acres 10 to 50 acres 50 to 100 acres	30,492 2,889 1,784 204 245	56,597 20,941 36,756 14,308 1,05,749	24.2% 8.9% 15.7% 6.1% 45.1%	1.86 7.25 20.60 70.14 431.63
Above 100 acres		2,34,351	100.0%	6.58
Total:	35,614			

Growth from 1956 to 1966

During the period 1956 to 1960 production of natural rubber in India remained practically static. But since then the rate of growth recorded is commendable. The following table gives the annual increase in production since 1956.

Table 4
Production of Natural Rubber

	the second secon
Year	Production (Tonnes)
1956-'57	24,060
1957-'58	24,534
1958-'59	24,169
1959-'60	24,173
1960-'61	25,697
1961-'62	27,446
1962-'63	32,239
1963-'64	37,487
1964-'65	45,616
1965-'66	50,530
1966-'67	54,818

From the above table, it is evident that production has nearly doubled during the last 5 years. It surpassed the Third Plan target of 45,000 tonnes by 12%.

Growth Rate of Rubber

The production indices of some important agricultural commodities published by the Central Statistical Organisation reveal that rubber leads all the crops in growth rate. Table 5 gives the production indices of a few selected commodities for 1965-'66 with 1950 as base year.

Highest in the World

An analysis of the production data published by the International Rubber Study Group for various countries indicates that India is leading in rate of increase in production. Table 6 gives the production indices

with 1960 as a base year for some of the major producers. The average annual increase in production during the period 1960 to 1966 for various countries has been as in Table 6.

Table 5

Commodity	Index number of Agricultural production 1965-'66 (Base 1950=100)	
Rubber	286.0*	
Coffee	250.3*	
Tea	140.1*	
Potato	224.7	
Sugarcane (Gur)	197.0	
Cotton	179.3	
Jute	135.9	
Wheat	158.8	
Rice	121.6	
All Commodities	131.7	

Table 6

	-
	13.37%
	5.65%
	4.89%
	4.02%
	3.53%
	2.15%
	3.27%
	3.41%
	2.74%
(-)	6.75%
	3.22%
	()

The increase in production may be either due to increase in area or increase in productivity or both. As far as India is concerned both these factors have made their contribution.

^{*} Estimates, Source: Central Statistical Organisation.

Increase in Area

There has been a substantial increase in newplanting during the last 10 years. Since 1956-157, 1,88,842 acres were brought under rubber cultivation. Out of this, 1,52,589 acres were accounted by small holdings of 50 acres and below in size and 36,253 acres by estates of above 50 acres in size. The number of small holdings during the period increased from 35,165 to 81,688. During the same period, the number of estates increased from 449 to 647 only. Table 7 gives the classification of estates and small holdings according to their size at the end of 1966-167.

Due to increased newplanting in the small holding sector, the contribution of small holdings in total area increased to 63% which was only 49% in 1956-257.

Four factors have contributed to this steady increase in area. First, rubber price had been steady during the period. Secondly, it was anticipated that rubber being a plantation crop would be exempted from land ceiling. Thirdly, large areas especially in central Travancore, which were under coconut were diverted to rubber as yield from coconut plantation fell considerably due to the prevalence of leaf disease. Above all the constant and vigorous drive initiated by the Rubber Board for increasing area under rubber by the provision of loans and subsidies and field publicity and propaganda

also contributed to a very large extent to this increase. In this connection, the service of the Plantation Corporation of Kerala Limited set up by the Government of Kerala is worth mentioning. So far the Corporation has planted 15,000 acres with rubber.

Tappable Area

Since rubber tree takes 6 to 7 years to become tappable and 12 to 15 years to become fully productive the increase in total area cannot be correlated with the increase in production for a short period. Only the yielding area has a direct bearing on production. Till 1960-'61, there was no appreciable increase in tappable area. A steady increase is noticed since then. 1960-'61, the total tappable area was 1,73,600 acres distributed as 95,800 acres (55%) under estates and 77,800 acres (45%) under small holdings. By 1965-'66, the area increased to 2,78,500 acres, an increase of nearly 1,04,900 acres. Out of the total increase of 1,04,900 acres, 94,000 acres or 86% were contributed by small holdings and 10,900 acres or 14% by estates. Consequently, the share of small holdings in total area in 1965-'66 increased to 62% as compared with 45% for 1960-'61.

High Yielding Area

In 1956-'57, out of the total planted area of 2,34,351 acres, only 56,984 acres were planted with high yielding rubber. In

Table 7

Classification of Estates and Small Holdings According to Their Size at the End of 1966-'67

1,38,299	32.7% 11.1%	1.95 7-16
81,620 24,694 1,31,616	19.3% 5.8% 31.1%	20.13 72.84 427.30
4.23,193	100.0%	5.14
		1,31,616 31.1%

Table 8

Area under High Yielding and Unselected Rubber at the End of 1956-57 and 1966-67

	High yi	elding	Unsele	ected	Total
Estates:					THE SECTION OF SECTION
1956-57	38,873	(32%)	81,184	(58%)	1,20,057
1966-'67	1,07,597	(69%)	48,713	(31%)	1,56,310
Increase	68,724				36,253
Small holdings:					
1956-'57	18,111	(16%)	96,183	(84%)	1,14,294
1966-'67	1,23,669	(46%)	1,43,214	(54%)	2,66,883
Increase	1,05,558		47,031		1,52,589
Total:					
1956-'57	56,984	(24%)	1,77,367	(76%)	2,34,351
1966-'67	2,31,266	(55%)	1,91,927	(45%)	4,23,193
Increase	1,74,282		14,560		1,88,842

1966-'67, the area under high yielding rubber increased to 2,31,266 acres. Out of this, 50,000 acres or 22% were replanted under the subsidy scheme. The estates and holdings-wise details are given in Table 8.

From the table, it is evident that during the last 10 years the total area under high yielding rubber has increased from 24% to 55% or 3% per annum.

Yield per Acre

Until '960-'61, the average yield per acre in India was more or less static. A steady and significant improvement is noticed only since then. In 1960-'61, the average yield per acre was 326 lb which gradually increased to 400 lb in 1965-'66 and again to 430 lb in 1966-'67. Table 9 gives the variations in yield per acre during the last ten years:—

Table 9

Year	Yield per acre (lb)
1956-'57	297
1957-'58	308
1958-'59	307
1959-'60	309
1960-'61	326
1961-'62	330
1962-'63	342
1963-'64	350
1964-'65	375
1965-'66	400
1966-'67	430

During the year 1960-'61, the average yield of small holdings and estates was 185 lb and 440 lb, respectively. The corresponding figures in 1965-'66 were 262 lb and

624 lb, respectively. In other words, during the five year period, the productivity in small holdings and estates increased by 41% and 42%, respectively. However, the overall increase was only 23%. It is due to the change in the structure of the industry. In 1960-'61 small holders' share in total tappable area was only 45% and by the end of 1965-'66 it had increased to 62%. The average yield in 1966-'67 is estimated at 430 lb per acre. This represents an increase of 30% over the yield in 1961-'62 or 6% per annum. The spectacular increase in per acre yield has been mainly due to two factors, increased use of high yielding planting materials and improved methods of husbandry.

Replanting

The Indian Rubber Board immediately after its constitution in 1947, applied its mind to the rejuvenation of the rubber industry and recommended to Government in 1949 a scheme to replant an area of 80,000 acres in 12 years beginning from 1950. According to that scheme, the replanting cost of Rs. 1,000/- per acre was to be shared equally between the planter and the Board. The development committee appointed by the Government of India in 1950 revised the area to be replanted to 120,000 acres and the period of the scheme to 16 years. It also recommended a cash subsidy of Rs. 500/- per acre. The Tariff Board, which went into the cost of production of raw rubber in 1951 also considered the scheme and remarked that "the proposals made under the scheme are well conceived" and recommended that the Indian Council of Agricultural Research should examine it. Again the Government of India referred the scheme to the ICAR which also recommended its adoption. However, this scheme was pending till 1957 with the Government.

The Replanting Subsidy Scheme was finally put into operation in 1957. The original scheme envisaged the replanting of 70,000 acres during a ten year period at

7000 acres per year. The scale of subsidy fixed per acre ranged from Rs. 325/- to 420/- for small holdings and Rs. 250/- to 300/- tor large estates of above 50 acres. In addition to this subsidy, the controlled price covered rehabilitation allowance of Rs. 6.82 per 100 th

During the period 1957 to 1959, the area actually replanted under the scheme was about 11,000 acres, against the target of 21,000 acres for 3 years. The Working Group for the Third Five Year Plan, after reviewing the unsatisfactory progress of the scheme, recommended the enhancement of the subsidy rate to Rs. 1,000/- per acre both to the large estates as well as to the small holdings and suggested the following target for replanting:

Year	Area	in acres
1960		7,500
1961		8,000
1962		8,500
963		9,000
1964		9,500
1965		10,000
	Total	52,500

The enhanced rate of subsidy came into force from August, 1960. By that time, the planting season for the year was almost over. Therefore, the effect of the enhanced rate could not be seen in the extent replanted during that year. Table 10 shows the area replanted under the subsidy scaeme since 1957.

Evidently the gap between target and achievement is decreasing year by year.

So far about 30% of the total planted area under unselected seedlings planted in or prior to 1936 has been replanted under the subsidy scheme. The average annual rate of replanting for the years 1961 to 1966 works out to 3.46% of the total area under unselected planting materials planted in or prior to 1956.

Progress of Replanting Subsidy Scheme

		Area re			
Year Target	Estates (above 50 acres)	Small holdings (50 acres and below)	Total	Achievement as a per- centage to target	
1957	7,000	1,367	1,472	2,839	41%
1958	7,000	2,083	2,098	4,181	60%
1959	7,000	1,798	2,168	3,966	57%
1960	7,500	1,459	1,697	3,156	42%
1961	8,000	2,903	2,707	5,610	70%
1962	8,500	2,943	2,662	5,605	66%
1963	9,000	3,155	2,025	5,180	58%
1964	9,500	4,421	1,898	6,319	67%
1965	10,000	5,741	2,553	8,294	83%
1966*	10,000	4,163	1,614	5,777	58%
Total:	83,500	30,033	20,894	50,927	60%

^{*} Figures for 1966 are incomplete. The actual area permitted for replanting during the year was 8,392 acres.

Co-operatives

The Rubber Board is giving various forms of assistance to small growers through coperatives. At present 170 co-operative societies are implementing the schemes of the Board. Besides the above societies, there are also 20 marketing societies of which 15 are exclusively marketing rubber. Some of the important schemes implemented through the co-operative societies are listed below:

- (a) Distribution of sprayers and dusters.
- (b) Subsidised supply of copper sulphate and copper fungicides.
- (c) Subsidised supply of manure.
- (d) Distribution of rubber rollers on hire purchase basis.

In order to encourage the production of quality sheets, the Board is giving financial assistance to co-operative societies for the construction of smoke houses.

The Board is also encouraging rubber marketing societies by granting working capital loans etc. Nearly about 10,000 small holdings are members of the marketing societies,

Taxes

The Rubber Board is collecting cess of 30 P for every kg of rubber produced in the country. This is collected from the manufacturers. The manufacturers are also obliged to pay to the Rubber Board the difference between the landed cost and the domestic price (controlled) when the former is lower than the latter. The cess of 30 P is for research, subsidy for replanting and for other developmental activities. The difference between the landed cost and the controlled price is credited to a separate fund known as 'pool fund.' This is exclusively for the rehabilitation of small budders.

The other taxes are mainly State levies, As 94% of the area under rubber is in Kerala, the taxes in Kerala State are given below:—

Land Tax

- (i) Basic Tax Rs. 2/- per acre.
- (ii) Plantation Tax Rs. 8/- (steps are being taken to revise it to Rs. 20/-) per
- (iii) Additional Tax Rs. 2/- per acre.

Sales Tax

- (i) State Sales Tax 2% on the purchase price plus a surcharge of 5% on S. T.
- (ii) Central Sales Tax 2% on purchase price.

Agricultural Income Tax R

- (i) On the first Rs. 1500/of total agricultural income Nil
- (ii) On the next Rs. 3,500/- 5 Paise in the Rupee
- (iii) On the next Rs. 5,000/- 11 do.
- (iv) On the next Rs. 5,000/- 18 do.
- (v) On the balance of the agricultural income 25 do.
- N. B. In the case of every Company, agricultural income tax shall be charged at the maximum rate on the whole of the total agricultural income.

Agricultural Super Tax

- (i) Persons other than Companies:
- (a) On the first Rs. 25,000/of total agricultural
 income
- (b) On the next

Rs. 15,000/- 12 Paise in the Rupee

- (c) do. Rs. 15,000/- 16 do
- (d) do. Rs. 15,000/- 22 do (e) do. Rs. 15,000/- 28 do
- (f) On the balance of the total agricultural income 34 d
- (ii) Companies
 - (a) Upto the first Rupees one lakh of total agricultural income
 - (b) On the next Rs. 2 lakhs 19 do.
 - (c) do. Rs. 7 lakhs 25 do.
 - (d) On the balance of the total agricultural income 31 do.

Besides the taxes mentioned above, there are Panchayat levies like, land tax, house tax, profession tax, factory licence fee, storage licence fee, etc.

The succeeding few paragraphs give a brief review of the progress in production and productivity in major rubber producing countries during the last one decade with particular reference to their important development plans.

To be continued)

Recent Advances in Rubber Research in India

K. T. Jacob and M. Abdul Kalam*

India's increasing demand for natural rubber can only be met, even partially, by increasing the unit production from the existing areas under the crop and also by producing the maximum possible from the areas being newly planted with rubber. Till recently, increased production was mostly attained by large-scale extension of the area under the crop, rather than by maximising unit production by scientific cultivation of the existing areas. Since the availability of new areas for large scale rubber cultivation is becoming increasingly difficult, more intensive and concentrated efforts are needed for increasing the unit vield to the highest possible level.

Over 40% of the total production of natural rubber in India comes from small holdings, accounting for nearly 62% of the total area. Most of the small holders have little or no facilities for processing the latex obtained from their holdings, to produce better grades of sheets, and more than 75% of them get their produce processed outside, with little or no quality control and incurring heavy expenditure. This makes their produce not only costly but also inferior in quality, which fetches a lower price. Hence it is essential that the small holder should have adequate facilities to prepare quality sheets in his holding, for which he should be provided with necessary technical help and advice on the scientific methods of collection and processing latex.

It is on these aspects that the Rubber Research Institute of India is concentrating its attention, with emphasis on the specific problems of the growers. Selection and development of high yielding planting material, choice of suitable areas likely to give high production in relation to the climatic and edaphic factors, proper methods of planting and cultural operations, and effective and economic methods of controlling diseases and pests infesting the crop, are the major items of work being studied. Regarding processing, improvements in the present techniques are being attempted at all stages of conversion of field latex into sheets.

Improvements of Planting Material

Yield potential of any planting material is mainly an inherent factor, though it is influenced to a great extent by environmental conditions. Hence selection and breeding are the basic aspects in the improvement of planting material for rubber. For a perennial crop, research on these lines is bound to be a slow process, requiring careful planning and experimentation over a number of years.

Hand pollination and selection are the usual methods of improving planting materials in rubber and work on these lines was initiated in India in 1954. Among the hand-pollinated series of 1954-56, 22 primary selections which were found to be

Director-cum-Rubber Production Commissioner, and Research Assistant, Rubber Research Institute of India, Kottayam—9, Kerala State.

very promising, are being tested further. to confirm their superiority over other clones. The two seedling materials viz, RRII 1 and RRII 2 which have been selected from an irradiated population of pBIG seedlings and Chemara population respectively, have recorded yields of 5 kg and 12.07 kg per tree annually, in the second and fourth year of tapping. The vield obtained from Tjir 1 seedling material grown under identical conditions was only 2.35 and 2.63 kg during the same period. The three estate clonal mother tree selections viz. RRII 3, RRII 4 and RRII 5 have recorded 6.92, 7.83 and 10.20 kg per tree in the third year of tapping, as against 2.49 kg in the control Tjir 1. These clones will be tested further and multiplied on a large scale and distributed to planters after their adaptability and higher yield potential

Mineral Nutrition

Nutritional problems of rubber have attained great importance in the plantation industry. Manuring on a scientific basis, after assessing the exact requirements of the crop for each area, based on the nutritional status of the soil and the leaves, is essential for getting optimum results at economic costs. For this, exhaustive manurial experiments have been conducted during 1956/1966, to study the nutritional requirements of the tree. Based on the results of these studies and the concurrent observations, fertilizer grades for immature and mature rubber proposed earlier and their schedule of applications have been revised. As per the revised recommendations, the quantity of phosphoric acid and potash to be applied during the immature period of 75 months of the growth phase, has been reduced to 257 kg and 103 kg per hectare respectively, against the carlier recommendation of 415 kg each, which was fixed tentatively without sufficient background information of the actual requirements of the tree. In the case of mature rubber, quantity of the above nutrients has been

reduced to 27 kg each, from the old recommendation of 79 and 94 kg respectively, thereby lowering the cost of maintenance of the plantations. The addition of magnesium to correct the magnesium deficiency noticed in most of the locations and a better balanced nutrition would result in higher yields and resistance/ tolerance to diseases.

Soil and leaf samples from areas representative of different soils and of varying weather conditions have been collected and analysed, which has enabled to formulate more precise requirements of the mature tree for the various mineral elements. According to the modern trends in mineral nutrition of the rubber tree. discriminatory fertiliser application should be adopted for specific areas, but due to many practical difficulties, a general recommendation can be adopted, if such recommendations are based on detailed study of the problems in representative areas. Accordingly, the present schedules recommended by the Institute are generally applicable to the rubber growing areas in India. Future work is being orientated to enable a more correct assessment of the requirements for different clones, in distinctly varying agro-climatic

For better growth and vigour of the seedling in the nursery, the importance of the application of trace elements along with the usual NPK mixture, has been indicated. Magnesium nutrition of the seedlings through foliar application has also been found to be more advantageous when compared to soil application, in obtaining maximum height for the seedlings.

Crop Protection

The abnormal leaf fall disease caused by Phytophthora palmivora is the most destructive disease of rubber in India. It has been observed that in older plants, crop losses due to this disease range from 25 to 50%, Subsequent deterioration of the tree is very serious. From a series of laboratory studies and field trials, it has become possible to control the disease by spraying the trees with the high volume bordeaux or with the low volume oil copper fungicide. Development of disease resistant clones, will have the additional advantage of minimising the cost of maintenance of the plantations and better protection from diseases. Field observations have indicated that the clones Gl 1, BD 10 and AVROS 255 were rather tolerant to the disease, compared to the highly susceptible materials like PB 86, Tjir 1 etc. Limited disease tolerance has been indicated by clones developed from hand-pollinated seedling families of Mil 3/2 × Gl 1 and Mil 3/2 × Tjir 1. A regular observational study has also indicated that shy seeders usually show less disease incidence, compared to prolifically seeding trees. Further screening tests are required to establish the above observations and to formulate future programme of work.

Effective control of pink disease caused by Pellicularia salmonicolor is now possible, by treating the affected trees with Bordeaux paste. The nursery leaf spot disease caused by Corynespora cassitoola could be effectively controlled by overhead shading of the nursery, along with fungicidal spray of Ferbam 0.4% repeated at roughly 20 days' intervals.

Loss of rubber due to drinking of latex from the panel and collection cups by slugs and snails is a serious problem in some of the northern and central regions of Kerala. A series of laboratory and field studies have been conducted at the Institute to find out suitable indigenously available cheap chemicals to control these slugs, but efforts made so far have not been very successful.

Coming to the physiological disturbances affecting the normal production of the trees, some advances have been made in the study of the conditions which lead to "brown bast." The latex collected from the brown bast affected trees recorded a much lower carotene content compared to the latex from

apparently healthy trees of the same clone. Since the metabolic pathways upto the isoprene stage in the formation of both rubber hydrocarbons and carotene are almost the same, it appears that some enzymatic reactions might have affected the formation of rubber hydrocarbons also at the initial stage of its biosynthesis. The flow pattern study of the brown bast affected trees has indicated that the rate of flow remained steady for a considerable time, possibly indicating that the flow ceasing mechanism is interfered with, in the case of affected trees.

Exploitation of the Tree

While providing the optimum conditions for maximum production, it has to be ensured that the production potential of the tree is utilised to the maximum. Productivity and profitability can be greatly increased by the adoption of the correct tapping system for each clone, either half spiral cut at reduced frequency or full spiral tapping at normal or reduced intensities. The normal tapping systems practised in India are half spiral alternate and half spiral once in three days. Certain clones yield better when tapped on full spiral. However, the systems have to be carefully studied for each clone, since full spiral systems of tapping may result in reduced girthing more severely than the conventional half spiral system. The results of the preliminary observations have shown that in clonal seedlings, the yield per tap was more under the half spiral once in three days system, though the total yield was more under the half spiral once in the days system. But this needs detailed investigations since certain other factors like the incidence of 'brown bast' etc are to be taken into consideration.

The depth of tapping has a direct bearing on the total yield obtained from the tree. Generally, it has been accepted that deeper the tapping, higher the yield. Studies conducted have indicated that according to our present tapping methods, only about 50% of the total latex vessel rows are opened in most cases, while the remaining 50% near the cambium are left unexploited. This has indicated the necessity for detailed investigations on the optimum depth of tapping

for different clones, under different systems of tapping.

In order to have a better idea on exploitation methods, studies on the internal factors affecting the latex formation and flow, simultaneously with the tapping studies, are conducted at the Institute. Such studies will also yield information on the mechanism involved in yield stimulation of the trees and the physiological disturbances affecting the yield. These studies have so far revealed that the duration of latex flow after tapping has no relationship with the initial rate of flow. Although the initial rate of flow may depend on the turgor pressure, duration of dripping appears to be influenced by the mechanism involved in the cessation of flow. The yield is influenced by the total flow pattern, rather than the initial rate of flow.

Comprehensive trials are in progress to find out the proper methods and systems of tapping, based on the available information of latex flow pattern in relation to depth of tapping. This when completed, will enable the Institute to recommend exploitation methods more specifically for each clone.

Chemical and Technological Research

Acid coagulation of latex is a primary process in the conversion of latex into sheets, either in the smallholdings or in estates. There is a general belief among the rubber growers in India that for proper coagulation, formic acid is the best available material. However, it was established from the studies at the Institute that acetic acid (produced indigenously) is a good coagulant, with 4 ml for the same day sheeting and 3 ml for the next day sheeting of ½ kg rubber. In fact, the sheets produced with acetic acid were in no way inferior to those obtained with formic acid; on the other hand the ageing characteristics of the former were slightly superior to those of the latter. This indicated that there is no further necessity for importing formic acid on large scale, thereby saving foreign exchange to the tune of about Rs. 5 lakhs annually.

Work on oil extension of natural rubber in the latex stage to effect economy in tyre manufacture, is being done. A rapid laboratory method has been evolved for the estimation of volatile fatty acids in latex, which will have definite advantages in quickness and simplicity, where large number of latex samples are to be analysed. Work on creaming of skim latex and developing improved types of smoke houses for small-holdings and estates are under way.

Solving some of the practical problems faced by the planters like shortage of planting materials, non-availability of sufficient fertilisers for preparing the various grades of manure mixtures recommended by the Institute and scarcity of equipments and accessories essential for the industry also commanded the attention of the Institute. The results of research findings are being communicated to the Plantation Industry through the Extension staff. The Rubber Board maintains nurseries for distribution of planting materials, either in the form of seedlings, budded stumps or budwood. To provide hybrid seeds of selected clones, polyclonal seed gardens have been established, from which seeds may be available by 1970, after which the import of such seeds from Malaysia can be completely stopped. In this connection it may be stated that during the year 1966-67, import of seeds worth cif value of Rs. 20 lakhs was granted by the Government of India.

The Rubber Research Institute has to do a great deal more in improving the unit yield in India and the quality of the produce, and it is hoped that it would be possible to achieve the desired objectives within the shortest possible period. It is essential that the planter should get the maximum return for his produce, for which proper grading systems on scientific lines are to be formulated. The quality of latex or sheets produced should be such that the exact requirements of specific industries should be met. Concerted and conscientious efforts being made by the Institute can bring the Indian rubber industry to a stage in the near future, when it could keep pace with the developments in other countries.

Fertiliser Grades and Fertiliser Schedules for Rubber during Pre-tapping and Mature Stages'

K. C. Ananth

Maximisation of crop production can be brought about by a combination of diverse factors which includes, (1) improved clones capable of producing higher yields, (2) control of weeds, pests and diseases, (3) better soil management methods to arrest crosion and to conserve moisture, and (4) increased and judicious use of fertilisers. All these factors are complementary and it is only by a simultaneous improvement of clones, and other agronomic practices, that the best results can be obtained. The interaction among the whole complex of these diverse factors re-inforces their individual action. In effect individual inputs can give only low increases while a combined effort can give better growth / yield responses. Therefore, when other conditions are taken care of, fertiliser should be applied to rubber according to the needs of plant and soil.

Occasionally, the application of a fertiliser or soil amendment actually brings about a reduction in rate of growth or yield because it accentuates an existing condition of unbalance. Many cases of unbalanced nutrition have been met with. An excess of potassium will tend to decrease the absorption of calcium and magnesium. Especially in plantation crops with a high magnesium requirement the effect will be

pronounced. On magnesium deficient soils the application of calcium depresses magnesium intake. Further, regular application of fertiliser mixture over a period of time, as is the case with plantation crops. might cause accumulation of certain nutrient elements in soil which in turn may bring about nutritional disorders. Generally, potassium fertilisation appears to bring about magnesium deficiency in the rubber leaves, especially when the potassium status of soil and leaf is low in the initial stages, and later significantly raised by the potassium manuring. Therefore, when the level of soil magnesium is low or the level of soil potassium is relatively high, the addition of potassium fertiliser may induce magnesium deficiency and should be balanced with corresponding applications of magnesium fertilisers. Similarly, repeated applications of phosphatic fertilisers due to its residual action, can bring about magnesium and zinc deficiencies in the plants grown in such environments. the experiments carried out and observations made under Indian conditions, coupled with this background information assisted us to some extent to formulate tentative and interim fertiliser grades and schedules for rubber. Certain of the relevant aspects which emanated from these studies are also discussed in the following pages.

¹ Paper presented at the All India Rubber Planters' Conference, Mundakayam (27 - 12-1966).

Deputy Director (Agronomy), Rubber Research Institute of India, Rubber Board, Kottayam-9, Kerala Stare.

Immature Rubber

Experiments laid-out in private estates have clearly demonstrated that rubber grown in association with leguminous cover crops responds to fertiliser application up to 4½ to 5½ years from planting. Higher levels of nitrogen (60 lb/acre), phosphoric acid (80 lb/acre) and potash (40 and 80 lb/ acre) were found to suppress the growth of rubber trees. Therefore, fertiliser application to the young rubber, during the pre-tapping stage, should be for accelerating the growth. This would result in early tappability of trees and should be considered as an important contribution to the profitability of a plantation. From the proper evaluation of experimental results and concurrent observations it became evident that application of NPK Mg 10:10:4:1.5 fertiliser grade could meet the requirements of young rubber grown in association with leguminous cover crops in most of the soil types in which rubber is grown in southern India. The bulk of the rubber growing soils, namely, lateritic gravelly loam, lateritic loam, lateritic clay loam and laterite soils are found to be deficient in available phosphate and potash and continues to remain so wherever cover crop is not established or when inter-cropped with other soil exhausting crops or badly eroded. In such cases NPK 8:12:12 fertiliser grade should give reasonable response. However, in replantings and in areas showing specific magnesium deficiency symptoms addition of magnesium should be considered essential, when employing this fertiliser grade, to get the desired response.

Though the rubber growing soils generally show low potash status, the applied potash at very low doses itself could meet the requirements of rubber plant, possibly applied potash is more easily leached by the rain on the light gravelly loam soils and therefore can reach the root system more easily and in larger quantity. The availability of such potash is also greater since

potash fixing power of these soils appear to be less when compared to soils with predominant clay fraction. In the light of the above observations and the experimental results so far available the fertiliser schedule can be revised to give more or less optimum amounts of different nutrients. First, as basal dose every planting hole is given 12 kg of compost or well rotted cattle manure and 125 gm of rock phosphate, while closing the pit just prior to the planting. Afterwards regular application of NPK 8:12:12 or NPK Mg 10:10:4:1.5 fertiliser grades, as the case may be, is recommended as detailed in the schedule for immature rubber.

By the adoption of the recommended fertiliser grades and schedules under the climatic and edaphic conditions in which rubber is grown in our country, it is possible to get the desired girth to commence tapping (22" at a height of 20" from ground level for seedlings; 20" at a height of 50" from bud union for buddings) within a period of 6 to 7 years from the date of planting against the usual period of 9 to 10 years. Thus the reduction of 2 to 3 years in the immature period of rubber by fertiliser use should be considered economically advantageous.

Mature Rubber under Tapping

Fertiliser application to rubber trees which are under tapping is mainly to increase its productivity. Healthy and rapid renewal of bark is also to be reckoned in rubber plantations and this depends greatly on the nutrient supply. Therefore, in any fertiliser schedule, the specific requirements of such mature and old trees with reference to earlier manural treatments, should be taken into consideration. As a blanket recommendation NPK 8: 10: 12 fertiliser grade is advocated to be used in areas where regular manuring was not in vogue either during immature period or afterwards. However,

Schedule for Immature Rubber NPK 8: 12; 12 or NPK Mg 10: 10: 4: 1.5

Months after transplanting into the fields	Time of application	Dose/Plant with 180 planting points	Approximate quantity per acre
3 Months	Sept-Oct.	225 gm	40 kg
9 "	March-April	450 ,,	80 ,,
15 ,,	Sept-Oct.	450 ,,	80 ,,
21 "	March-April	550 ,,	100 ,,
27 "	Sept-Oct.	550 ,,	100 ,,
33 "	March-April	450 ,,	80 ,,
39 "	Sept-Oct.	450 ,,	80 ,,
45 "	March-April	450 ,,	80 ,,
51 "	Sept-Oct.	450 ,,	80 ,,
57 ,,	March-April	450 ,,	80 ,,
63 ,,	Sept-Oct.	450 "	90
69 ,,	March-April	450 ,,	90
75 "	Sept-Oct.	450 ,,	80 ,,

Note:—1. With the above schedule of application for NPK 8:12:12 grade it will be 83.2 kg nitrogen, 124.8 kg P₂O₃ and 124.8 of potash (K₂O) per acre for the entire period of 75 months.

- On the other hand the NPK Mg. 10: 10: 4: 1.5 fertiliser grade when employed at the recommended schedule will give 104 kg nitrogen, 104 kg phosphoric acid (P₂O₃), 41.6 kg potash (K₂O) and 15.6 kg magnesium (MgO) per acre for the entire period of 75 months.
- In replantings and in areas showing specific magnesium deficiency symptoms, addition of 20 kg
 of commercial magnesium sulphate to every 100 kg of NPK 8:12:12 fertiliser mixture is
 recommended.

The dose of 450 gm per planting point twice a year may be continued till the area is put under tapping.

Composition of NPK 8: 12: 12 Fertiliser Grade

Ingredients	Quantity		Ana	lysis
	in kg	N	P ₂ O ₅	K ₂ C
Ammonium sulphate (20.6% N)	39.0	8		
Rock phosphate (29% P2O5)	41.0		12	
Muriate of potash (59%K ₂ O)	20.0			12
	100.0	8	12	12

Note :- Ammonium sulphate nitrate can also be used instead of ammonium sulphate.

Composition of NPK Mg 10:10: 4: 1.5 Fertiliser Grade

Ingredients		Quantity in kg	Analysis			
			N	P ₂ O _s	K,O	MgO
Ammonium sulphate (20.6%N)		48.5	10			
Rock phosphate (29%P2Os)		34.5		10		
Muriate of potash (59% K ₂ O)		7.0			4	
Magnesium sulphate (commercial) ((16%MgO)	10.0				1.5
		100.0	10	10	4	1.5

Note: Ammonium sulphate nitrate can also be used instead of ammonium sulphate.

regular application of manures and continuation of any specific schedule over a period of years appear to show a build up of certain nutrients in the soil. In such cases, the soils can be analysed and if warranted, reduction or cessation of the application of these elements could also be done. With well maintained stand, high yields are expected by nitrogen application alone, provided soil phosphate, potash and magnesium levels are adequate. However, it may be pointed out that some phosphate is essential in most areas to maintain mature rubber trees in a healthy state and potassium is required in areas where the natural supply from the parent rock is deficient. It has been the experience of other rubber growing

countries that phosphates improve deficient bark renewal and the application of potash on deficient soils check die-back of branches and restore the crowns of the trees.

Because of the above mentioned factors, another fertiliser grade for rubber under tapping which receives regular fertiliser applications during immature period is introduced. The tentative NPKMg 12: 6: 6: 1:7 fertiliser grade is expected to cater the general needs of the mature rubber coming under this category. Here again, the fertiliser schedule is reduced for the reasons already stated.

The revised schedule for mature and old rubber is given below:

Schedule for Mature and Old Rubber. NPK 8: 10: 12 or NPKMg 12: 6: 6: 1.7

	Type of mature	Fertiliser grade	Recommendation dose/acre
1.	Old rubber hitherto	NPK 8: 10: 12*	150 to 180 kg/acre per year in two split applications
2.	not manured Areas regularly manured from immature stage	NPKMg 12:6:6:1.7	

For areas showing specific magnesium deficiency symptoms addition of 20 kg of commercial magnesium sulphate to every 100 kg is recommended.

Schedule for Immature Rubber NPK 8: 12; 12 or NPK Mg 10: 10: 4: 1.5

Months after transplanting into the fields	Time of application	Dose/Plant with 180 planting points	Approximate quantity per acre		
3 Months	Sept-Oct.	225 gm	40 kg		
9 "	March-April	450 ,,	80 ,,		
15 ,,	Sept-Oct.	450 ,,	80 "		
21 ,,	March-April	550 ,,	100 ,,		
27 ,,	Sept-Oct.	550 ,,	100 ,,		
33 ,,	March-April	450 ,,	80 "		
39 "	Sept-Oct.	450 ,,	80 "		
45 "	March-April	450 ,,	80 "		
51 "	Sept-Oct.	450 ,,	80 ,,		
57 "	March-April	450 ,,	90		
63 ,,	Sept-Oct.	450 ,,	90		
-69 ,,	March-April	450 ,,	90		
75 "	Sept-Oct.	450 ,,	80 ,,		

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 - In replantings and in areas showing specific magnesium deficiency symptoms, addition of 20 kg
 of commercial magnesium sulphate to every 100 kg of NPK 8:12:12 fertiliser mixture is
 recommended.

The dose of 450 gm per planting point twice a year may be continued till the area is put under tapping.

Composition of NPK 8: 12: 12 Fertiliser Grade

Ingredients	Quantity		Analysis		
	in kg	N	P ₂ O ₅	K ₂ C	
Ammonium sulphate (20.6% N)	39.0	8			
Rock phosphate (29% P2O5)	41.0		12		
Muriate of potash (59%K ₂ O)	20.0			12	
	100.0	8	12	12	

Note: - Ammonium sulphate nitrate can also be used instead of ammonium sulphate.

Composition of NPK Mg 10:10: 4: 1.5 Fertiliser Grade

Ingredients	Quantity	Analysis			
	in kg	N	P ₂ O ₅	K ₂ O	MgO
Ammonium sulphate (20.6%N)	48.5	10			
Rock phosphate (29%P ₂ O ₅)	34.5		10		
Muriate of potash (59%K ₂ O)	7.0			4	
Magnesium sulphate (commercial) (16%Mg	O) 10·0				1.5
	100.0	10	10	4	1.5

Note: Ammonium sulphate nitrate can also be used instead of ammonium sulphate.

regular application of manures and continuation of any specific schedule over a period of years appear to show a build up of certain nutrients in the soil. In such cases, the soils can be analysed and if warranted, reduction or cessation of the application of these elements could also be done. With well maintained stand, high yields are expected by nitrogen application alone, provided soil phosphate, potash and magnesium levels are adequate. However, it may be pointed out that some phosphate is essential in most areas to maintain mature rubber trees in a healthy state and potassium is required in areas where the natural supply from the parent rock is deficient. It has been the experience of other rubber growing

countries that phosphates improve deficient bark renewal and the application of potash on deficient soils check die-back of branches and restore the crowns of the trees.

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Type of mature	Fertiliser grade	Recommendation dose/acre
rubber	10 108	150 to 180 kg/acre per year in
1. Old rubber hitherto	NPK 8: 10: 12*	two split applications
not manured 2. Areas regularly manured	NPKMg 12:6:6:	1.7 Do.
from immature stage		addition of 20 kg of commercial

^{*} For areas showing specific magnesium deficiency symptoms addition of 20 kg of commenced magnesium sulphate to every 100 kg is recommended.

Composition of NPK 8: 10: 12 Fertiliser Grade

Ingredients	Quantity	Analysis		
Artistanta (A. Carlo	in kg	N	P ₂ O ₅	K ₂ O
Ammonium sulphate (20.6%N)	39.0	8		
Rock phosphate (29%P ₂ O ₅)	35.0		10	
Muriate of potash (59%K,O)	20.0			12
Filler materials	6.0			
	100.0	8	10	12

Note: - Ammonium sulphate nitrate can also be used instead of ammonium sulphate.

Composition of NPKMg 12: 6: 6: 1.7 Fertiliser Grade

Ingredients	Quantity	Analysis				
	ni kg	N	P ₂ O ₅	K ₂ O	MgO	
Ammonium sulphate (20.6%N)	58.5	12				
Rock phosphate (29%P ₂ O ₅)	21.0		6	·	***	
Muriate of potash (59%K ₂ O)	10.0			6		
Magnesium sulphate (commercial) (16% MgO)	10.5				1.7	
	100.0	12	6	6	1.7	

Note: Ammonium sulphate nitrate can also be used instead of ammonium sulphate,

Time and Method of Application

The annual dose recommended is preferably given in two split applications, one in March-May and the other in September-October. The application in March-May should be made after the first few premonsoon showers and before the out-break of the monsoon, thus giving an interval of 4 to 5 weeks of light showers between fertiliser application and the regular monsoon rains. The September-October application is to be undertaken during the break in the monsoon when a dry interval of 4 to 5 weeks will be usually available.

For the first three years fertilisers may be applied around the base of each plant in annular bands to the extent of root development. Six months after planting, this area should be a circle of eighteen inches or more in diameter and should progressively increase to about 4 feet when the plants are three years old. The fertiliser is slightly forked into the top two or three inches of soil, after spreading in broad bands as indicated above. The forking in of fertilisers may not be necessary, wherever adequate mulchingto over the applied fertilisers, is carried out.

From the fourth year onwards, application in annular bands may not be an effective method as the leguminous ground covers would have grown and spread by this time and these would be badly disturbed by circular band application. Therefore, broadcasting the fertilisers in square or rectangular patches in between tree rows, each patch serving four plant positions appear to be advantageous and economical. In flat and gentle slopy areas fertiliser can be broadcast in a broad band in between two rows. The fertilisers thus applied may be lightly forked-in wherever the ground is exposed, without proper soil cover.

Future Programmes

Dr. K. T. Jacob, Director of Research, Rubber Research Institute of India, after his recent Malaysian tour has recommended certain useful and significant changes in the fertiliser applications for rubber. Mention may have to be made of the suggestions regarding the possibilities of applying different fertiliser components separately or in combination of two elements like giving nitrogen for rubber and phosphate and potash for cover crops. He has also suggested the possibilities of cessation of regular fertiliser applications or applying only a maintenance dose after the third year. These substantial suggestions are contemplated to be implemented in our country wherever applicable, as soon as the soil and foliar analyses studies already undertaken by this Institute are completed.

Further, experiments to find out the suitable time of application of fertilisers either singly or in combination, adopting either broadcast or placement methods are programmed to be undertaken as suggested in the report of the Director of Research on his Malaysian visit.

Conclusion

Blankent fertiliser practices or general recommendations are not only of little value in plantation crop fertilisation to-day but may produce soil problems hard to overcome, decrease yields, and increase fertiliser costs. It is well-known that no set fertiliser programme is good for all time in any given plantation. Change is one of the immutable laws of nature and it applies to soil management practices as well as to anything else in this world. However, the fertiliser mixtures recommended in this note provide a wide range for the varied requirements of rubber grown in our country. Further to cater to the needs of certain progressive planters who have built up the phosphate and potash levels of their soil by regular manuring or by virtue of planting rubber in certain locations with high available phosphate or potash, it becomes necessary to have further range of fertiliser grades. In all these specific cases as per available information on nutrient status, by soil and leaf analyses, appropriate fertiliser recommendations could be made to individual planters when requested, as far as practicable.

Thus manuring is more sophisticated than other agronomical inputs creating certain soil problems which require constant solution. Therefore, in due course, the results from existing and new field experiments properly correlated with soil test, leaf analysis and crop data, may give us still more precise basis for formulating fertiliser grades and fertiliser schedules for rubber grown in southern India.

Mikania cordata, B. L. Robin, an Alien New to South India

V. K. Bhaskaran Nair

Mikania cordata was noted by the writer at the Rubber Research Institute of India Experiment Station at Puthupally for the first time on 11-11-1965, near the budwood multiplication nursery. During the following week, general weeding of the area was undertaken and the plant was severely slashed. However, it has been observed that the plant could regenerate quickly. During December, 1965, a further search was made to find out the possible occurrence of the plant in the different fields of the Experiment Station and plants were noticed in Fields 3, 13 and other adjacent rubber nursery sites. This plant was unnoticed here before, and to the writer's knowledge it appears to be an alien new to this region. Specimens were sent to the Botanical Survey of India, Calcutta and it was identified as M. cordata B. L. Robin. They further stated that this has been recorded in India from Bengal and regions north and east of Bengal-Haines in his Botany of Bihar and Orissa mentions this as an introduced plant but does not describe or give the precise locality wherefrom it was collected by him. There is no other report of its distribution in India, west of Bengal.

The present report of the occurrence of this plant at the R. R. I. I. Experiment Station appears to be the first record for South India or regions west of Bengal in India.

The growth of M. cordata was very much suppressed during the severe drought experienced during January—March, 1966 period, but regenerated satisfactorily after the receipt of pre-monsoon showers. Figures 1-4 and Plate I are from the specimens collected from the regenerated growth.

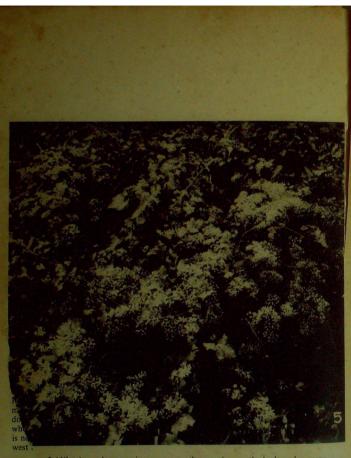
In April, 1966, fresh specimens were collected by Sri M. J. George, Botany Division, Rubber Research Institute of India, from a Tea garden at Poonjar about 30 miles from Kottayam. It was further learnt that M. cordata was fairly common to the east of Palai. It was growing in abundance along with other weeds on the roadsides near Palai and Erattupetta. Stray plants were also observed in the suburbs of Kottayam town. It may be mentioned here, that no exhaustive survey on the distribution of this plant has been made.

M. cordata is a common twining climber which is found in Malayan post-war replantings.* Although this plant has been confused with M. scandens for a long time, it has now been stated that the North American species of M. scandens is slightly different from the Malayan M. cordata. In Malaya, Mikania as a choice ground cover has got both supporters and detractors. It performs all the functions of cover crops; provision of mulch and smothering effect on other weeds; but has no ability to fix nitrogen as is the case with leguminous covers. It grows very fast and if uncontrolled, can

Deputy Director (Botany), Rubber Research Institute of India, Kottayam-9, Kerala State.



- 1. Creeping stem with broadly triangular leaves.
- 2. Inflorescence.
- Head of four flowers with involucre of four phyllaries subtended by bra
- Tubular white flower.



The Le I Mikania cordata growing amongst other weeds near the budwood nursery, plant at appears 1 in profuse flowering in late December 1960.

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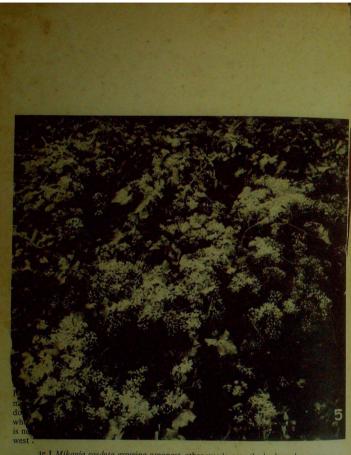
Mikania cordata B. L. Robin (Natural order Compositae); is a creeping or twining perennial, slightly pubescent. Leaves opposite, submembraneous, cordate or broadly triangular, wavy margin, palmately reticulate, leaf blade 7 to 8 cm long and 4 to 5 cm broad, with somewhat long petioles, 8 cm or more. Inflorescence corymbose panicled with milkwhite or white fragrant flowers. Heads homogamous, I mm in diameter, 4 perfect florets occasionally 5, epigynous. Involucre of 4 abruptly pointed pale green phyllaris about 5 mm in length, subtended by a bractlet. Five bracts seen in case of 5 flowered capitula. Tubular corolla inserted in pappus, pentamerous, style exerted with curled branches. Achenes hispedulous or nearly so with longitudinal ridges, about 1 to 1.5 mm in length, one seeded angled fruit with a pappus of 30 to 35 barbed bristles. Pappus bristles longer than the body of the achene. Flowering and fruiting from November to December.

The plant appears to be a recent introduction to the rubber growing regions of this country.

The author expresses his thanks to Dr. K. T. Jacob, Director of Research, Rubber Research Institute of India, for his keen interest in the study, and to Smt. K. G. Aleyamma, Research Assistant, for help in this study.

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- (1) Fernald M. L. 1949. Gray's manual of Botany.
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Effect of Marking Immature Rubber Trees on the Subsequent Girthing

M. J George*

Introduction

It is common among small holders, even now, to cut grooves on the trunks of immature trees, anticipating that this practice would enhance girthing. Queries on this practice are occasionally received from planters and the subject is often raised during planters' seminars. The Rubber Research Institute of Malaya, in response to a query from an Indian correspondent, carried out a small trial. From the results they concluded that "the practice of grooving has no value. This result seems to justify the fact that the practice has not survived in Malaya." They have further stated that "It would be interesting to receive further details of its use and suggested merits in India." (Pl. Bull., 1963). It was in this context that the present experiment was forcid out.

Materials and Methods

The experiment was laid out towards the beginning of 1966, on clone Gl 1, buddings of which were planted in 1957 on the boundary of Field VA and Field VI of the R. R. I. I. Experiment Station. The lay out was based on a single tree single plot design with 14 replications, incorporating the following treatments.

- (i) A single half spiral cut at 50° height from the bud union at an angle of 30° from the horizontal with two vertical cuts, each one foot in length, on opposite sides of the trunk starting from the panel ends, downwards.
- (ii) Two half spiral cuts, one at 50" height from the bud union at an angle of 30° from the horizontal, with two vertical cuts, each of one foot length, starting from the panel ends, downwards and the other at 60° from the bud union on the opposite side at an angle of 30°, with two vertical cuts, each of 10" length, starting from the panel ends, downwards and joining the vertical cuts of the lower panel.
 - (iii) Control, without marking.

The trees in (i) and (ii) above, were grooved on March 31, 1965. The grooves were further deepened on 2nd and 4th of April, 1966.

The girth of the individual trees at 50° and at 60° from the bud union were first recorded in March, 19.6, just prior to the imposition of the marking in (i) and (ii) and was continued to be recorded at regular monthly intervals till February, 1967.

Results

At the time of imposition of the marking, the trees had a mean girth of 440 mm and

Junior Research Assistant, Botany Division, Rubber Research Institute of India, Kottayam-9 Kerala State.

29 mm at 50° and 60° height respectively. The gith increments, from March, 1966 to rebrusty, 1967, at 50° height were 58.4 mm in treatment (ii), 57.8 mm in treatment (ii) and 58.2 mm in the case of control. The nerments at 60° height were 59.2 mm, 18.4 mm and 58.4 mm respectively.

The data were statistically analysed. The mean girth during March, 1966, the mean

girth during February, 1967 and the girth increment during this period are given in Table 1. The corresponding figures at 60° height are given in Table 2.

The analysis showed that there is no significant difference in the rate of girth increment between the two treatments and the control, either at 50° or at 60° from the bud union.

Table 1

Mean Girth and Girth Increment at 59" Height

Mean girth in mm at 50" height				Mean girth inc	rement in 1966 to F	mm at ebruary	50" height 1967	
-		Treat (i)	ments (ii)	Control		Treat (i)	ments (ii)	Control
-	March 1966	430	445	450	Mean girth increment	58.4	57.8	58.2
1	S. E.	16	15		S. E.	2.59	2.40	
2.	February 1967 S. E.	488 17	502 16	508				

Table 2

Mean Girth and Girth Increment at 60° Height

Mean girth in	mm at	60" he	ight	Mean girth inci	1300 10		Contro	
	Treat		Control		Treatments (i) (ii)			
	(i)	(ii)		Mean girth	59.2	58.4	58.4	
Jarch 1966	413	435	438	increment	2.54	2.35		
	17	16		S. E.				
uary 1967	478 17	493 16	496					

Discussion

The vigour of various planting materials of Hevea has been defined in terms of their comparative girth increment, mainly because the relative time taken by the different planting materials to reach tappable stage is one of the most important criteria in their commercial exploitation. The girth increment which is fast during the immature period, is comparatively slow once the trees are opened for tapping.

It is not clear how the notion, that grooving the trunks of immature trees may enhance girth increase, has become popular. If grooving may be considered as similar to opening for tapping, an enhancement in the rate of girth increase should not be expected since all systems of tapping are recorded to retard the rate of girth increment (Pl. Bull., 1953). Certain clones and selected seedling families may, however, show localised increases in girth directly above the tapping cut, resembling 'ring bark effect' (Dijkman, 1951), which probably is due to the accumulation of translocated food in the sieve tubes of the outer bark. This phenomenon, though it does not compensate for the general growth retardation on tapping, may be ascribed as one of the probable reasons for the belief that immature trees might show increased girthing if they are marked.

The results from the experiment show that grooving the trunks does not enhance the rate of girth increment. It also shows that grooving does not, however, retard the rate of girthing as is noted in the case of the different tapping systems. There was no significant difference in the rate of girth increment and mean girth at 50° and at 60° from the bud union, of the two treatments and the control. Similar results were obtained in a trial conducted on PR 107 by the Rubber Research Institute of Malaya, on the basis of which they concluded that grooving the trunks has little value (Pl. Bull.,

1963). The effect of grooving the trunks of clones other than Gi 1 and PR 107 is, however, not known.

The mean monthly girth increment both at 50" and at 60" height from the bud union showed that the maximum girth increment occurred during the period August to September. Increase in girth was poor during January to February. The period April to May also showed comparatively poor girth increment. The mean girth increments of the trees included in the two treatments as well as the control were found to agree with each other. The mean girth increment at 50", that at 60" and the rain fall during the period when the experiment was conducted are presented in figures 1, 2 and 3 respectively. It is also clear from these figures that rubber trees respond to seasonal changes which is manifested by their growth behaviour.

Acknowledgment

The author is grateful to Dr. K. T. Jacob, Director of Research, Rubber Research Institute of India, for his encouragement and to Shri V. K. Bhaskaran Nair, Deputy Director (Botany), for giving guidance and for the sustained interest shown in this work. Thanks are also due to Shri A. O. N. Panicker, Cyto-Anatomist, for his help in preparing this manuscript and to Shri G. Subharayalu, Statistical Officer, for analysing the data.

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n drc and percentage recovery of the rubber from the skim latex. From Table 1, it is evident that the optimum concentration of the tamarind seed gum is between 0.5 and 0.7 in spite of the fact that there is a wide variation of the non-rubber constituents of the skim latex. The initial drc of the skim latex has little or only a small effect on the optimum concentration of the creaming agent. The slight variation of the optimum concentration that may be met with can easily be adjusted by running a trial experiment.

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late Table 1

rubbect of variation of non-rubber to rubber and ptimum concentration of creaming agent

DRC of skim	Optimum concentration of tamarind seed gum	DRC of cream
9.4	0.7	40.3
8.4	0.7	42.2
10.3	0.6	43.6
	0.6	37.9
	0,6	40.1
	0.6	40.1
	0.7	40.5
	0.7	41.7
15.4	0.5	44.6
	9.4 8.4 10.3 9.1 8.5 6.9 10.3 10 9	DRC of skim concentration of tamarind seed gum 9.4 0.7 8.4 0.7 10.3 0.6 9.1 0.6 8.5 0.6 6.9 0.6 10.3 0.7 10.9 0.7 15.4 0.5

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The results from the experiment signoving the trunks does not expect used rate of girth increment. It also ubber latex, grooving does not, however ragacanth and of girthing as is noted used for creaming different tapping samarind seed gum is the significant differer patent for concentration increment and Synthetic water soluble from the b such as poly vinyl alcohol, and the poly acrylate, methyl cellulose etc. obtaic successfully used to cream field latex the hough many factors like the initial secondary of creaming agent, the proportion of creaming agent, the age of the solution, uniformity of the solution and the quality of latex affect the efficiency of

creaming, "it does not depend on the original rubber content of the latex".

Since it has been established that many reaming agents affect the distribution of otein between the rubber globules and serum, experiments were conducted to the thou best this phenomenon can be see of to improve the quality of the ber. It has also been reported the decrease the decrease of latex will decrease the other than the second of the second o

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in seed gum, Latcol HV* (a gallacto mannan base) and the gallacto mannan base and the gallacto mannan base) and the gallacto mannan base and the gallact

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The aul HV and Sarcell TPH were swelled Directorer and the swelled up solution was tute of as creaming agent.

(Bo) A known volume of skim latex of known skire and TS was mixed with a known amount of creaming agent, stirred for 15 to 20 minutes and poured into a separating funnel. After 24 hours the creamed layer was separated and its dre and TS were determined by usual methods. The dre of the skim latex was determined by the method of Broeck and Schrieck¹⁵.

The nitrogen and copper were determined by the BS method. However, for copper determination a wet ashing proposed by Zachariah. was followed.

^{*} A product of Messrs Indian Gum Industries Ltd., Bombay.

[@] A product of Messrs Hochest Dyes and Chemicals Ltd., 264 Thambu Chetty Street, Madras—1.

Results and Discussion

In all cases, the concentration of creaming agent is expressed as a percentage of the solid (creaming agent) on the latex phase.

(i) Creaming with Tamarind Seed Gum
Detailed studies were conducted only with
tamarind seed gum as it is readily available
and is the cheapest of all the three creaming
agents tried. There is an optimum concentration of the creaming agent at which the
efficiency of the creaming is maximum, based

on drc and percentage recovery of the rubber from the skim latex. From Table 1, it is evident that the optimum concentration of the tamarind seed gum is between 0.5 and 0.7 in spite of the fact that there is a wide variation of the non-rubber constituents of the skim latex. The initial drc of the skim latex has little or only a small effect on the optimum concentration of the creaming agent. The slight variation of the optimum concentration that may be met with can easily be adjusted by running a trial experiment.

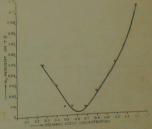
Table 1

The effect of variation of non-rubber to rubber ratio on optimum concentration of creaming agent

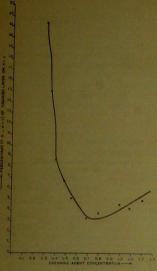
Sample	Rubber to non-rubber ratio	DRC of skim	Optimum concentration of tamarind seed gum	DRC of cream
	2.6:1	9.4	0.7	40.3
1	2.3:1	8.4	0.7	42.2
2	2.9:1	10.3	0.6	43.6
3	2.4:1	9.1	0.6	37.9
4		8,5	0.6	40.1
5	2.3:1	6.9	0.6	40.1
6	16:1	10.3	0.7	40,5
7	2.6:1	10.9	0.7	41.7
8	2.7 : 1 4.5 : 1	15.4	0.5	44.6

It is interesting to note from graph 1 that there is a mark decrease in the non-rubber constituents and introgen at the optimum concentration of the creaming agent and their percentage is a minimum at the optimum concentration of the creaming agent. As the conce, tration of the creaming agent is increased above the optimum, the percentage of the non-rubber content and nitrogen also tend to increase. This is in conformity with the experiments conducted by other workers also.³

The main drawback of the skim rubber produced by acid coagulation is its high percentages of nitrogen, copper and acctone extract. It was observed that by creaming,



Graph I A. Relation of nitrogen content of T. S. of creamed skim latex to creaming agent concentration (Tamarind seed gum).



Graph 1 B. Percentage non-rubber content of creamed latex rubber on T. S. against creaming agent concentration (Tamarind seed gum),

the rubber obtained from creamed layer showed a marked decrease in nitrogen and copper contents. Table 2 shows the reduction in nitrogen and copper contents of the rubber obtained from skim latex after creaming the latter with tamarind seed gum.

In most cases, nitrogen and copper contents are reduced far below the SMR specifications¹⁸. It should be emphasised here that the rubber obtained from the creamed layer and the skim rubber are not creped or washed in washing machine. It is likely that if the coagulum from the creamed latex is creped and washed in washing machines, the nitrogen and copper contents may be reduced still further.

The colour of the rubber obtained by creaming skim latex is much better than the colour of the ordinary skim rubber.

(ii) Creaming with Latcol HV and Sarcell TPH

Latcol HV and Sarcell TPH can be used for creaming of skim latex and optimum concentrations are 0.4% and 0.3% respectively. A reduction in non-rubber constituents is observed with both the creaming agents. However, they do not warrant a detailed study as the cost of the creaming

Table 2
The comparison of nitrogen and copper contents of skim rubber and rubber obtained by creaming skim latex

Rubber to				% of Nitrogen		Cu in ppm	
Sample	non-rubber ratio of skim latex	DRC of skim latex	DRC of cream latex	Skim rubber	Cream rubber	Skim	Cream
1	2.3:1	8.6 6.9	42.2 40.1	1.58	0.67	18	6 7
3 4	1.6:1 4.5:1 2.9:1	15.4 12.6	44.6 43.6	1.10	0.55	1/2	5

The estimation of N and Cu were carried out on dry rubber samples obtained by the usual coagulation methods.

agent is very high compared with that of Recovery Aspects tamarind seed gum.

General Considerations

Of the three creaming agents studied. tamarind seed gum is the cheapest and most suitable. It may be mentioned that the pH age and initial dre of the latex, the temperature of the creaming etc are not considered in detail because such factors, though of prime importance in deproteinisation, have little or very limited bearing on the present study. The additional cost of creaming and processing will be comparable or even less than that in methods of Dunlop and Firestone in improving the skim rubber. It should be mentioned here that the cost of the present method will be much less than that in deproteinisation method.

like acetic acid or formic acid can be used for coagulation of the creamed skim latex economically and with ease. The trouble-some process of de-ammoniation before coagulation can safely be avoided.

A point to be remembered in all skim purification processes is a reduction in yield^{7,2}. In Dunlop method and in Firestone method the percentage recoveries are 82 and 79 respectively7. The present method compares favourably with those methods in the recovery of rubber; about 85 to 90% recovery is possible by creaming of the skim

Cost Considerations

Table 4 shows the cost of chemicals alone for the purification of skim rubber in various processes in comparison with the present method. The cost of chemicals for each process is recalculated to take account of the current prices in India However, it should be emphasised that in the Dunlop and Firestone methods more acid is required for coagulation or adjustment of pH.

Comparison of the properties of the purified rubber is given in Table 3. The properties of the purified rubber obtained by the present method compare favourably with that of the rubber prepared by other methods.

Comparison of protein, copper and acetone extract values of rubber obtained by different methods of purification.

Property	Tamarind seed gum creaming (average values)	Dunlop method (6)	Unpurified skim rubber (average value)
Protein	3.80%	2.75%	9.50%
Copper	6 ppm	7 ppm	18 ppm
Acetone extract	4.81%	5.48%	5.28%

Table 4

Relative cost of chemicals for purification of skim
rubber by different methods

	Trypsin digestion method (2, 7)	Firestone patented method (7)	Tamarind seed gum creaming	Latcol HV creaming	Sarcell TPH creaming
Cost of chemicals der kg of purified rubber	29 Paise	4 Paise for patent rights alone. Chemical and other things not disclosed	14 Paise	43 Paise	49 Paise

Summary

The non-rubber constituents in skim rubber are reduced considerably by creaming skim latex with tamarind seed gum. The non-rubber constituents are reduced from 20% to 4% by creaming. The nitrogen content is reduced to less than 0.7% and the copper to less than 8 ppm. This method of purifying skim rubber is compared with other similar methods.

Acknowledgement

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Wind Damage in Rubber Plantations

M. Mathew and C. M. George

Introduction

In recent years, losses due to wind damage have been found to be on the increase in the rubber plantations in South India. Measures to reduce, if not to prevent, the damages caused by wind to rubber trees have, therefore, assumed topical importance.

The nature and intensity of damages caused by wind depend on the force exerted on the trees. It is reported that the over-all force sustained by the tree will be proportional to its size and the square of the velocity of wind. The force exerted by wind on a tree will be transmitted through its trunk and branches. Hence tall trees with high canopies will exert greater leverage on the trunk than squat trees.

Types of Damages

The various types of wind damages occurring in rubber plantations are stem bending, branch breakage, trunk snap and uprooting. Of these, uprooting and trunk snap are most serious, as they are often beyond repair and they occur at a stage in the life of the plantation, when replacement is uneconomic.

(1) Stem Bending

Stem bending which occurs during the immaturity period, appears to be due to imbalance between the crown and the stem of the tree. It is necessary that there should be an optimum relationship between the canopy of a tree and its stem size. If sudden flushes of heavy foliage are induced, there will be a risk of at least temporary imbalance resulting in stem bending. Usually incidence of stem bending is noticed in

plantations when leguminous ground covers start dying out due to the shade of the trees.

(2) Branch Breakage

Branch breakage is usually considered a clonal characteristic due to certain specific branching habits. Tjir I is a well-known example. Branches break off at the fork, tearing away a large portion of the trunk with them. Trees become susceptible to this damage in cases where the branches are formed at acute angles and rival the leader.

(3) Trunk Snape

Usually occurs in the case of certain high yielding clones which are generally susceptible to this damage. Mostly young plantations in their early years of tapping, are prone to trunk snap damage. Many factors, particularly the nature of the crown, the height of the tree and the structure of the wood, which are connected with the genetic constitution of the planting material, play their part in making a tree susceptible to trunk snap and therefore it is considered a complicated problem¹.

(4) Uprooting

Uprooting is usually due to the poor development of the tap root. In areas where sheet rock and laterite horizon or impervious clay layers are present within three or four feet from the ground level, tap root formation will be poor. This results in insufficient anchorage. In such areas, losses due to uprooting may be appreciable. It cannot be attributed to any inherent

susceptibility of the planting material to wind damage. Uprooting may also occur in cases where the trees are strong enough to withstand branch breakage and trunk snap.

Factors Influencing Wind

Many factors influence wind damage, of which the most important may be:

(1) Monsoon Winds

Two mons oons, associated with strong winds, are prevalent in the main rubber growing areas of South India, which are mainly located on the hills and slopes. Due to the variable topography of the rubber growing areas, the effects of strong monsoon winds may vary considerably, depending upon the location of the plantation. Therefore, the location of the area should be considered an extremely important factor in the general incidence of wind damage during the monsoon season. Even some of the clones which are well-known for their marked resistance to wind damage can suffer considerable damage by monsoon storms which are rare occurrences in protected locations. Therefore, while selecting land for rubber cultivation, it would be desirable to avoid areas highly exposed to wind. Also, for planting in locations known to be exposed to heavy monsoon storms, clones like Gl 1, PB 86, GT 1 etc., which show tolerance to wind damage, should be selected to reduce incidence.

(2) Use of Planting Materials Which Are Susceptible to Wind Damage

The various high yielding clones available in the country can be classified broadly into three groups viz, (1) clones susceptible to wind damage such as LCB 1320 RRIM 501 etc., (2) clones moderately susceptible to wind damage such as Tjir 1, RRIM 605, 623, 628 etc., and (3) clones fairly resistant to wind damage such as Gl 1, PB 86, GT 1 etc.

The planting materials susceptible to wind damage, generally have a heavy crown. It is well-known that trees with a dense heavy canopy, will be more susceptible to wind damage, than trees with a light canopy, Also, clones with a tendency of growing very tall, will be generally susceptible to wind damage. Other clonal characteristics such as rate of girthing, branching habit and wood strength also influence the incidence of wind damaget Clones which grow very rapidly during immaturity period but girth only very slowly, when tapped, are found to be highly susceptible to wind damage4. In such cases, it would be advisable to delay tapping for some more time to allow extra girthing to avoid tendency towards imbalance leading to increased incidence of wind damage2. Clones characterised by leaning stem and dense upward growing branch system with weak branch unions, are also found to be highly susceptible to wind damage. A consideration of the clonal characteristics of one of the moderately susceptible clones i. e., Tiir I. will be helpful in understanding how clonal characteristics influence the incidence of wind damage. Tjir 1 is a vigorous grower, characterised by a dense upward growing branch system, forming a heavy spherical crown. Further, the main branches of Tjir I have weak unions and are often bigger than the leader and these characters make the clone susceptible to branch breakage, stem bending, trunk snap and uprooting. Therefore, to reduce wind damages in future plantations, it is essential to give due consideration to the choice of planting materials.

(3) Size, Density and Height of the Foliage Canopy

Trees with heavy foliage favour the incidence of wind damage. Damage due to wind occurs as a result of the force exerted on the tree by the wind. The magnitude of this force which determines the extent of the damage, depends on the speed of the wind and the size, density and height of the canopy. It means that the development of

tall, large and heavy canopy in the trees will favour the incidence of wind damage in a plantation. The size, density and height of the canopy are influenced by various factors such as clonal characteristics, degree of leaf disease incidence and its control, soil management, soil fertility and manuring, of which the influence of clonal characteristics has already been mentioned.

Leaf fall due to Phytophthora palmivora and Oidium is a serious problem in the rubber growing areas in India. But it is possible to control these leaf diseases by adopting suitable and timely plant protection measures. Therefore, in plantations where successful control of the leaf diseases is being regularly practised, a dense canopy will develop in due course. The increased incidence of wind damage reported from estates, where leaf diseases are being successfully controlled, can therefore be attributed to a certain extent, to the development of heavy foliage.

Rubber is usually planted in association with a leguminous ground cover like Pueraria. The legume ground cover mobilises considerable quantities of plant nutrients, especially nitrogen, during its first two to three years of growth phase and will release these mobilised plant nutrients during subsequent years, for uptake by the rubber plants. The increased uptake of plant nutrients, especially nitrogen, by rubber will result in excessive branch and leaf development, which may result in stem bending and wind damage. It is reported from Malaysia that nitrogen significantly increases individual leaf weight, upto 20% within two months'. Therefore in areas where vigorous leguminous ground cover exists, it is necessary that manuring after years should be carried out, considering the tree growth at that time. If the trees have already developed heavy canopies and the planting material used is susceptible to wind damage, then a decrease or even complete cessation of fertilizer application for some years would be justified. Therefore it

is imperative that due consideration should be given for the beneficial effects of leguminous ground cover, when manuring policies are decided in order to reduce the incidence of wind damage in rubber plantations.

Nutrition of trees, which is related mainly to the fertility of the soil and the manuring practices, is another most important factor which influences the incidence of wind damage in an estate. It is known that leaf growth, wood strength and girthing, which are factors connected with susceptibility to wind damage incidence, are also closely related to the nutrition of the tree. An examination of the evidence available on the influence of different nutrients on leaf growth. wood strength, girthing and wind damage, is therefore considered useful. In cases, where nitrogen availability to the plant is high, generally, a heavy crown will develop. Development of a heavy crown results in an increase in the weight of the canopy, without a compensating increase in the girth of the trunk, and impairs the balance of the tree thereby increasing susceptibility to wind damage. Regarding the effect of other plant nutrients on leaf growth, much evidences are not available. But it has been observed that deficiencies usually result in reduced leaf weight or leaf size.

As regards the effect of different nutrients on wood strength, the results available from Malaysia indicate that the effects of potassium and nitrogen fertilizers on wood strength are significant, both giving weaker wood.

Regarding the effect of nutrients on girthing, the beneficial effects of phosphorus and nitrogen have been clearly established in our country. On the other hand, potassium showed no beneficial effects? But from the evidences available from Malaysia, increased application of either nitrogen or phosphorus also leads to increased wind losses. When considering the effects of manuring, it may be stated that only very few cases of wind damage incidence are noticed in the large

number of small holdings, where no manuring or very little manuring has been practised. Summarising the above evidences, it can be stated that excess nitrogen application to rubber plant leads to heavier canopies and that high levels of nitrogen and potassium application may result in weaker wood. Higher levels of nitrogen and phosphorus application also are reported to result in greater wind damage while complete absence of manuring reduces wind damage. It would therefore appear that excessive application of even a balanced NPK or NPK Mg mixture may make the trees more susceptible to wind damage and that excess nitrogen may be more detrimental than others.

Adequate manuring, however, is necessary for better girthing. It is known that better girthing makes the trees susceptible to wind damage. In the successful cultivation of rubber, though adequate manuring is highly essential, excess manuring should be avoided.

(4) Continuity of the Canopy

Experience shows that in a rubber estate, continuity of the canopy is an important factor influencing wind damage incidence. When there is discontinuity of canopy in an estate, the wind not only makes greater impact on each tree but also will develop stronger suction on the leeside by drawing air out of the gaps in the canopy. The continuity of the canopy is influenced by various factors such as spacing, degree of disease incidence and control and the method of thinning out3. To get a continuous canopy it is essential to plant rubber adopting suitable planting distances, depending upon the type of planting material. Adoption of wide avenue system of planting does not give a continuous canopy and therefore, for reducing wind damages, such systems of plantings are not favoured.

Loss of plants in patches due to root disease, pink disease, sun scorch or other natural calamities also can lead to a discontinuous canopy. Therefore it is essential to take adequate precautionary measures in avoiding loss of plants in patches, to reduce wind damages.

Thinning out of unwanted trees in a clearing without discretion, also may sometimes result in the discontinuity of the canopy. Therefore in thinning out, much care should be taken to avoid discontinuity of the canopy, which will lead to wind losses. For ensuring a continuous foliage canopy, it is preferable to carry out thinning at an early stage in the life of a plantation.

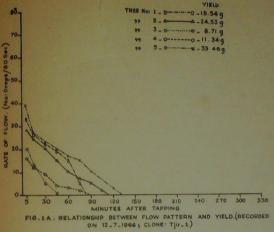
In some of the large estates where replanting is in progress, it is difficult to achieve a continuous canopy due to the removal of old rubber from areas adjacent to young rubber; such conditions favour increased incidence of wind damage.

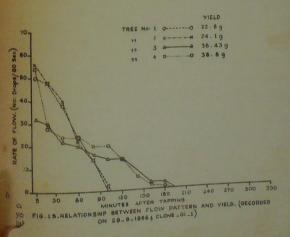
(5) Removal of Natural Wind Belt

The clearing of natural jungle, adjacent to rubber plantations, also may sometimes result in increased incidence of wind damage. Removal of jungle in such cases makes the rubber plantations exposed to the direct action of the wind, thereby causing more damage.

(6) Nature of Rooting and Nature of the Soil

Rubber trees under favourable conditions, will have a well developed tap root and lateral roots and hence planting methods or soil conditions that hamper their normal development, have been found to make the trees susceptible to damage by uprooting. In the case of seed at stake planting, the root system is found better developed than in the case of stumped planting. Therefore to reduce losses due to uprooting, seed at stake planting may prove to be better suited and may be resorted to at least in wind exposed areas. Lack of soil depth, presence of sheet rock, laterite horizon and any impermeable layers within 3 to 4 ft of the ground, also may result in the poor development of the root system, which may lead to





RATE OF F

FIG. 1.C. I

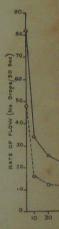


FIG. 2. FI



increased losses by uprooting. In heavy clay soils, in poorly drained soils and in areas where the water table is very high-root development may be hampered considerably. In such cases also, the tendency for increased wind damage is found to be more. Therefore to avoid damages due to uprooting, plantations should be raised in areas, where favourable soil conditions exist, adopting the right method of planting.

Tentative Recommendations

From the above considerations, it would appear that the following recommendations may prove to be useful in reducing wind damages in our rubber plantations.

- Areas highly exposed to strong winds should be avoided, as far as possible, for planting rubber.
- In locations known to be exposed to strong winds, wind resistant planting materials should be used.
- To minimise damage due to uprooting in areas exposed to wind, planting seed at stake or seedlings or basket plants may be tried.
- 4. The continuity of the canopy should be ensured as far as possible in a plantation by adopting proper spaing, by carrying out thinning operation early and by avoiding chances of patchy loss of plants.
- 5. Under conditions of poor soil fertility, where leguminous ground covers are not established and maintained properly, the normal fertilizer programmes can be carried out with benefit.
- Pruning operations in rubber should be carried out preferably before the third year, to effect maximum economy in labour cost, to save time and to prevent

imbalance in tree growth, with regard to crown development. The side shoot should be pruned in such a way as to obtain a balanced crown, the branches as far spaced out as possible, evenly on all sides. Large branches which arise at acute angles and rival the leader may be cut or sawn off flush with the main stem, for clones susceptible to branch breakage. A wound dressing compound should be applied at the cut end.

- Even under conditions of moderate fertility, where leguminous ground covers are established and maintained, if proper leaf disease control measures are not taken, the normal fertiliser programmes can be carried out without any deleterious effect.
- 8. When the ground cover starts dying out in areas where fertility of the soils are properly maintained by establishing a vigorous leguminous ground cover, by proper mulching, and by systematic manuring and where proper leaf disease control measures are practised, tendencies of stem bending may be noticed. In such areas it is advisable to suspend the fertiliser application for two or three seasons.
- 9. Where leguminous ground covers had been properly established and maintained, a reduction in the level of nitrogenous fertiliser during the period from 4½ years to 7 years after planting is advisable for clones or areas known to be susceptible to wind damage.
- Areas with adverse soil conditions, such as poor depth and lack of drainage, high water table, presence of sheet rock and laterite horizon or clay pans, should be avoided, while selecting land for rubber cultivation.

Acknowledgements

The authors wish to thank Dr. K. T. Jacob, Director-cum-Rubber Production Commissioner, Rubber Research Institute of India, for the very valuable suggestions he had offered in the preparation of this note. Thanks are also due to Sri. P. N. Radha-krishna Pillay, Head of the Small Holders' Advisory Service, for the help rendered.

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Standardisation of Natural Rubber*

P. S. Habeeb Mohamed

It is a matter of great pleasure for me that Sub-Committees have been set up by the Indian Standards Institution to go into grading and standardising of natural rubber. They were meeting here for the last two days and I am glad to find that certain draft standards are almost in the process of getting finalised.

We are all aware of the position of natural rubber industry as compared with the synthetic rubber industry in the country. The closed economy in which we are operating today need not operate for a long time to come and unless the natural rubber industry improves its competitive aspect, difficult times may be ahead. There is only one synthetic rubber plant now working in this country, but even during the Fourth Plan period more units are likely to be set up and in any case some more units are likely to go into production in the Fifth Plan period. Now there is one important aspect to be remembered. As you already know, it is not possible for the items like wages for labour, cost of fertilisers and plant protection chemicals to go down in the near future. Therefore the prime objective should be to reduce the cost of production. The plantation industry has done quite a lot in this direction by using high yielding planting materials, using correct dosage of manuring and so on. But it

is the weakest today in presentation aspect. I am afraid that hardly any natural rubber producing country in the world is as low as India in this respect.

Presentation Aspect

The Indian Standards Institution has been doing excellent work in drawing out specifications for natural rubber for the last two or three years. You may be aware that in the recent report submitted by the Tariff Commission the necessity for improving the competitive nature of natural rubber has been emphasised. They have made it very clear that natural rubber is wanted in India and may fetch a good price, but so far as the presentation is concerned, a lot of work has to be done than has been already done. You may also remember that India's position in rubber production is very unique in the sense that it is the only country, excepting Brazil, which is producing both natural and synthetic rubbers and consuming the entire quantity. It is precisely in such a situation that we have to make the maximum development so far as the presentation, packing, grading etc. are concerned. Though the synthetic rubber industry is in existence in India only for the last three or four years, it is well organised and has got a very good selling system and it has been able to reach the nooks and corners of our country. It shows the extent to which they can penetrate and the advantages enjoyed in laying predetermined standards and selling to specifications and so on. They have also got a service organisation which goes into the

Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 5th meeting of the Raw Rubber Sectional Committee of the Indian Standards Institution held on 23-8-1967 at the Rubber Board, Kottayam.

problems and the difficulties in using synthetic rubber. The structure of natural rubber industry has undergone considerable changes in the last one or two decades or so. There are about 80,000 smallholders' units, while large growers units come to only about 700. Large growers have done a good work and it should be very easy for them to switch over to the grading the Sub-Committee has drawn up, though there may be some difficulty. So far as the small-growers are concerned, it may present some problems, but it only underlines the importance of the work that we have to do. Planters should switch over to the technical grading system as early as possible, to strengthen the competitive position of the industry and to make its position alright when the synthetic rubber industry develops. These problems are almost unknown today to the small growers in India.

SMR Scheme

Almost in all natural rubber producing countries rubber has to be exported, except a negligible percentage for internal consumption, and they are facing competition from other natural rubber producing countries and the synthetic rubber producing countries and the African countries have to sell their natural rubber in a highly competitive market. They have been using high yielding materials for planting and they have also done very good work so far as technical specifications are concerned. You are all aware that Malaysia has gone over to the Standard Malaysia has gone over to the Standard Malaysia Rubber Scheme and a lot of work has been done there on this. Though only about 10 to 15 thousand tonnes are produced according to specifications, certainly it is gathering momentum there. The small growers have already come into the picture and for them two pilot projects have been established in Malaysia. The Government of Ceylon is anxious to get over to this system. They were to send their personnel to Malaysia to study the techniques of this system. They know that they should switch over from the visual

grading system now in practice to a better system of grading. New natural rubber producing countries have the advantage in this that readily available system of technical specification is now in vogue so that they can easily adopt them. Liberia and Ivory Coast have been emphasising the importance of the scheme. It is all the more important for a country like ours that this matter is given due importance. We are having both synthetic and natural rubber producing units in our country and the present position does not call for alarm, but the problem in the future is something we cannot visualise.

Therefore this problem commands great importance. We should also send our men to Malaysia to study the Standard Malaysian Rubber specifications It is necessary that we also set up pilot projects to educate small growers in switching over to technical specifications, as in Malaysia. The times are rapidly changing and with the changes in usage of rubber, a lot more can be done. The officials of the Indian Standards Institution have taken this problem right in hand and now it is for the Rubber Board and the planters to play their part in effecting this change as early as possible. Certainly it will not be easy, because our people are accustomed to the existing selling pattern in our marketing system. As you know, the price of rubber has been fixed and if you have to derive the maximum out of it, you have to change the present system of marketing. I do not know how far the specifications laid down here compare with the specifications operating in the SMR system. These are of course for technical experts like you to consider and I am quite sure that the work which you have done here will also be in accordance with the international standards.

We cannot function in isolation and therefore the standards which we lay down should have some relation to the standards laid down in Malaysia and the standards laid down by the ISO.

I am sure, the excellent work done by the Committee will contribute to the real growth of the rubber plantation industry.

The Fifty Seventh Meeting of the Rubber Board

The fifty-seventh meeting of the Rubber Board was held on Tuesday, the 12th September, 1967, at the Board's Office at Kottayam under the presidentship of Shri P. S. Habeeb Mohamed, Chairman, Rubber Board. Eighteen members, besides some special invitees, attended the meeting. Dr. P. C. Alexander, Joint Secretary to the Government of India, Ministry of Commerce, was also present.

Before taking up the agenda, the Chairman mentioned the sad demise of Dr. K. B. Menon on the 6th September. 1967. Dr. K. B. Menon was a member of the Board representing Lok Sabha and had taken very keen interest in the activities of the Board. The meeting resolved to place on record its deep sorrow at the death of Dr. K. B. Menon and the members stood up in silence for two minutes to pay homage to him.

The Chairman thankfully acknowledged the services rendered by the retiring members Sarvashri K. C. Sankaranarayanan and A. K. K. Nambiar. He welcomed the new members of the Board, Sarvashri K. Chandrasekharan, representing Rajya Sabha, G. Y. Krishnan and P. K. Vasudevan Nair, representing Lok Sabha. He welcomed Dr. P. C. Alexander and said that it was because of the keen interest Dr. Alexander had been taking in the affairs of the rubber plantation industry that he had readily agreed to attend the meeting.

The purpose of the meeting, the Chairman continued, was to discuss the fixation of the price of rubber and the scheme of cash

subsidy for the small growers. The import policy for the year 1967-68 and the revised estimates of the current year and the budget estimates for the next year had also to be discussed. But before going into the subjects for discussion, a background of the rubber plantation industry had to be given, the Chairman said.

Expansion

The planted area under rubber at the end of 1966-67 was about 4,23,000 acres. The targets set for expansion of area and production for the Third Plan had been exceeded. The target for production of natural rubber was 45,000 tonnes, but the production exceeded 50,000 tonnes by the end of the Third Plan period. During 1966-67, the production of natural rubber was 55,000 tonnes. During 1967-68, the production would go up to 64,000 tonnes. There had been considerable newplanting during 1967-68. The Board had set a record in the distribution of planting materials during the year. It could be expected that at least 20,000 acres would be planted during 1967. This would be in addition to the planting in the estates in the public and private sectors. The Government of Kerala had been going ahead with its programme of planting through the Plantation Corporation of Kerala. Plantation in the Malabar region might come up on an extensive scale in the coming years either in the public sector or the private sector.

The Government of Madras has a scheme for planting about 2,000 acres. The

Government of Mysore has a scheme for planting 5,000 acres through the forest department. If the Rehabilitation Ministry would make sufficient funds available for resettling the repatriates from Ceylon, the Government of Mysore might extend the plantation to 33,000 acres. A scheme for planting 6,000 acres in Andamans in the public sector has been sanctioned. Then there has been the scheme of the Agricultural Refinance Corporation. Adequate progress has not been recorded under this scheme, as the scheduled banks have found it difficult to accept applications for planting on a large scale.

The Chairman stated that though increased tempo of planting was indicated, it did not mean that the price announced was remunerative or provided sufficient incentives to the grower. The price had been fixed purely on the basis of the cost of production, which should not be the only basis for fixing the prices of rubber.

Productivity

The increase in productivity in this country has also been very good. In the rate of increase in production and productivity, India is leading the world, and is better than Malaysia, Liberia, Nigeria or any other major rubber producing country in the rate of increase in productivity, though the productivity itself is not very high. But this has been so because we started from a low base and have to do a lot to catch up with other countries. Undoubtedly India would catch up with the major rubber producing countries in the years to come.

Production and Consumption

The Rubber Board had estimated the production for 1967-68 at 64,000 tonnes, but in some estimates of production made by the Government, the figure was shown as 60,000 tonnes. So far as the production of natural rubber was concerned, the estimate of the Board was a vital factor. The stock

position of different types of rubber had to be taken into account before issuing import licences.

Regarding the purchase of natural rubber made by some manufacturing units, the Chairman said that there was little purchase of RMA 1 grade. Sheets were graded somewhere at RMA 5 and the price paid was about Rs. 3.50 per kg.

The Chairman continued that so far as the estimates of consumption were concerned the Board had arrived at a figure of 1,05,000 tonnes for 1967–68. The Directorate General of Technical Development estimated the consumption figure at 1,02,000 tonnes, but later they revised it to 1,10,000 tonnes. The Tariff Commission had estimated it as 1,18,000 tonnes, including 12 to 13 thousand tonnes of reclaimed rubber. Some recent estimates made by the Government show that the consumption would be 1,07,000 tonnes. This would mean that there were different estimates so far as the consumption of rubber during 1967–68 was concerned.

The Chairman drew the attention of the members to the fact that the manufacturers were now having a stock equivalent to about 4½ months' consumption, as against about two months' stock in previous years. He said that he did not find any reason why the manufacturers should stick on to a stock of 4 months. The Board had calculated the requirement for 1967-68 on three months' stock basis and no import had been envisaged during the year. Over and above the licences issued to import rubber to fill up the gap between production and consumption, the manufacturers were entitled to free import licence to the value of a specified percentage of the export earnings.

Imports

The Chairman then referred to the statistics of rubber imports during 1966-67 and 1967-68. The Board had recommended import of 29,000 tonnes of rubber in 1966-67.

The Government granted licences for imporing above 30,000 tonnes. Of this, 27,000
tonnes were imported upto March, 1967.
There was a quantity of about 3,000 tonnes
to be imported as the balance. But from
the statistics of rubber imports from April
to fully, 1967, it had been found that the
import of rubber was to the tune of 6,959
tonnes, which would show that more than
3,000 tonnes of rubber had been imported
during the four months which must be the
stock relating to licences issued under the
Export Promotion Scheme. Extra imports
licensed and rubber imported through the
Export Promotion quota had resulted in the
build up of about 5 months' stock with the
manufacturers, or at least more than 4
months' stock. These would show that in
the current year there would absolutely be
no case for imports.

Summing up, the Chairman said that three things needed urgent attention of the Government:—(1) Notification of the price of rubber at Rs. 415 per quintal as the minimum price, leaving the maximum open. (2) No imports to be allowed during 1967-68. (3) Announcement that there would be no imports during 1967-68.

After some preliminary discussions, the meeting took up the agenda for discussion. Some of the important decisions of the meeting are given below:—

Cash Subsidy Scheme

The scheme envisaged giving of cash subsidy to smallholders owning less than 10 acres or 4 hectares in two slabs. The idea was to help the smallholders in meeting part of their cost of production. The money given to smallholders should go really for cultural operations. The scheme, according to the Government, aimed at improving the conomic viability of the smallholders and supplement the efforts of the small growers in improving their productive efficiency.

The meeting decided that, (1) the subsidy should be given in cash, not in kind, (2) there should be a minimum stand of 60 rubber trees per acre (148 trees per hectare), (3) the subsidy should be given at the rate of Rs. 175/- per hectare to units ranging from 0-2 hectares and for units between 2 and 4 hectares at the rate of Rs. 150/- per hectare, (4) all mature and immature holdings covered by item 3, would be eligible for subsidy, irrespective of the extent of the units, (5) the areas should be registered with the Board on or before 1-4-1967, provided that in the case of units covered by item 3 already registered with the Board prior to 1-4-1967, if the ownership has changed hands, the subsidy could be given to the present owner or owners if the ownership could be proved by valid documents and if the transactions resulting in the present ownership took place prior to 1-4-1967, and (6) land allotted under the Kerala Government's scheme could also be brought under the purview of the scheme.

Budget

The Board approved the revised estimates of the Board for 1967-68 and budget estimates for 1968-69.

Import of Rubber

The Board resolved that no import licence need be recommended for the period till the end of December, 1967, and an assessment of the position should be made in January, 1968

Educational Stipend Scheme

It was decided that the Board's scheme of granting educational stipend to children of workers and employees in rubber estates should be continued during 1967-68.

Supply of Rubber Rollers

The Board resolved that the benefits of the scheme for supply of rubber rollers on hire purchase basis should be extended to the Government aided rubber planters' co-operative societies and that the following clause be added to Rule I of the scheme.

"But Government aided rubber planters' co-operative societies are eligible to apply and get the rollers from the Board on behalf of their members. The rollers will be sanctioned to such societies which will instal the rollers at a suitable central place for the use and benefit of the members and collect a nominal hire charge from the members.

Subsidy for Fungicide

The following rates of subsidy for copper fungicide supplied to small growers through co-operative societies during 1967-68 were approved by the Board.

- (1) Copper sulphate Rs. 2.50 per kg.
- (2) Copper oxychloride (oil based):
- (a) Mature area —Rs. 32 per acre or 50% of the actual cost of spraying materials charged by the society, whichever is less.
- (b) Immature area—Rs. 23/- per acre or 50% of the actual cost of spraying materials charged by the society, whichever is less.

Subsidy for Fertilizers

The meeting resolved that the rate of subsidy at 50% on NPK 8: 12: 12 rubber mixture be fixed at Rs. 226/- per metric tonne or 50% of the actual cost of fertilizer, which ever is less, in the case of the scheme for subsidising fertilizer mixture to immature area (upto 15 acres) through co-operative societies during 1967-68. It was also resolved that the benefits of the scheme be extended to those planters also who test their soil at the Rubber Research Institute for India and get a fertilizer mixture recommended other than NPK 8: 12: 12.

Cost of Planting Materials

The Board discussed the question of starting a publicity campaign for establishment of nurseries by the planters and relaxation of the rules on reimbursement of the cost of planting materials. It also resolved that the benefits of the scheme for reimbursement of the cost of planting materials for replanting or newplanting under the Board's development schemes be extended to planters who utilise the materials from their own nurseries raised from seeds obtained from approved sources.

The meeting came to a close with a vote of thanks to the chair.

The 81st Meeting of the International Rubber Study Group

The Eighty-first Meeting of the International Rubber Study Group, held in The Hague under the Chairmanship of Mr. A. de Bloeme, leader of the delegation of the Netherlands, opened on May 9th and ended on May 12th, 1967.

The meeting was attended by delegations from: Austria, Belgium, Brazil, Canada, Ceylon, Czechoslovakia, Denmark, France, Federal Republic of Germany, Hungary, India, Indonesia, Italy, Japan, Liberia, Malaysia, Netherlands, Nigeria, Singapore, Sweden, Thailand, United Kingdom, United States of America, Union of Soviet Socialist Republics and Viet-Nam.

Observers from the following countries and organisations were also present; Argentina, Mexico, Poland, Spain, Yugoslavia, Unted Nations Conference on Trade and Development, Food and Agriculture Organisation, Commission of the European Economic Community, Commonwealth Secretariat, International Bank for Reconstruction and Development, International Institute of Synthetic Rubber Producers, International Rubber Research and Development Board, the Far Eastern Freight Conference and the Bureau de Liaison des Industries du Caoutchouc de la Communaute Europeenne.

The Group examined the statistical position of rubber and made estimates for natural and synthetic rubber requirements and supply during 1957. It was estimated that the world would consume, i. e., turn into manufactured goods, some 2,555,000 long tons of natural rubber and 3,350,000 long tons of synthetic rubber. In addition, the Group estimated that a further amount of some 10,000 long tons of natural rubber would be required to maintain natural rubber stocks at an adequate level.

World supplies of natural rubber, including deliveries from the United States Government surplus stocks were estimated at 2,600,000 long tons and the supply of synthetic rubber at 3,525,000 long tons. The estimates for synthetic rubber production and consumption do not include allowances for synthetic rubber produced in the Union of Soviet Socialist Republics, Mainland China or in non-member countries in Eastern Europe.

The tables of estimates made by the Group are attached.

While there was some divergence of view regarding the analysis of the problems facing natural rubber upto 1975, the Group was unanimously agreed that measures to improve the efficiency of the natural rubber industry, both in regard to its production costs and the presentation of its product, should be undertaken as a matter of urgency. The Group therefore approved the following programme of action:—

For action by the International Rubber Study Group

 The Group should endeavour to obtain more information about the minimumprices likely to be necessary to attract investment in new capacity over the next few years, and such other information on the economics of the synthetic.

- rubber industry which is likely to have a bearing on the future of natural rubber.
- 2. It is important that the Group should continue to make, at regular intervals, a careful assessment of the future prospects for rubber in the light of the best information available at the time.
- A study should be made of national policies of protection for and subsidies to the rubber producing industries, and their effects on world prices.
- 4. The Group should give immediate consideration to ways in which effective and continuing international co-operation can best be developed for:
 - (a) the greater exchange of information, both nationally and internationally, on all aspects of natural rubber production costs
 - (b) encouraging natural rubber producers to adopt the most efficient methods
 - (c) ensuring an adequate supply of highyielding material.
- 5. The Group should undertake a study of the cost elements in respect of ocean and inland freights and insurance for both natural and synthetic rubber. In the first instance a review should be made of the present cost elements in ocean freight and insurance for natural rubber.
- The Group should initiate, with the assistance of the appropriate organisations and individuals, practical and comparative studies of the cost elements—
 - (a) unloading and port charges
 - (b) inspection and possible arbitration
 - (c) handling and storage in the factory
 - (d) compound cost

- (e) inventory financing costs
 to ensure that there should be a more
 rapid and widespread adoption of improvements already made, and to
 investigate whether cost reductions
 can be made in other areas.
- 7. The Group should without delay hold discussions with the appropriate international financial organisations to urge that sympathetic consideration should be given to any request for external financial assistance to aid the industry to reduce its costs of production by replanting and other measures designed to improve its competitive position.
- The Group should undertake a study of the possibility of international action designed to bring more stability to natural rubber prices.

For action by natural rubber producing countries

- Each natural rubber producing country should pursue a vigorous replanting programme to replace low-yielding rubber trees with high-yielding ones where conditions were favourable and where no alternative crop held out more attractive prospects.
- Producing countries should provide smallholders with special assistance in the form of adequate and efficient advisory services and supplies of the most suitable high-yielding material for replanting.
- Natural rubber producing countries should as a matter of urgency consult together to—
 - (a) review the adequacy of present and planned natural rubber research and development
 - (b) determine the funds required for natural rubber research and development and their sources

- (e) decide how more comprehensive and effective international co-operation could best be organised in the field of natural rubber research and development.
 - If natural rubber producing countries agree, the Group should initiate arrangements for such consultations at a time and place convenient to the participating countries.
- Natural rubber producing countries should review the progress made and the further measures required to reduce the danger of the spread of dothidella niei (South American leaf blight).
- 13. Natural rubber producing countries should determine what domestic financial resources can reasonably be expected to be forthcoming for investment in the natural rubber industry, and then examine the possibility of external financial resources supplying any balance that might be required.

Other action

- 14. It is important that the Group should have more adequate information about current and future rubber policy in centrally-planned economy countries and in other countries where rubber policy is wholly or largely determined by government policy.
- The appropriate natural rubber and synthetic rubber authorities should examine current marketing practices which are likely to depress prices unnecessarily.
- 16. There were grounds for both the natural rubber and general-purpose synthetic rubber industries to co-operate in devising appropriate policies to deal with problems of mutual interest.

With reference to the above programme of action the Group decided to review the progress made in its implementation at the 19th Assembly of the Group, which commences on the 25th September 1967 in Sao

Paulo, Brazil. It specifically directed that the following studies should be completed in time for them to be considered in the Assembly:—

- The possibility of international action designed to bring more stability to natural rubber prices
- 2. The present cost elements in ocean freights and insurance for natural rubber
- 3. Measures to reduce the danger of the spread of dothidella ulei (South American leaf blight)

The Group expressed its great appreciation for the excellent arrangements made for the Meeting by the Government of the Netherlands and for the kindness and hospitality shown to all participants.

Table 1
Estimated Natural and Synthetic Rubber
Consumption in 1967
(in thousand long tons)

Territory	Natural	Synthetic	Total
United States			
of America	540	1,690	2,230
Japan	226	246	472
United Kingdom	175	193	368
Fed. Republic			
of Germany	134	186	320
Union of Soviet			
Socialist Republics	* 285	10	295
France	123	172	295
Italy	94	142	236
Canada	49	115	164
India	69	27	96
Czechoslovakia	44	45	89
Brazil	33	54	87
Australia	36	37	73
Sweden	20	31	51
Belgium-Luxembur	g 19	31	50
Netherlands	22	26	48
Austria	10	18	28
Indonesia	24	***	24
Hungary	18	2	20
Malaysia	18	1	19
Denmark	6	5	11
Other Countries	610	319	929
Other Transfer	2,555	3,350	5,905

For the Union of Soviet Socialist Republics the figures refer to imports.

Table 2 Table 3 Estimated Natural Rubber Supply in 1967 Estimated Synthetic Production in 1967 (in thousand long tons) (in thousand long tons) (a) Production United States of America Malaysia 1,045 700 205 2,000 Thailand Ceylon Nigeria Liberia 268 Canada United Kingdom 200 187 India Cambodia Viet-Nam Federal Republic of Germany 168 Italy 130 Netherlands Brazil Fed. Republic of Cameroon Territory of Papua and New Guinea Ivory Coast Other Countries Brazil 64 Czechoslovakia Australia 56 India Belgium 2,480 20 (b) Deliveries from Stockpile 120 Others 68 Total New Supply 2,600 Total

Price Policy for Natural Rubber and Economics of Small Holdings

The Minister of Commerce, Government of India, made the following statement in the Rajya Sabha on the 18th August, 1967, on the price policy for indigenous natural rubber.

Minister's Statement

"The question of fixing a fair price of indigenous natural rubber has been engaging the attention of the Government for sometime now. The Tariff Commission was requested to enquire into the cost of production of raw rubber. The report of the Commission has been received by the Government and has been examined.

The Commission has recommended that Rs. 4,150 per tonne f, o, b, Cochin would be a fair selling price for RMA grade 1 rubber. The Government of India have decided to accept this recommendation.

The Government's decision on the various other recommendations made by the Commission, and which are still under examination, would be announced subsequently.

In the course of examining the question of fair prices of raw rubber, it has been observed that the small growers of rubber are in need of some immediate support to improve their economic viability. The Government are of the view that the small growers should also be able to acquire sufficient competetive strength to stand on their own. It is, therefore, proposed to set up shortly a committee to go in depth into the economics of these small holdings and to recommend to the Government such supporting measures as may be necessary to stabilise this sector.

In the meanwhile, Government have decided to provide interim relief to growers having small holdings. It is, therefore, proposed to give the small growers having holdings up to two hectares, a cash subsidy not exceeding Rs. 175.00 per hectare, and small growers with holdings above two hectares but up to four hectares, a cash subsidy not exceeding Rs. 150.00 per hectare for a period of one year. This subsidy is intended to supplement the efforts of small growers in improving their productive efficiency. The subsidy has been proposed on the assumption that actual market prices of rubber will, in fact, be held around the fair selling price as recommended by the Tariff Commission. The details of the subsidy scheme including the criteria for eligibility and other relevant aspects will be announced shortly."

Committee of Enquiry

By a resolution published in the Gazette of India Extraordinary, dated the 27th September, 1967, the Government of India have appointed a committee to go in depth into the economics of the small holdings and to suggest such measures as may be necessary to improve the efficiency and to contribute to the stability of this sector.

The Committee will, among other matters that it may find necessary to go into in this

(i) take into account the various kinds of assistance that are already being extended to the small growers by the Rubber Board and consider whether any additional assistance to this sector is necessary and if so, suggest the manner and extent to which such assistance should be given, and the period for which such assistance should be continued;

(ii) consider and advise Government on other measures which are required to be taken to enable the small growers to attain economic viability on the basis of the fair selling price of raw rubber accepted by the Government; and

(iii) advise the Government on the role of co-operatives in stabilising the small sector.

The Committee has been constituted with the following members:—

- (1) Shri T. M. Abdullah, Retired Judge, Rahmath Bagh, Cannanore (Kerala).
- (2) Additional Secretary,
 Agriculture Department,
 Government of Kerala,
 Trivandrum.
- (3) Shri Mathew Maniyangadan, (Ex. M. P.), Member Kottayam (Kerala).
- (4) Shri Cheriyan Kappan,
 (Ex. M. P.), Member
 Palai (Kerala).

(5) Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, Kottayam (Kerala).

(6) Dr. K. T. Jacob,
Director/Rubber Production
Commissioner,
Rubber Board,
Kottayam (Kerala),

The Committee has been asked to submit its report to the Government within a period of six months.

Minimum and Maximum Prices

The Government of India, Ministry of Commerce, by their Notification No. 16 (4) Plant (B)/67 dated the 20th October, 1967, have fixed the minimum and maximum prices for the various grades and qualities of rubber and latex of different concentrations. The revised price rates are fixed with effect from the 20th October, 1967. It may also be mentioned that according to section 13, sub-section 3 of the Rubber Act, 1947, if any person buys or sells or agrees to buy or sell rubber at a price which is more than the maximum price or less than the minimum price, fixed by the Central Government, he shall be punishable with imprisonment for a term which may extend to one year, or with fine, or with both.

The relevant notification is published below.

NOTIFICATION

Chairman

Member

In exercise of the powers conferred by sub-section (I) of section 13 of the Rubber Act, 1947 (24 of 1947) and in supersession of the Government of India, late Ministry of International Trade Notification S. O. No. 3549 dated the 19th December, 1963, the Central Government hereby fixes with immediate effect for all classes of business the following maximum and minimum prices, exclusive of cess and sales tax, for the various grades and qualities of rubber and latex of different concentrations, excluding the cost of container, as mentioned below, namely:—

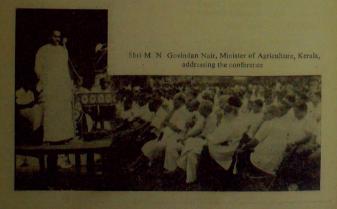
Group	Grade and quality	FOB Cochin	FOB Cochin for 100 kg		
	of rubber	maximum price	minimum price		
1	2	3	4		
		Rs.	Rs.		
Group 1	RMA 1x RMA 1	416.00 416.00	415.00 415.00		
Group 2	RMA 2 RMA 3 Cuttings No. 1	412.70 409.40 392.86	411.70 408.40 391.86		
Group 3	RMA 4 RMA 5 Cuttings No. 2	401.68 392.86 379.64	400.68 391.86 378.64		
Group 4	Precoagulated Crepe Pale Latex Crepe 1x Pale Latex Crepe 1 Pale Latex Crepe 2 Pale Latex Crepe 3 FAQ	428.14 423.72 419.32 417.12 414.92	427.14 422.72 418.32 416.12 413.92		
Group 5	EBC. Super 1x Estate Brown Crepe 1x Estate Brown Crepe 2x Smoked Blanket Remilled Crepe 2	406.08 397.26 390.66 397.26 380.74	405.08 396.26 389.66 396.26 379.74		
Group 6	Estate Brown Crepe 3x Remilled Crepe 3 Remilled Crepe 4	373.02 368.62 356.48	372.02 367.62 355.48		
Group 7	Flat Bark	337.74	336.74		
Preserved	normal latex upto 35% concentrates	Rs. 416 plus a premium of Rs. 38.58 per 100 kg of DRC	Rs. 415 plus a premium of Rs. 38.58 per 100 kg of DRC		
Preserved	latex concentrates of 36% to 50% (both inclusive)	Rs. 416 plus a premium of Rs. 72.76 per 100 kg of DRC	Rs. 415 plus a premium of Rs. 72.76 per 100 kg of DRC		
Preserved	latex concentrates of 51% to 60% (both inclusive)	Rs. 416 plus a premium of Rs. 94.80 per 100 kg of DRC	Rs. 415 plus a premium of Rs. 94.80 per 100 kg of DRC		

NEWS AND NOTES

Quilon District Rubber Growers Conference

The Quilon District Rubber Growers Conference held at Parakode in May last succeeded in creating a sense of confidence among the growers that their problems could be solved if they had a common approach and outlook. The conference held at the P. G. M. High School, Parakode, under the auspices of the Kunnathur Taluk Rubber Planters' Co-operative Society was attended by about 200 delegates representing about 3500 rubber growers from different parts of the Quilon district.

In the morning His Grace Mar Thoma Divanyosis hoisted the flag which marked the beginning of the programme. The cooperative conference was inaugurated by Shri R. Ramachandran Nair, District Collector, Quilon. Shri K. P. Phalgunan, Dy. Registrar, Rubber Board, presided. In his inaugural address Shri Ramachandran Nair spoke of the need for maintaining a steady and reasonable price level for natural rubber. Shri K. P. Phalgunan exhorted the rubber growers to take advantage of the assistance given by the Board. Analysing the working of the co-operative societies, he spoke of the important role played by the co-operatives in safeguarding the interests of the growers. Shri Kamath who spoke on the occasion advised the growers to take up replanting in earnest. Shri Phalgunan who initiated the discussions clarified the doubts raised by the delegates. Shri K, Parameswaran Pillai



welcomed the gathering and Shri Eapen proposed a vote of thanks.

In the discussions that followed Shri Thomas K. Joseph presented a paper on "Rubber growers and their problems," which tried to analyse the various problems confronting the growers. Among other things, the paper made a detailed study of the loan schemes of the Board, modernisation of the planting practices, marketing of rubber and the role of the co-operative sector.

Dr. K. T. Jacob presided over the afternoon session. Sarvashree P. P. Cherian, M. Mathew, P. N. Radhakrishna Pillai. P. K. Narayanan and Dr. John Jacob led the discussions on planting materials, manuring, diseases and control, processing and modernisation of cultivation.

A public meeting was organised in the evening in connection with the conference. Shri M. N. Govindan Nair, Minister for Agriculture, Kerala and Shri P. S. Habeeb Mohamed, Chairman, Rubber Board spoke

on the occasion. As a solution to the price fluctuations and its impact on the economy of the small holding sector, the Minister suggested that rubber manufacturing industries should be started in Kerala so that the rubber produced in the State could be consumed there itself. He said that industrialisation was the answer to many of the problems of the State.

Shri P. S. Habeeb Mohamed in his speech analysed the steps taken by the Board to meet the price situation and advised the growers not to be slow or lazy in their planting and replanting programmes. Increased production was the lasting answer to all the evils that confronted the industry. Shri K. V. M. Pandala, convener of the conference, presented memoranda both to the Chairman and the Minister. Sarvashri A. M. G. Anthraper, Cheriyan Kappan, P. J. Thomas, P. Ramalingam, R. Balakrishna Pillai and A. K. Rajapadmanabhan spoke.

A film show was organised by the Rubber Board in connection with the conference.

Seminar at Kaduthuruthy

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, deelared that the Board would not hesitate to enter into the field of marketing, if it was found necessary to protect the interests of the rubber growers. Even if the Board did not take up the responsibility, the whole work connected with this would be entrusted to the marketing societies, the Chairman added. To purchase more rubber for proper storage and to sell it at the appropriate time, the Rubber Board would extend financial assistance, With this end in view, the co-operative societies had been brought under a well

constituted set up, the Chairman stated.

The Chairman was inaugurating the public meeting held in connection with the seminar of rubber growers organised under the join auspices of the Rubber Board and the Sreechithira Thirunal Rubber Growers' Cooperative Society. Shri T. V. Joseph, Secretary, Rubber Board, presided. In his short speech made on the occasion, Shri Joseph observed that it was only due to the interest shown by the common man that rubber cultivation had expanded phenomenally in the country.

Study Group on Plantation Labour

Kutty Vaidyar, A. E. Antony, U. K. Laxman Gowda, C. M. Stephen, P. L. Perumal, Mir Masood AliKhan and Smt. Parvathi Krishnan are the members of the study group.

The first meeting of the study group was held at Bangalore in July last. Shri P. S. Habeeb Mohamed presided over the meeting. The meeting discussed procedural matters and finalised the questionnaire to be distributed among concerned parties. Shri T. V. Joseph, Secretary, Rubber Board participated in the meeting, representing the Rubber Board. The second meeting of the group was held at the office of the Rubber Board on the 3rd October, 1967. The group decided to tour important plantation areas and meet planters and trade union leaders to collect information.

The National Commission on Labour has been constituted to review the changes in the conditions of labour since independence and to make recommendations on the levels of workers' earnings, standards of living, social security, labour legislations, industrial relations, existing arrangements for labour intelligence and research etc. The Chairman of the National Commission is Shri P. B. Gagendragadkar, former Chief Justice of the Supreme Court of India.

A study group on plantation (coffee) rubber) labour has been constituted with headquarters at Bangalore by the National Commission on Labour. Shri P. S. Habeeb Mohamed, (Chairman, Rubber Board) has been nominated as convener of the study group. Messrs. T. V. Joseph, A. Gopalan



A meeting of the Study Group was held at the Rubber Board, Kettayam, on the 3rd October, 1967, Shri P. S. Habeeb Mohamed presiding.

From left to right: Shri P. S. Habeeb Mohamed, Smt. Parvathi Krishnan, Shri A. E. Antony, Shri U. K. Lakshman Gowda and Shri A. Gopalankutty Vaidyar

Small Holdings Economics Enquiry Committee

The committee appointed by the Government of India with Shri T. M. Abdullah as Chairman to enquire into the economics of small holdings and to suggest such measures as may be necessary to improve the efficiency and to contribute to the stability of the small holding sector, had its first meeting at the office of the Rubber Board on the 7th October, 1967. The committee held prelimination of the committee held prelimination.

minary discussions on the subjects of study and approved a questionnaire to be circulated among selected small holders. The second meeting of the committee was held on the 31st October, 1967, at Ernakulam and a programme to visit important rubber growing centres and to meet representatives of small growers, co-operative societies etc. was finalised.



The first meeting of the committee was held at the Rubber Board on the 7th October, 1967

Cash Subsidy Scheme Finalised

It is estimated that an amount of Rs. 130 lakhs will be disbursed to about 80,000 small rubber growers as cash subsidy during the year 1967-68. The subsidy is intended to supplement the efforts of small growers in improving their productive efficiency. At present it is sanctioned for a period of one

year. Holdings up to 4 hectares (9.88 acres) are eligible for the cash subsidy. The rate of subsidy payable is an amount not exceeding Rs. 175/- per hectare for small growers owning up to 2 hectares and Rs. 150/- per hectare to those owning above two hectares but up to 4 hectares. Proportionate subsidy

will be sanctioned for holdings less than one hectare in extent subject to other conditions. Only holdings which have been registered with the Board as on 1-4-1967 will be eligible for the cash subsidy. The minimum number of plants or trees required for eligibility is 148 per hectare or 60 per acre. Both immature and mature rubber areas will get the subsidy.

Applications have been invited by the Board from eligible small growers for grant of subsidy. The applications have to be submitted in duplicate to the Assistant Development Officer of the regional office in whose jurisdiction the estate is situated. Two copies of the survey plan of the estate if available should be submitted along with

the application. Legible sketches in ink indicating the boundary measurements of the estate could be submitted if no survey plan is available. After checking up records and spot verification, subsidy will be sanctioned by the Assistant Development Officer and it will be disbursed by cheque or by money order.

Arrears of excise duty, cost of manure or any other amount due from the small grower to the Board will be recovered by deducting from the subsidy amount.

The Board has opened new sub-offices at Thiruvalla, Karukachal, Thodupuzha, Ramapuram, Kottayam and Ayoor for the expeditious disposal of applications for the cash subsidy.

74th UPASI Conference

The 74th Annual Conference of the United Planters Association of Southern India was held at Coonoor from 1st to 4th September, 1967. Shri V. V. Giri, Vice-President of India, inaugurated the conference on the 2nd September, 1967.

In his inaugural address the Vice-President said that he frankly appreciated the Planters Association for changing its many attitudes and policies to suit the present democratic set up in the country and in trying to march with the times. The plantation industry is mainly labour intensive and sufficient attention should be paid to have a contented labour force and the maintenance of good industrial relations. The Vice-President said that if possible we should evolve measures to improve the present production levels, marketing and also the quality.

Another matter which should receive our attention is raising productivity. Shri Giri referred to the demand that the taxation and excise duty on the plantation products were high and should be reduced and said that it might not be possible as the State was called upon to expend greater amount of money. The remedy to reduce costs could be found only by modernisation of the industry and raising productivity, the Vice-President concluded.

Earlier Shri M. R. M. Punja, President, UPASI, in his presidential address made a forceful plea for investment in plantation development, the re-orientation of Government policy and attitude so that confidence is built up and planters are consulted on plantation policy. Reviewing the state of the plantation industries, Shri Punja said that plantation crops had made a uniformly impressive show during the past year. In all the three major plantation crops, tea, coffee and rubber, new records had been achieved in the levels of production and vields.

In the afternoon session, the Chairmen of the Commodity Boards addressed the planters. The Tea Board Chairman, Shri Bhagwan Singh, who addressed the gathering, dealt at some length with the role of the Tea Board and the relationship of producers with the Tea Board and the Government.

Shri G. Mathias, Chairman, Coffee Board, Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, and Shri L. N. Birla, President, Federation of Indian Chambers of Commerce also addressed the meeting.

The Chairman, Rubber Board, in his short speech referred to the enquiry conducted by the Tariff Commission about the prices of natural rubber and stressed the need for fixing an attractive minimum price for natural rubber. The Tariff Commission had selected units with more than average productivity for calculating the cost of production of rubber and that showed that the Commission had accepted productivity as an important criteria.

The Chairman said that in the rate of increase in production and productivity,

India was leading the world and was better than Malaysia, Liberia, Nigeria or any other major rubber producing country in the rate of increase in productivity.

The targets set for expansion of area and production for the Third Plan had been exceeded. The production of natural rubber was 55,000 tonnes during 1966-67 and the production would go up to 64,000 tonnes during 1967-68. There had been considerable new planting during the year and the Board had set a record in the distribution of planting materials this year.

The Chairman concluded his speech exhorting the planters to co-operate with the Board in the implementation of the various development programmes for the rubber plantation industry.



Dr. K. T. Jacob, Director, Rubber Research Institute of India, presenting a paper at the UPASI scientific conference



Shri B. N. Banerjee, Special Secretary, Ministry of Commerce at the Rubber Board's Stall

In the UPASI Scientific Conference held on the 1st September, Dr. K. T. Jacob, Director, Rubber Research Institute of India, presented a paper on "planting materials and planting in rubber plantation industry."

The Rubber Board also participated in the exhibition organised in connection with

the UPASI Conference. Charts and photographs were exhibited in the Board's stall. Most of the visitors were impressed by the attractive show. Shr! V. V. Gir!. Vice-President and Shri B. N. Banerjee, Special Secretary in the Commerce Ministry, visited the Board's stall.

Mr. C. H. S. London was elected president of the UPASI for the year 1967-68.

Draft Standards for Natural Rubber

The draft standard for specification of raw natural rubber was discussed at the I. S. I. Chemicals Division Council Sub-committee CDC 42:2 on 22nd August, 1967 and also by CDC 42 on 23rd August, 1967. This will be circulated widely and finalised only after obtaining comments. It

was also decided at the meeting that further samples of RMA grades should be collected from small holdings and co-operative societies and tested in the mean time.

The draft standard prescribes the limits for impurities in natural rubber based on general

end-use quality requirements for manufaclimed rubber products which are not takennot consideration in the present practice of risual grading. This standard, however, does not preclude any other grade of rubbershich does not fall within the limits precribed in this standard from being sold

according to the normal trade practice.

The Sub-committee CDC 42:1 constituted by the Indian Standards Institution for evolving test methods for natural rubber also met at the office of the Rubber Board on 21st August 1967.

Programme for Spraying in Rubber Plantations

A conference of representatives of rubber planters, pesticide manufacturers and suppliers, spraying agencies and spraying equipment manufacturers, co-operative societies and concerned officials of the Government and the Rubber Board was held at the office of the Rubber Board on the 28th October, 1967, to discuss matters pertaining to the spraying of rubber plantations during the spraying season in 1968. About fifty members representing various interests attended the conference. Shri P. S. Habeeb Mohammed, Chairman, Rubber Board, presided.

Reviewing the results of the spraying programme during 1967, Dr. K. T. Jacob, Director, Rubber Research Institute of India, said that the results were not completely satisfactory, though many reasons could be attributed for the failure.

It was decided at the conference that during the 1968 spraying season a total of about 1.5 lakh acres should be sprayed with copper fungicides employing the three different techniques of spraying in vogue viz. high volume Bordeaux spraying, low volume ground spraying and aerial spraying.



A view of the conference

On the question of availability of pesticides and spraying equipments, the representatives of manufacturers assured that they would be able to meet the full requirements and that it would be possible to keep

the cost of spraying at the 1967 level.

Shri George John, Vice-Chairman, Rubber Board, welcomed the gathering and Dr. K. T. Jacob proposed a vote of thanks.

Rubber Marketing by Co-operative Societies

The eo-operative rubber marketing societies functioning in various rubber growing districts have improved their turnover during 1966-67 by trading 3026 tonnes of rubber worth Rs. 140 lakhs compared to their 1965-66 trade which was less by Rs. 27 lakhs. The quantity of rubber involved in the trade through the co-operative sector,

works out to 5.5 percent of the total Indian production. The District Co-operative Rubber Marketing Society at Kozhikode topped the list by transacting 927 tonnes of rubber worth Rs. 42 lakhs, while the second and third positions were held by the societies at Kanjirappally and Kottayam.

Indonesian Expert's Visit

Dr. T. Natapermade, Indonesian Crop Specialist attached to the Technical and Economic Survey Team of the Asian Development Bank visited the Rubber Board and the Rubber Research Institute of India on the 13th October, 1967. He met leading

rubber planters at the Rubber Board and discussed with them their problems. The Chairman Shri P. S. Habeeb Mohamed and Dr. K. T. Jacob, Director/Rubber Production Commissioner were present on the occasion.

New Members of the Board

The Government of India have nominated Shri K. Chandrasekharan, member of the Rajya Sabha and Shri G. Y. Krishnan and

Shri P. K. Vasudevan Nair, members of the Lok Sabha, as members of the Rubber Board.

Rubber Board News

Shri P. S. Habeeb Mohamed, Chairman Rubber Board, has been concurrently appointed as Chairman, Cardamom Board, Ernakulam, Chairman, Cashew Export Promotion Council, Ernakulam and Chairman Spices Export Promotion Council, Ernakulam.

Shri K. V. George, Deputy Director (Pathology), Rubber Research Institute of

India, left the service of the Rubber Board to join the Cardamom Board, Ernakulam, as Director of Development.

Dr. N. H. Sivaramakrishnan, Deputy Director (Chemistry and Rubber Technology), Rubber Research Institute of India, left the service of the Board to join the Hindustan Latex Limited, Trivandrum, as Latex Technologist. The following provisional promotions and appointments have been made.

Shri R. G. Unni, Statistical Officer, has been appointed as Statistician. Shri v. Bhaskara Pillai, Cost Accountant, has been appointed as Costing Officer. Kumari Lalithakumari, Statistical Assistant, has been promoted as Statistical Officer.

Shri M. G. Jagadish Das, Assistant Development Officer, has been appointed as Deputy Rubber Production Commissioner. Shri K. R. Ravindran Nair, Field Officer, has been promoted and posted as Assistant Development Officer in charge of the Central Farm. Shri M. O. Joseph, Field Officer, has been promoted and posted as Assistant Development Officer, Trivandrum Regional Office. Shri P. S. Kuriakose, Field Officer, has been promoted and posted

aş Assistant Development Officer, Palai Regional Office with headquarters at Kottayam. Shri M. J. Henry, Field Officer, has been promoted and posted as Assistant Development Officer, Kottayam Regional Office.

Shri C. M. George, Assistant Soil Chemist, and Shri P. N. Radhakrishna Pillay, Head of the Small Holders' Advisory Service, Rubber Research Institute of India, have been deputed for training at the Rubber Research Institute of Malaya for a period of six months. The training programme has been arranged under the Expanded Programme of Technical Assistance of the FAO. Shri George will be attached to the Soils Division and Shri Radhakrishna Pillay to the Pathology Division of the R. R. I. M. during the training period.



Obituary

We record with deep regret the death of Shri K. P. Phalgunan, Officer on Special Duty (Co-operation), Rubber Board, in his office on the 17th October, 1067

Shri Phalgunan was 57. He joined the Rubber Board in 1964 and was in charge of the various development schemes in the co-operative sector.

Shri Phalgunan is survived by his wife, a daughter and four sons.

On the question of availability of pesticides and spraying equipments, the representatives of manufacturers assured that they would be able to meet the full requirements and that it would be possible to keep

the cost of spraying at the 1967 level.

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Shri M. G. Jagadish Das, Assistant Development Officer, has been appointed as Deputy Rubber Production Commissioner. Shri K. R. Ravindran Nair, Field Officer, has been promoted and posted as Assistant Development Officer in charge of the Central Farm. Shri M. O. Joseph, Field Officer, has been promoted and posted as Assistant Development Officer, Trivandrum Regional Office. Shri P. S. Kuriakose, Field Officer, has been promoted and posted

as Assistant Development Officer, Palai Regional Office with headquarters at Kottayam. Shri M. J. Henry, Field Officer, has been promoted and posted as Assistant Development Officer, Kottayam Regional Office.

Shri C. M. George, Assistant Soil Chemist, and Shri P. N. Radhakrishna Pillay, Head of the Small Holders' Advisory Service, Rubber Research Institute of India, have been deputed for training at the Rubber Research Institute of Malaya for a period of six months. The training programme has been arranged under the Expanded Programme of Technical Assistance of the FAO. Shri George will be attached to the Soils Division and Shri Radhakrishna Pillay to the Pathology Division of the R. R. I. M. during the training period.

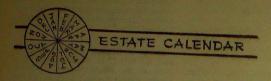


Obituary

We record with deep regret the death of Shri K. P. Phalgunan, Officer on Special Duty (Co-operation), Rubber Board, in his office on the 17th October, 1967.

Shri Phalgunan was 57. He joined the Rubber Board in 1964 and was in charge of the various development schemes in the co-operative sector.

Shri Phalgunan is survived by his wife, a daughter and four sons.



For Rubber Growers

January

In the northern regions wintering may commence. This is the time when annual tapping rest is to be adopted and the panels protected with prowax or rubber kote-prowax mixture. Felling and clearing for newplanting or replanting is done at this time. This is also the time to start collection of *Purearia* seeds.

February

Wintering spreads effectively in most of the areas. The trees wintered earlier will start to refoliate. This is the time when sulphur dusting against powdery mildew has to be commenced. Many of the estates are allowed to enjoy tapping rest. Marking for the next season tapping can be done. Preparation of the land for planting is continued. Collection of cover crop seeds can also be continued.

March

Tapping rest can be discontinued and tapping commenced. Young areas are opened for tapping. Sulphur dusting rounds against powdery mildew is to be continued. Weeding is done in immature areas. Manuring can be started. In nurseries budding is done. Towards the end of the month spraying of fungicides against abnormal leaf-fall is started in large estates, In areas where planting has to be done, terracing, lining, pitting etc. should be done. Stimulants may be applied on trees 20 or more years old.

April

Weeding and manuring are continued. Spraying against leaf-fall also is continued. Budding in oursery and field is carried on. Preparation of land for planting is continued. The natural undergrowth is slashed. Dead woods are removed from the garden.

May

Spraying is continued. Treatment to prevent pink disease is done. Budding can be continued if necessary. Slashing of undergrowth is carried on. Sowing of cover crop seeds can be commenced.

New flushes of young plants have to be given spraying. Nurseries are to be sprayed. The pits are filled and planting started. The tapping panels are disinfected with fungicides and water proofing with prowax or wax rex treseal done. If needed, the beds for sowing seeds can be prepared. Cover

July

New flushes in nursery and young plants are sprayed. Planting is continued. If trees are tapped during this month panel protection should be given.

August

New flushes in nursery and young plants, in regions where shoot rot is prevalent, are sprayed. Treatment against pink disease is done. Seed collection is continued. Panel protection is given in areas where tapping is done. Rubber seeds are sown.

September

This is the time for weeding and manuring. Sowing of seeds can be continued. Repeated inspection and treatment of pink disease should be done. Young rubber buddings planted out during June-July should be given shade. Yield stimulants may be applied on trees 20 or more years old.

October

Weeding and manuring may be continued. Dead woods should be removed, Tapping panel should be given protective treatments.

November

Mulching should be done in nurseries and round young plants. Young plants should be guarded against sun-scorch. Stems of young plants 2-7 years old and of older plants should be lime-washed if exposed to sun.

December

Lime-washing and mulching is continued if found necessary. Calopogonium seeds are collected during this menth.



Table 1

Area Under Rubber at the End of Each Year

Year	Area in hectares
1950–51	69001
1951–52	69279
1952–53	69924
1953-54	70271
1954-55	71487
1955–56	83867
1956–57	94839
1957–58	106027
1958-59	115970
1959-60	123612
1960-61	129905
1961-62	
1962-63	140880
1963-t4	146149
1964–65	152946
1965-66	155324
1966–67	164713
1700-07	171260

Table 2
Planted Area Under Different Planting Materials at the End of 1966-1967

Plantin materia		Newplanted area	Replanted area	Total area
Ordina	ry	74917	1941	76858
) Budded	21430	9877	31307
High	Clonal	45396	12027	57423
yielding	Total	66826	27576*	94402*
Grand	Total:	141743	29517	171260

^{*} Includes unclassified area also, hence may not tally with the total of the previous two figures.

Table 3

Classification of Holdings and Estates According to Size at the End of 1966-1967

Size	No. of units	Area in hectares
Small holdings (20 hectares and below)		
2 hectares and below	71095	55963
Above 2 hectares and upto and including 4 hectares	6558	19006
Above 4 hectares and upto and including 6 hectares	1863	9568
Above 6 hectares and upto and including 10 hectares	1275	10272
Above 10 hectares and upto and including 20 hectares	897	13190
Total:	81688	108004
B. Estates (Above 20 hectares)		
Above 20 hectares and upto and including 40 hectares	339	9993
Above 40 hectares and upto and including 200 hectares	242	19808
Above 200 hectares and upto and including 400 hectares	32	8852
Above 400 hectares and upto and including 600 hectares	20	9737
Above 600 hectares and upto and including 800 hectares	4	2697
Above 800 hectares	10	12169
Total:	647	63256
Grand Total:	82335	171260

Table 4
Statewise Distribution of Area at the End of 1966-67

			(Area	in nectates	,		
	Holdin (20 hectares ar		ings and below)		ates () hectares)	Total	
Sta		No. of	Area	No. of units	Area	No. of units	Area
		units		593	56318	81015	161074
1.	Kerala	80422	104756	41	5130	1249	8082
2.	Madras	1208	2952		1572	66	1844
3.	Mysore	56	272	10	236	3	236
4.	Andamans			2		1	8
5.	Tripura	1	8			1	16
	Maharashtr	a 1	16	***	63256	82335	171260
	TOTAL:	81688	108004	647	03230		

Table 5
Statewise Production of Natural Rubber (Metric tonnes)

State	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67
Kerala	23,175	24.954	29,057	33,792	41,391		1200-07
Madras	2,040	2,060	2,695	3,176	3,724	46,953	50,495
Mysore	452	402	447	468	481	3,195	3,927
Andamans	30	30	40	51	20	382	396
TOTAL:	25,697	27,446	32,239	37,487	45,616	50,530	54,818

Table 6

Production, Import and Consumption of Natural and Synthetic Rubbers
(Metric tonnes)

	Pio	duction	AN LAC		Import			Consumption			
Year	Natural	Synthetic	Total	Natural	Synthetic	Total		Synthetic			
1958-59			24169	12538	4229	16767	35767	3477	39244		
1959-60	24173		24173	15287	5718	21005	40491	4964	45455		
1960-61	25697		25697	23125	8097	31222	48148	7397	55545		
1961-62			27446	22528	10121	32649	48410	10186	58596		
1962-63	THE PERSON NAMED IN		32239	23360	10297	33657	53553	10723	64276		
1963-64	37487	8075	45562	26275	8812	35087	61155	11959	73114		
1964-65	45616	11633	57249	15003	3315	18318	61057	15285	76342		
1965-66	50530	14741	65271	16357	2735	19092	63765	21553	83518		
1966-67	54818	22358	77176	23544	5606	29150	68685	23592	92277		

Table 7

Reclaimed Rubber Acquired and Consumed by Manufacturers (Metric tonnes)

Year	Imported/Acquired	Consumed
1958-59	3973	4102
1959-60	5177	4969
1960-61	5183	5453
1961-62	6422	6046
1962-63	6839	6850
1963-64	8251	7982
1964-65	9349	9369
1965-66	9764	9774
1966-67	11635	10913

Table 8
Stock of Natural Rubber at the End of each Month (Metric tonnes)

0,035 9,067 8,138 8,545	8,571 8,186 8,128	9,696 9,716 8,462	11,003	12,818 12,894	16,129 16,212	13,122	15,628
8,138	8,128			12,894			
		8,462	10 102				15,904
8,545	0.007		12,193	14,003	16,798	15,430	15,012
	8,067	8,256	12,475	14,824	16,609	14,418	12,810
8,968	8,489	9,235	12,218	14,239	15,913	15.324	11,571
8,995	9,157	9,744	12,723	14,302	16,069	16,992	11,935
9,810	10,265	11,291	13,917	15,605	16,312	18,636	15,671
0,467	10,742	12,120	15,059	17,142	17,756	19,830	17,041
0,793	12,993	13,359	16,334	18,314	19,110	20,486	22,368
0.496	13,036	12,990	15,940	18,381	17,950	20,525	26,143
9,583	11,185.	11,511	13,879	16,437	15,77:	17,707	23,991
9,201	9,875	11,439	13,485	16,092	14,094	16,573	25 978
20 00 00 00	3,968 3,995 9,810 0,467 0,793 0,496 9,583	3,968 8,489 3,995 9,157 9,810 10,265 0,467 10,742 0,793 12,993 0,496 13,036 9,583 11,185	9,968 8,489 9,235 3,995 9,157 9,744 9,810 10,265 11,291 0,467 10,742 12,120 0,793 12,993 13,335 0,496 13,036 12,990 9,583 11,185 11,511	8,968 8,489 9,235 12,218 8,995 9,157 9,744 12,723 9,810 10,265 11,291 13,917 0,467 10,742 12,120 15,059 0,793 12,993 13,359 16,334 0,496 13,036 12,990 15,940 9,583 11,185 11,511 13,879	8,968 8,489 9,235 12,218 14,239 8,995 9,157 9,744 12,723 14,302 9,810 10,265 11,291 13,917 15,605 0,467 10,742 12,120 15,059 17,142 0,793 12,993 13,359 16,334 18,314 0,496 13,036 12,990 15,940 18,381 9,583 11,185 11,511 13,879 16,437	8,968 8,489 9,235 12,218 14,239 15,913 8,995 9,157 9,744 12,723 14,302 16,069 9,810 10,265 11,291 13,917 15,605 16,312 0,467 10,742 12,120 15,059 17,142 17,756 0,793 12,993 13,3359 16,334 18,314 19,110 0,496 13,036 12,990 15,940 18,381 17,950 9,583 11,185 11,511 13,879 16,437 15,77:	8,968 8,489 9,235 12,218 14,239 15,913 15,324 8,995 9,157 9,744 12,723 14,302 16,069 16,992 9,810 10,265 11,291 13,917 15,605 16,312 18,636 0,467 10,742 12,120 15,059 17,142 17,756 19,830 0,793 12,993 13,359 16,334 18,314 19,110 20,486 0,496 13,036 12,990 15,940 18,381 17,950 10,525 9,583 11,185 11,511 13,879 16,437 15,77: 17,707

Table 9

Rubber Position during April 1967 to September 1967 (Metric tonnes)

		April 67 to Sept. 67	April 66 to Sept. 66
Production {	Natural Synthetic	30,566 7,613	24,715 8,48i
Consumption {	Natural Synthetic	37,197 12,496	33,524 9,645
Import {	Natural Synthetic	8,135	4.548 2,041
Stock at the end	Natural Synthetic	26.788	11,935 4,827



The Rubber Board

Vol. 9

Estate Calendar Rubber Statistics

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1968

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> Cover: Young leaves of Herea affected by powdery mildew.

P. K. Narayanan

sst. Editor :

T. N. V. Namboodiri

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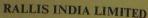
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A Critical Review

The report of the Tariff Commission (1967) on raw rubber prices has recently been published and it may not be out of place here to review some of the more important aspects considered by the Commission in determining the cost of production and in fixing the prices of natural rubber.

The Tariff Commission selected 11 estates and five smallholdings fixed on the basis of the cost of production of the selected smallholdings. This is a significant departure from the previous enquiries, as it is the first time price of rubber has been fixed on the basis of the cost of smallholdings. But one important aspect that cannot be overlooked in this connection is that though the Commission based their decision on prices on the cost of production of five selected smallholdings, they do not appear to have made a factual verification of the representative character of these holdings.

The rubber prices have been fixed by the Commission on the basis of an estimated average yield of 766 kg per hectare in respect of the smallholdings costed. This yield rate is quite unrealistic and unrepresentative of the small holdings sector, as the five smallholdings selected for costing represented the most efficient units in the industry and most of them also enjoyed certain special advantages. On account of all these the price fixation tended to be vitiated.

The Commission also anticipated that the holdings below 10 acres might incur a higher cost of production than that fixed for determination of price, which meant an immediate shrinkage in their profits. The cash subsidy announced by the Government might have been intended for making up this loss in income of this section of the smallholders.

The observation made by the Commission that "indigenous raw rubber cannot hope for all time to have a sheltered market" does not seem to be fair in the context of the performance of the industry. Since 1950-51, the rubber plantation industry has achieved steady and consistent progress in production and productivity. The average yield in the industry in 1950-51 was 284 kg per hectare, which rose to 483 kg in 1966-67—an increase of about 70 per cent during the period of 16 years. During 1950-51, the price to be retained by the rubber grower was about Rs. 277]- per kg. Against the price now fixed by the Tariff Commission is Rs. 415 per this, the price now fixed by the Tariff Commission is Rs. 415 per this, the price now fixed by the Tariff Commission is Rs. 415 per this, the price now fixed by the Tariff Commission is Rs. 415 per this, the price now fixed by the Tariff Commission is Rs. 415 per this, the price now fixed by the Tariff Commission is Rs. 415 per this, the price of the prices of other agricultural commodities during this compared to the prices of other agricultural commodities during this period.

Certain discrepancies are also noticed in the computation of cost made by the Tariff Commission. The item 'freight and handling charges' can be cited as an instance. As per the report of the Tariff Board (1951), the average expense for the year 1949-50 on account of 'transportation from estate to Cochin' of the five costed estates

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Certain discrepancies are also noticed in the computation of cost made by the Tariff Commission. The item 'freight and handling charges' can be cited as an instance. As per the report of the Tariff Board (1951), the average expense for the year 1949–50 on account of 'transportation from estate to Cochin' of the five costed estates

came to Rs. 3.08 per 100 lb (Rs. 6.76 per 100 kg.). In the report of the Tariff Commission (1960), this item of expense was shown as Rs. 6.94 per 100 kg, whereas the amount provided in the present price structure is only Rs. 4.02 per 100 kg. The abnormal increase that has occurred in the cost of services since the last price fixation does not appear to have been taken into account while estimating the expenses under this item.

Another example of discrepancy is grade differential. The significance of grade differential is that it indicates the quality of rubber in relation to RMA 1. The grade differential adopted in the price structure is Rs. 3.78 per 100 kg. This is the grade differential of the costed smallholdings. The grade differential of the costed smallholdings. The grade differentials are supposed to represent the respective sectors of the industry, we have to reach the curious conclusion that the estates in spite of their reputed efficiency, were able to produce only lower grades of rubber, while the small growers produced top grades. Obviously this cannot be true. A persistent complaint is that the rubber produced by the smallholders is always accepted and paid for as lower grades. Hence it is a contradiction for a low grade differential to find a place in the cost structure which is supposed to represent the smallholding sector.

The Commission have allowed an amount of Rs. 1200/- per hectare as fair return to the growers. This is really a higher amount compared to the amount allowed in the previous enquiry. But in the prevailing conditions of production and marketing of rubber, it is doubtful whether this full amount of return will be really available to the growers, particularly the small growers. The price fixed is for RMA 1 and for other grades the relative differentials have to be adjusted in the basic price of RMA 1. As the grades go down the price obtainable is reduced. There may not be much change in the cost of production of sheet rubber. Almost the entire production (mostly sheet rubber) of the smallholders is accepted as lower grades by manufacturers and hence it cannot be expected that they will be able to earn the fair return envisaged by the Tariff Commission.

The Commission has recommended three different scales of replanting subsidy to different categories of growers according to their size. Probably the Commission made this recommendation in order to set right the discrepancy in income between the different sectors as a result of the new prices fixed by them. But this scheme of different scales of subsidy is fraught with practical difficulties for implementation and if it is accepted it may unsettle the replanting programmes of the estate sector and cause confusion and frustration among the planters. It does not seem to be advisable to link subsidy rates with profit and loss accruing to different sectors consequent on price fixation.

From the many observations made by the Tariff Commission it is clear that they were aware of the importance of the smallholding sector in the rubber plantation industry and the need for special attention to be given for the progress of this sector. The decision of the Commission to fix the price of rubber on the basis of the cost of production of smallholdings is a clear indication of this awareness. But the benefit which the industry should have obtained on account of price fixation on the basis of the cost structure of the smallholdings has been lost to a great extent, due to wrong selection of units and consequent unrepresentative data for price fixation.

Price Control and Imports*

P. S. Habeeb Mohamed

Since we met in September, the important development has been the fixation of the price of rubber. The price notification has been given wide publicity and you must be aware of the details of the price. For RMA 1, a price of Rs. 4.15 per kilogram has been fixed f. o. b. Cochin. This is the minimum price. The maximum price fixed is Rs. 4.16 per kilogram. You are aware there was no maximum on the price of rubber since December, 1963; but the maximum price has been re-imposed in the interests of national economy.

Stock of rubber

It was expected that the market price would go up from its previous levels and

that the price of rubber in the market which was a little over the previous notified price of Rs. 3.23 per kilogram would reach the level of Rs. 4.15 per kilogram; but our expectations have not been fulfilled. This is mainly due to the fact that there has been a considerable stock of rubber built up in this country, mainly on account of imports and to a lesser extent by the increase in the indigenous production of natural and synthetic rubbers.

The present stock position is as follows :-

The present stock in the country is sufficient to meet more than $4\frac{1}{2}$ months' consumption.

Period		Stock at ti	he end of t	he period	Consumption during the	Number of months the total stock is sufficient
		N. R.	S. R.	Total	period (NR & SR)	to meet the consumption
		1	(N	A. Tonnes)		
April	1967	26,574	7,579	34,153	7,957 7,951	4.3
May	,,	27,012	7,783	34,795	8.250	4.3
June	33	27,295	8,173	35,468	8,231	4.3
July	,,,	26,871	8,222	35,093	8,638	3.9
August	22	27,139	6,896	34,035	8,666	3.7
September October	,,	26,788 27,663	5,680 6,343	32,468 34,006	7,015	4.8

Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 58th meeting of the Board, held on the 21st December, 1967.

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		1	(N	A. Tonnes)		
April	1967	26,574	7.579	34,153	7,957	4.3
May		27,012	7,783	34,795	7,951	4.4
June	33	27,295	8,173	35,468	8,250	4.3
July	**	26,871	8,222	35,093	8,231 8,638	3.9
August		27,139	6,896	34,035		3.7
September October	"	26,788 27,663	5,680 6,343	32,468 34,006	8,666 7,015	4.8

Speech delivered by Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, at the 58th meeting of the Board, held on the 21st December, 1967.

Almost all the leading companies are as stock. The following table will illustrate retaining more than 4 months' consumption

Companies	Average consumption during April to October, 1967			October	c at the e , 1967 (i ck in tran	No. of months the total stock is sufficient	
	N. R.	S. R.	Total	N. R.	S. R.	Total	to meet the
		(M. Tonn	es)			
Dunlop Firestone	1,484	570	2,054	3,496	983	4,479	2.2
Ceat Tyres	300 430	192	492 583	861	928	1,789	3.7
Good Year	291	192	483	1,656	847 803	2,503 2,441	4.3 5.0
Madras Rubber Factory	355	104	459	1,139	285	1,424	3.1
Batas	339	193	532	2,492	128	2,620	5.0

As a result of the increased stock and excessive imports the off take of indigenous rubber by the manufacturers has declined substantially. During the period August to November, 1967, the five leading tyre companies have lifted only 40% of the total production, as against 46% in the corresponding period in 1965. Of course during 1966 there was an unusual situation, and the bigger manufacturers hardly lifted any substantial quantity of natural rubber dursubstantial quantity of lactual Tooler can ing the period from September, 1965 to March, 1967. It is true that the Govern-ment did announce in Parliament that no import licences had been issued from April, 1967; but imports have taken place on the basis of the import licences issued in the previous year and also to some extent from the import licences under the Export Promotion Schemes. Even recently we understand that some import licences from out of the Export Promotion Incentive Scheme have been issued. On the whole, there has been an import of 40,000 tonnes during 1966-'67 and for the period ending October, 1967. You may remember that the Board had recommended for import of 29,500 tonnes for 1966-'67 and no import at all during 1967-'68. We were given to understand

that import licences for only 30,700 tonnes were issued. Even assuming that a portion of the 40,000 tonnes was imported from the licences issued in 1965-'66, it is clear that a substantial portion of the imports was on the basis of licences issued in 1966-67. Import figures for the period from April to November, 1967 are given below:-

Mon	ths	Natural	Syn-	Total
	(M. tonnes)	
April	1967	1,877	394	2,271
May	"	1,866	555	2,421
June	"	1,190	223	1,413
July	33	752	102	854
August	33	1,651	226	1,877
September	,,,	799	163	962
October	,,	194	205	399
November	**	52	190	242*
	Total	8,381	2,058	10,439

The stock of natural rubber at the end of October, 1967 was about 76% more, as compared with the stock in October, 1966. For neutralising the stock position, it will take some time and it is absolutely necessary to stress that there should not be any

import during the remaining period of the current year. There is also no ground for any import during the year 1969-769, A detailed memorandum in this connection is being placed before the Board. We are also placing before the Board, a memorandum for aiding the existing co-operative societies. Without financial aid, it may be difficult for them to carry on the business, particularly in the face of severe competition from dealers. A proposal for the Board to enter the market is also placed for approval.

Though it has been difficult for us to take legal action, because the bills record the correct amount according to the notified price, several instances have been brought to our notice where the parties have alleged that they have received prices much less than the notified price. This position has to be rectified.

Enquiry Committee

Members are aware that since we met last the Government of India have constituted a committee to go into the economics of small holdings. The terms of reference of the committee are as follows:—

The committee will, among other matters that it may find necessary to go into in this connection:—

- (i) take into account the various kinds of assistance that are already being extended to the small growers by the Rubber Board and consider whether any additional assistance to this sector is necessary and if so, suggest the manner and extent to which such assistance should be given, and the period for which such assistance should be continued.
- (ii) consider and advise Government on other measures which are required to be taken to enable the small growers

- to attain economic viability on the basis of the fair selling price of raw rubber accepted by the Government;
- (iii) advise the Government on the role of co-operatives in stabilising the small sector

The committee is touring various parts of Kerala and other rubber growing areas in this country. It is expected that the committee would recommend measures for the rehabilitation of the small growers in addition to the existing schemes now sponsored by the Rubber Board.

Finances

A peculiar situation may arise, if the Government does not make available necessary finances to the Board to carry not the schemes which are now met from the Pool Fund. By the end of this year, the balance under the Pool Fund will be practically nil. By the time the committee, appointed to go into the economics of small holdings, submits its report, the Board may not be in a position even to carry on the existing schemes for the rehabilitation of small growers unless additional assistance is given by the Government.

Cash Subsidy

The machinery for distribution of Cash Subsidy to small growers has been streamlined and inspections have been started already. According to the figures of the Accounts Section an amount of Rs. 38,307,60 has already been distributed. We have received 54,176 applications out of which 23,434 have been sent for inspection. So far 2,199 reports have been received by the various Assistant Development Officers. Subsidy for 1,584 applicants involving three lakhs of rupees has already been sanctioned. We are confident that a major portion of the subsidy will be sanctioned by 31st of March, 1968.

A Review of the Progress of the Natural Rubber Industry in the various Rubber Producing Countries¹

R. Gangadharan Unni

Malaysia

Malaysia is the world's largest producer of natural rubber. By sharing 33% of the world rubber area she contributes 41% of the world production. More than 60% of the total cultivated area in the country is planted with rubber. This crop accounts for about 40% of the country's export earnings and 30% of its national revenue. About 25% of the population is dependent on rubber alone.

West Malaysia* Area, production and yield per acre

In Malaysia, rubber was planted on an experimental scale in the late 1880's. Commercial planting was, however, started only in 1900. In the first decade, one million acres were brought under rubber. By 1925 it increased to 3.1 million acres and again to 3.6 million acres in 1950. The present area under rubber is reported to be about 4.3 million acres.

Table 11 gives the annual rate of increase in area under rubber since 1960, separately under estates and small holdings:—

* Includes Singapore also.

Table 11

Year	Estates (100 acres and above in size)	Holdings (below 100 acres in size)	Total
	('000')	acres)	
1960	1942	1906	3848
1961	1945	1986	3931
1962	1933	2061	3994
1963	1925	2145	4070
1964	1899	2210	4110
1965	1866	2370	4236

Evidently the acreage devoted to rubber in estates has declined from 19,42,000 acres in 1960 to 18,66,000 acres in 1965. It is mainly due to fragmentation and increased replanting with other crops. However, during the same period, the acreage with small holdings has increased from 19,06,000 acres to 23,70,000 acres As a result the share of small holders in total area has increased from 50% to 56%. During the five year period, the total area under rubber in West Malaysia has increased only by about 10%.

In 1952, only about 34% of the planted area in the estates and 8% of the planted area in small holdings were under high yielding rubber. By 1960, due to replanting and new planting with high yielding

¹ Continued from vol. 9, No. 3, 1967.

^a Statistician, Rubber Board, Kottayam 9, Kerala State

the materials, percentages increased to 58 and 25, respectively. The present proportion of area under high yielding material is estimated to be 81% for estate sector and 54% for the small holding sector or 66% for estates and small holdings together. The average annual rate of increase is estimated at 4% per annum.

Table 12 gives the progress in production in West Malaysia :-

Table 12

MARKET TO			
Year	Estates	Holdings	Total
	(,000	tonnes)	
1940	339	217	556
1950	383	322	705
1956	357	279	636
1957	375	273	648
1958	396	277	673
1959	421	299	720
1960	421	299	720
1961	437	312	749
1962	446	318	764
1963	467	334	801
1964	486	353	839
1965	500	386	886
1966	510	433	943

The rubber output in West Malaysia has increased by about 31% during the last 6 years. During the same period, the area has increased only about 12%. Hence, the high rate of increase in production is mainly due to the increased productivity. In 1960 the estimated average yield in West Malaysia was 550 lb per acre (676 lb per acre for estate sector and 450 lb per acre for smallholding sector). By 1955, the yield per acre increased to 675 lb (850 lb for estate sector and 550 lb for small holdings). The increase in productivity has been about 23%.

Replanting

West Malaysia has done remarkably well in replanting over 1.5 million acres under

unselected seedlings with high-yielding planting materials within 15 years. The Rubber Industry (Replanting) Fund Ordinance of 1952 was the first official move to encourage replanting on a planned basis. Under the Ordinance, the Rubber Industry Replanting Board was constituted. The replanting scheme is operated separately for estates and holdings:

(a) Holdings

The replanting scheme for small holders was started in 1952. It envisaged replanting of 4,80,000 acres by the end of 1959, with specified target for each year from 1953. dollars (Rs. 980/- post devaluation rate) per acre. This was raised to 500 dollars (Rs. 1225/- post devaluation rate) with retrospective effect from 1953. From 1956 onwards, the subsidy rate was further increased to 600 dollars (Rs. 1,470/- post devaluation rate) per acre.

Results of the total acreage replanted year by year from 1953 to 1959 showed that the target set was not achieved. Out of a target of 4,80,300 acres, only 3,17,820 acres

In 1962, the subsidy rate for small growers was further enhanced to 800 dollars (Rs. 1960 - post devaluation rate) for small holdings of below 5 acres and to 750 dollars. (Rs. 1837/- post devaluation rate) for small holdings of 5 to 100 acres.

During the period 1960 to 1965, about 4.56,400 acres were replanted under the subsidy scheme. Thus, till the end of 1965 since the introduction of the scheme, about 47% of the total area of small holders' rubber was replanted. The annual rate of replanting works out to 3.35%. (The annual rate of replanting is given in Table 13).

(b) Estates

At present, the rate of subsidy for replanting the estates is fixed at 450 dollars (Re. 1102/- post devaluation rate) per acre.

During the period 195? to 1965, about 8,45,000 acres of uneconomic rubber lands were replanted in the estate sector. This area represents 63% of the total area under unselected seedlings planted prior to 1952. The annual rate of replanting works out to 42%. Table 13 gives the rate of replanting in estates and holdings:

Table 13

Year	Area replanted (acres)		
	Estates	Holdings	
1952	51,600	4.200	
1953	29,800	29,500	
1954	39,100	22,600	
1955	57,600	25,300	
1956	78,400	46,500	
1957	76,300	49,800	
1958	64,800	59,700	
1959	68,200	69,100	
1960	75,200	69,500	
1961	70,500	57,300	
1962	63,100	69,100	
1963	58,700	83,400	
1964	58 950	79,700	
1965	53,200	97,400	
Total	8 45,450	7,63,100	

Newplanting

The estates are not undertaking any large scale newplanting. Their acreage has remained more or less static during the last two decades. Evidently, newplantings of estates, if any, were only sufficient to replace areas abandoned or replanted with other crops.

The State is actively assisting the settlement of small holders. There are two block planting schemes for small holders. One is administered by the Federal Land Development Authority and the other by the State Development Board.

The major development scheme is now the responsibility of the Federal Land Development Authority. It finances and manages large block schemes ranging in size from 4,000 to 7,000 acres taking 30) to 600 families. Each scheme has a central village, main crop and subsidiary crop areas. A typical holding consists of 8 acres of rubber, two acres for subsidiary crops and a space for a house. Under this scheme since for a house. Under this scheme since with rubber. Block Development Schemes of this type can have the advantage of large scale planting, without concentration of wealth in a few hands.

Taxes

i) Export duty and cess

In Malaysia, export duty is levied on a sliding scale of prices. The rates when the price varies from 40 cents to 75 cents per lb are given in Table 14.

Table 14

Price per lb		Export duty per lb	
Cents	Paise*	Cents	Paise*
40	98	1 5/8	4
50	122	2	5
60	147	2 3/8	6
65	154	3 3/8	8
70	171	4 1/4	10
75	184	5 1/4	13

(* Post devaluation rate)

Collections under this head go to general revenues. Besides, there are three cesses. There is a cess of f cent (2.45 Paise) per lb for research. Another cess is for replanting at the rate of 4½ cents (11 paise) per lb. When the price of rubber goes above one dollar, an anti-inflationary cess is also levied.

(ii) Income tax

The rate for companies is 40%. The individual incomes are assessed on a sliding scale, the maximum of which is 45%. In calculating income for assessment, full replanting cost and a portion of newplanting cost are allowed.

State taxes

Besides a land tax of \$ 6 (Rs. 14.70) per acre, an education cess of 1 to 2 dollars (Rs, 2.45 to 4.90) is levied by the individual States. (The particulars regarding income tax and State taxes are collected from some publications relating to 1963. It is not known whether any revision has taken place since then).

Sarawak: In Sarawak rubber covers about 60% of the total planted area.

Area, production and yield per acre

In 1940, the total area planted with rubber in Sarawak was only 2,40,000 acres. By 1956, it increased to 2,66 000 acres. The total area at the end of 1965 is estimated to be in the region of 4,06,700 acres, 8,370 acres (2%) under estates and 3,98,400 acres (98%) under smallholdings. Only about 28% of the total area is planted with high yielding rubber. Compared to West Malaysia, standards of production in small holdings remain low. Much of the small holders' crop is poorly planted and maintained.

The rubber output of this region is decreasing in spite of the increase in area under rubber. Table 15 depicts this fact.

Table 1:

Year	Production (tonn
1940	35,560
1955	39,861
1956	41,378
1957	41,638
1958	39,540
1959	44,119
1960	50,453
1961	48,070
1962	44,143
1963	45,291
1964	45,406
1965	40,501
1966	36,601
1500	The second second second

The average yield per acre in Sarawak for 1965 is estimated at 390 lb.

Replanting and newplanting

A good proportion of the area under rubber in Sarawak is planted with old unselected seedling trees rapidly nearing the end of their economic life. To rejuvenate the rubber plantation industry, in 1956, a subsidised rubber planting scheme was introduced. Under the scheme subsidies are granted at the rate of \$ 400 (Rs. 930)-post devaluation rate) per acre for newplanting and \$ 600 (Rs. 1,470 post devaluation rate) per acre for replanting. The progress of the scheme is reported to be satisfactory. Under the scheme, by the end of 1955 about 1,04,400 acres of rubber had been planted, most of which was newplanting. The rate of newplanting and replanting since 1962 was as given in Table 16.

Table 16

Year	Newplanting (acres)	Replanting (acres)
1962	11,900	1,600
1963	12,000	400
1964	15,500	700
1965	11,100	1,800

Saba

Area, production and yield per acre

In 1962, the planted area under rubber in Sabah was only 2,18,685 acres. During the last 3 years about 32,788 acres were added to this, raising the total area at the end of 1965 to 2,51,473 acres. Out of this, 83,455 acres (33%), were under estates and 1,68,018 acres (67%) under small holdings. In 1966 the total rubber output in this region of Malaysia was 24,081 tonnes as against 20,178 tonnes in 1956. The average yield per acre for 1965 is estimated at 330 lb. About 54% of the total area during the year was under high yielding rubber. The annual rate of increase in production was given in Table 17.

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Year	Area replanted (acres)		
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1954	39,100	22,600	
1955	57,600	25,300	
1956	78,400	46,500	
1957	76,300	49,800	
1958	64,800	59 700	
1959	68,200	69,100	
1960	75,200	69,500	
1961	70,500	57,300	
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(* Post devaluation rate)

Collections under this head go to general revenues. Besides, there are three cesses. There is a cess of \$ cent (2.45 Paise) per lb for research. Another cess is for replanting at the rate of \$4\frac{1}{2}\$ cents (11 paise) per lb. When the price of rubber goes above one dollar, an anti-inflationary cess is also levied

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Besides a land tax of \$ 6 (Rs. 14.70) per acre, an education cess of 1 to 2 dollars (Rs. 2.45 to 4.90) is levied by the individual States. (The particulars regarding income tax and State taxes are collected from some publications relating to 1963. It is not known whether any revision has taken place since then).

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In 1940, the total area planted with rubber in Sarawak was only 2,40,000 acres. By 1956, it increased to 2,66 000 acres. The total area at the end of 1965 is estimated to be in the region of 4,06,700 acres, 8,370 acres (2%) under estates and 3,98,400 acres (98%) under smallholdings. Only about 28% of the total area is planted with high yielding rubber. Compared to West Malaysia, standards of production in small holdings remain low. Much of the small holders' crop is poorly planted and maintained.

The rubber output of this region is decreasing in spite of the increase in area under rubber. Table 15 depicts this fact.

Table I

Year	Production	(tonne
1940	35,560	
1955	39,861	
1956	41,378	
1957	41,638	
1958	39,540	
1959	44,119	
1960	50,453	
1961	48,070	
1962	44,143	
1963	45,291	
	45,406	
1964	40,501	
1965 1966	36,601	

The average yield per acre in Sarawak for 1965 is estimated at 390 lb.

Replanting and newplanting

A good proportion of the area under rubber in Sarawak is planted with old unselected seedling trees rapidly nearing the end of their economic life. To rejuvenate the rubber plantation industry, in 1956, a subsidised rubber planting scheme was introduced. Under the scheme subsidies are granted at the rate of \$ 400 (Rs. 980/post devaluation rate) per acre for newplanting and \$ 600 (Rs. 1,470 post devaluation rate) per acre for replanting. The progress of the scheme is reported to be satisfactory. Under the scheme, by the end of 1955 about 1,04,400 acres of rubber had been planted, most of which was newplanting, The rate of newplanting and replanting since 1962 was as given in Table 16.

Table 16

Year	Newplanting (acres)	Replanting (acres)
1962	11,900	1,600
1963	12,000	400
1964	15,500	700
1965	11,100	1,800

Sabal

Area, production and yield per acre

In 1962, the planted area under rubber in Sabah was only 2,18,685 acres. During the last 3 years about 32,788 acres were added to this, raising the total area at the end of 1965 to 2,51,473 acres. Out of this, 33,455 acres (33%) were under estates and 1,68,018 acres (67%) under small holdings. In 1966 the total rubber output in this region of Malaysia was 24,081 tonnes as against 20,178 tonnes in 1956. The average yield per acre for 1965 is estimated at 330 lb. About 54% of the total area during the year was under high yielding rubber. The annual rate of increase in production was a given in Table 17.

Table I

Year		Production (tonnes
1956		20,178
1957		20,189
1958	Bridge St	20,559
1959		23,256
196C		22,387
1961		23,989
1962	***	22,709
1963		21,560
1964		23,169
1965		24,230
1966	***	24,081

Replanting and newplanting

In Sabah, newplanting and replanting of rubber with high yielding material are carried out under the impetus of a subsidised Government scheme. Grants are at the rate of \$120 (Rs. 270)- post devaluation rate) per acre for newplanting and \$500 (Rs. 1,225]- post devaluation rate) per acre for replanting. The progress of replanting and newplanting since 1961 is shown in Table 18.

Table 18

Year	Newplanting (acres)	Replanting (acres)
1961	15,000	3,100
1962	15,400	2,500
1963	12,500	2,000
1964	12,200	1,500
1965	8,100	1,700

Indonesia

Until 1956, Indonesia was the world's largest rubber producer. But since then her production has declined and now she is only second to Malaysia, though still holding the highest percentage in area. Even though she accounts for 34% of the world area, her share in production is only 29%.

Area, production and yield per acre

Table 19 given below illustrates the progress in rubber acreage in Indonesia during the last 25 years:—

Table 19

Year	Area under estates (100 acres and above)	Area under small holdings (below 100 acres)	Total
	((000 acres)	
1940	1,567 (46%)	1,807 (54%)	3,374 (100%)
1965	1,283 (25%)	3,626 (75%)	4,909 (100%)

Evidently, Indonesian area under rubber has increased by about 15,35,000 acres (31%) during the last 25 years. Small holders' acreage has nearly doubled. In 1940 only 54% of the total area was accounted by small holdings; by 1965 their share increased to 75%.

In spite of the increase in area, there is no appreciable improvement in total yield.

Table 20 gives the progress in area and the variations in yield since 1956.

Table 20

Year	Total area ('000 acres)	Production ('000 tonnes)		
1956	N. A.	698		
1957	N. A.	695		
1958	4434	669		
1959	N. A.	705		
1960	4450	620		
1961	4469	682		
1962	N. A.	682		
1963	4735	582		
1964	N.A.	649		
1965	4910	717		
1966		711		

(N. A.=Not Available)

Data regarding the acreage planted with high yielding and unselected planting materials are not available. However, it is reported that a majority of the estates and holdings are planted with old unselected mibber.

Compared to other rubber producing countries, the average yield per unit area in Indonesia is very poor. In 1965, the estimated average yield of estates and mall holdings together was only around 340 lb per acre.

Replanting and newplanting

In Indonesia replantation of rubber was surted soon after the end of World War II at the initiative of the respective entrepeneurs. This has produced satisfactory results, although it did not proceed as fast as expected. In 1961, the Government of Indonesia embarked on a scheme for boosting the rate of replanting and newplanting. The scheme stipulates the following:—

- (i) A premium is paid to the small holders and estates for their replanted and newplanted areas.
- (ii) The amount of grant is limited to a maximum of Rp. 16,00.1/- per hectare (Rs. 1,079/- per acre).

(iii) The payment of grant for small holders applies only to units covering at least 50 hectares (124 acres) each.

The obligation imposed upon the small holders to carry rejuvenation collectively covering at least 50 hectares per unit as the condition for obtaining grant is reported to be to establish the basis for co-operative enterprise. The co-operatives will enable the small holders to derive a greater share of profit from this crop.

The funds needed by the Government to pay the grants are obtained from the cess imposed on rubber exported from the country.

Originally, the target for replanting and newplanting for a period of 8 years (1961 to 1968) was fixed, at 2.08,000 hectares (6,92,000 acres). But later, on the basis of the satisfactory progress of the scheme during 1961 and 1962 the target was enhanced to 3,45,500 hectares (8,53,700 acres). The year-wise break-up of the target was as eiven in Table 21.

Table 21

	Small ho	Idinos	Estates	
Year -	Agras		Hectares	Acres
	Hectares		22,000	54,362
1963	15,000	37,065	24,000	59,304
1964	17,500	43,242	24,000	59,304
1965	20,000	49,420	24,000	59,304
1966	24,000	59,304	24,000	59,304
1967	29,000	71,659	24,000	59,304
1968	34,000	84,014	24,000	59,304
1969	40,000	98,840	1,66,000	4,10,186
Total	1 79 500	4,43,544	1,00,000	

The progress of the scheme since 1961 was as given in Table 22.

Table 22

Year	Replanting (acres)	Newplanting (acres)
1961	47,900	26,500
1962	43,700	32,200
1963	47,900	37,500
1964	52,900	43,800
1965	52,900	50,000

Co-operatives

In Indonesia, much importance is given to co-operatives. The Department of Transmigration, Co-operatives and Community Development takes the lead in establishing small holders' rubber co-operatives and guiding them until they become strong economic units.

It is also aimed at guaranteeing the continuity and efficiency of production, improving the qualities of rubber, channelising incentives and giving assistance in the implementation of replanting plans. At present, rubber co-operatives have been established throughout Indonesia from primary co-operatives to central federation of co-operatives and their centres. In 1963, 12,000 primary co-operatives were operating.

Also production and marketing units have been formed on co-operative basis, by the rubber producers themselves, with a view to eliminating the middleman in the marketing of small holders' rubber. Government is also—

- (i) issuing credits to small holders for erecting sheet factories and smoke houses.
- (ii) supplying materials for the processing of sheets.
- (iii) training rubber producers.

Thailand

Thailand occupies the third place among natural rubber producing countries. She shares 9% of the world production of natural rubber. Practically, all the rubber produced in the country is being exported.

Area, production and yield per acre

The area devoted to rubber in Thailand has increased from 4,19,000 acres in 1940 to 8,39,600 acres in 1954 and to 18,16,000 acres in 1965. The average rate of increase in area, during the last 11 years has been as high as about 11% which is perhaps the highest rate in the world. It is expected that the rubber acreage will continue to increase, since Thailand still has much unused suitable land. Practically, the entire area is owned by small holdings (below 100 acres in size). A majority of the rubber area is planted with unselected old seedlings. Only 27% of the total area is reported to be under high yielding rubber.

In 1950, the total production of rubber in the country was only 1,14,000 tonnes which increased to 2,22,000 tonnes in 1964. However, in 1965 and 1966, production has slightly declined. Table 23 gives the rate of increase in production since 1956.

Table 23

Year	Production (tonnes)
1956	1,36,707
1957	1,36,107
1958	1,40,630
1959	1,73,996
1960	1.70,856
1961	1,86,103
1962	1.95,377
1963	1,89,830
1964	2,21,654
1965	2,16,474
1966	2,07,164

The increase in production is mainly due to the increase in area. The average yield per acre in 1965 is estimated at 360 lb.

Replanting and newplanting

In Thailand, the Rubber Replanting Subsidy Scheme was put into operation only in 1961. It provides a subsidy of Baht 1,500 per rai (Rs. 1 350/- per acre) to replanters. The progress of the scheme is reported to be satisfactory.

Table 2

Year	Rate of	
1 cui	Replanting Newplanting	
	(acres)	
1961	9,800	5,800
1962	33,300	2,100
1963	12,700	1,600
1964	16,600	1,000
1965	13,700	1,200

The Government of Thailand is encouraging newplanting with high yielding planting materials.

Thailand is also giving technical and other forms of assistance to rubber growers through co-operatives.

(To be continued)

Planting Material and Planting in Rubber Plantation Industry

K. T. Jacob* and P. N. Radhakrishna Pillay **

Plantation crops play a significant role in the agricultural and industrial development of our country. Among such crops, rubber has a special status, since the total internal production of this strategically important material falls short of the national requirements. Other plantation crops like tea, coffee and cardamom are mostly export oriented.

Among the various plantation crops in the world, rubber is of comparatively recent origin. In India, the area under this crop has progressively increased from .02 hectares in 1902 to 1,71,260 hectares by the end of March, 1967. The total area under rubber in the world is estimated to be about 58,13,300 hectares. The phenomenal increase in the planted area is mainly due to the overwhelming world demand for rubber, following a few significant scientific discoveries like vulcanisation and other compounding processes. Invention of pneumatic tyres and the subsequent tremendous progress in the automobile industry the world over, have given great impetus to the progress of this plantation industry.

Soil and climatic requirements

Rubber tree (Hevea brasiliensis) belongs to the natural order Euphorbiaceae. Though

the original habitat was the tidal areas in the Amazon river valley, it has adapted itself well to the new environments in the South and South-east Asian countries after introduction.

Rubber plant thrives well in a warm humid equable climate (20-30°C). An evenly distributed rainfall of not less than 2000 mm is essential for its healthy growth. However, it is interesting to note that this perennial tree yielding all the year round. is not very exacting in its climatic and edaphic requirements. In other words, rubber can successfully be established under slightly varying climatic and soil conditions. But prolonged drought with very high temperature and extreme cold with temperature going below the tolerance limit are not suitable. Similarly, very high preci-pitation for extended periods makes the rubber plant vulnerable to the incidence of several destructive diseases. It thrives well in deep well drained acidic soils with pH varying from 4.5 to 6 and where the water table is not very high, but alkaline soils are unsuitable. Normally, rubber can be grown successfully in lower elevations, and its performance above 1500 ft MSL is unpredictable. Here again, under high elevation conditions, the tree generally becomes

Director / Rubber Production Commissioner, Rubber Research of Institute of India, Kottayam-9.

^{**} Mycologist, Rubber Research Institute of India, Kottayam-9

susceptible to leaf diseases in some cases throughout the year. Still, several cases of successful establishment of economic units have been noticed in marginally suitable areas and in protected pockets of generally unsuitable areas.

Varieties of planting materials

In modern agriculture, several varieties of the same crop suitable for different climatic conditions, soil types and with certain specific qualities, are available. Rubber is no exception to this, as it has also many varieties with specific qualities suitable for particular environments. Today the planting materials used in rubber plantations could be broadly classified as: (i) ordinary unselected seeds, (2) primary clones, (3) clonal seedlings, and (4) secondary

1. Ordinary seeds

As in other crops, cultivation of rubber commenced with unselected seeds obtained from its native habitat. Later it was found that yield from this planting material and its progenies was far from satisfactory. Therefore, for economic rubber cultivation, unselected variety has no place, and the planting of such materials has been banned by law in our country.

2. Primary clones

Selection of high yielding individual mother plants was made from the original seedling stock and attempts were made to grow their progenies. During this process vegetative multiplication of the mother plant was successfully introduced. Those mother plants which transmitted their desirable qualities to successive generations through vegetative multiplication (budgrafts) such as PB 86, Tjir 1, PR 107, Gl 1, GT 1 and LCB 1320, were termed as primary clones. By planting such clones, five to six-fold increase in yield was recorded.

3. Clonal seedlings

Clonal seeds were extensively tested for their yielding capacity and other desirable characters. It was observed that the progenies of a few families of clonal seeds gave higher yields. Outstanding among them. are selfed seeds of Tjir I, RRIM 501 and PB 5/51. As cheap and good planting materials, monoclonal seeds of Tjir I have attained popularity, especially among small holders of our country. However exploitation of heterosis or hybrid vigour had been found to be a better method of improving the quality of seeds as planting material. Choosing suitable seed parents, several high yielding vigorous polyclonal seedling families like Further Proof, Preliminary Proof and GG series were evolved. Further scientific advances have made it possible to produce high yielding polyclonal seeds in specially laid out seed gardens, planted with known desirable seed parents. For producing such polyclonal hybrid seeds, seed gardens have been established in our

4. Secondary clones

In a systematic research for high yielding rubber planting materials, the advances made in the science of plant breeding were utilised with encouraging results. Crossing of two progenies and vegetative multiplication of the selected plants were carried out. which though a slow and time consuming process, often taking about 15 to 20 years for evolving a desirable clone, gave such high yielding secondary clones like RRIM 500, 600 (including the 'wonder clone RRIM 500'), 700 series and some PB fractional

Agro-climatic zones for planting rubber

Although rubber can be grown under slightly varying climatic and soil conditions, optimum returns could be obtained only when planted under suitable conditions. On the basis of climatic and soil conditions, the rubber growing areas in our country could be broadly classified into the following regions. The different types of planting materials suitable or not favourable to these agro-climatic zones are also indicated,

I. Kanyakumari region

This region with more or less an evenly distributed rainfall and with comparatively deep and fertile soils with good moisture retaining capacity, is very good for rubber cultivation. It is almost free from the incidence of abnormal leaf fall of rubber, which is considered to be the most damaging disease prevalent in most of the rubber growing areas of our country. However, the incidence of powdery mildew disease is rather severe here.

In this region all the modern high yielding budgrafts like RRIM 600, 623, 628 and high yielding PB fractional clones could be grown with advantage. The performance of old primary clones like Tjir 1, PB 86 etc. has also been found to be satisfactory. However, caution should be exercised in planting clones susceptible to powdery mildew disease, such as PB 5/139, PB 6/9 and RRIM 605.

2. Kottayam, Ernakulam and part of Trichur region

Rubber cultivation in our country is mostly concentrated in this region. The rainfall especially during the south-west monsoon, is rather heavy and consequently, incidence of abnormal leaf fall disease is severe in this region, necessitating adoption of costly control measures. Soils of this region are mostly lateritic and comparatively poor in plant nutrient status. Clones like PB 85 and Tjir 1, which are known to be highly susceptible to abnormal leaf fall disease should be avoided. However, other high yielding budgrafts in general and clonal seedlings in special areas, could be grown.

3. Quilon-Trivandrum region

The total rainfall here is slightly lower than the former, but abnormal leaf fall disease is prevalent. Soil is lateritic and better suited to rubber cultivation, but summer drought is more prolonged. Here again, clones susceptible to abnormal leaf fall disease may be avoided. The performance of the primary clone GI 1 is reported to be very encouraging in this area. Other

high yielding clones like RRIM series, GT 1, PB fractional clones and clonal seedlings could be tried.

4. Kozhikode and Cannanore region

This region is peculiar in its climatic conditions with very heavy rainfall, leading to severe abnormal leaf fall disease incidence and with a more extended drought period than the other regions. Here, the comparative annual growth of rubber tree is likely to be poor. The soil is mostly lateritic with low plant nutrient status. Hence clones like Gl 1. PB 86 and RRIM 600 which are slow growers, may not be suitable. Clones highly susceptible to abnormal leaf fall disease may be avoided. Also clones like Tjir 1 with pronounced depression in yield during the summer months, may not be suitable. But vigorously growing clones of RRIM series, PB fractional clones and clonal seedlings may be tried.

5. Palghat and part of Trichur region

Here the total rainfall is much less than in other regions, with the major portion received during the south-west monsoon. The incidence of abnormal leaf fall is mild. The soil is slightly acidic and comparatively rich in plant nutrients. However a prolonged drought period and severe wind lashing often work as limiting factors in successful rubber cultivation. Therefore slow growing and wind susceptible clones may be avoided. Probably, clonal seedlings may be more suitable for the major portion of this region.

6. Mysore region

This region may be considered as outside the conventional rubber growing belt of our country and characterised by marked winter and summer seasons. Here, the annual rainfall is low and the growth of rubber is likely to be poor. Conditions favourable to abnormal leaf fall and powdery mildew incidence are also prevalent. Vigorous clones and polyclonal hybrid seeds may be tried.

7. Andaman and Nicobar region

The climatic conditions of this region are almost similar to that of the favourable parts of Malaysia, with an evenly distributed rainfall and without pronounced wet and dry seasons. As far as the climatic conditions are concerned, this is probably the hest region for rubber cultivation in our country. But soil variations are very pronounced. Low lying areas with high water table and clayey soils not suitable for rubber cultivation, are present in this region The growth of rubber plant has been found to be very satisfactory in the Andaman area, where the Rubber Board has established a Research-cum-Development Station in a 202 hectare plot. All the high yielding modern budgrafts will be suitable to this locality, but for wind swept areas wind fast clones have to be selected. In the low lying areas Gl 1 may be tried. Clonal seedlings could also be tried in other problem areas in this region.

8. Regions with specific problems

Selection of planting material for these problem areas has to be made after carefully analysing the special factors prevailing in the individual areas and suitable materials which can overcome or atleast withstand the unfavourable factors may be selected.

Planting and planting season

Areas proposed to be planted with rubber have to be cleared of other vegetation. Usually, if found necessary a light burning of the undergrowth is recommended, but excessive burning will result in destruction of humus in the soil. Land has to be prepared for planting by adopting suitable methods like contour lining in slopy areas or square or rectangular planting in flat areas. In a perennial tree crop like rubber, density per hectare is of great importance, as an optimum stand will produce the maximum crop. But many planters, especially the small growers, generally plant and maintain a high population per hectare

under the impression that more the number of trees higher will be the yield, which is cultivation. If the stand per hectare is high, initial girthing will be low and plants will show a tendency to grow tall and lanky with poor bark renewal. The only advantage in favour of high density planting is that the total yield initially will be slightly high. The high cost of planting and the maintenance of high stand per hectare will offset the advantage of initial higher yields. Hence it is recommended that an initial stand of about 450 plants per hectare in the case of buddings and 500 for seedlings be maintained, to be progressively thinned out. to retain the optimum stand at the time of tapping. In this connection it may be stated that during the 1967 Planters Couference at the Rubber Research Institute of Malaya a suggestion which received wide support was to have an initial planting density of 140 budded plants per acre, to be reduced to 125 at the time of tapping. This may be seriously considered by planters of our country also, for increased rubber production at economic costs.

For quick establishment and better growth, young rubber plants should be planted in suitable pits. The usual pit size recommended is $2\frac{1}{2} \times 2\frac{1}{2} \times 2\frac{1}{2}$ ft in loose soils and $3\times 3\times 3$ ft in hard caked-up soils. Wide shallow pits with a deep crow-bar hole in the centre, may also be tried with advantage. These pits have to be refilled preferably with top soil, which should be allowed to settle before planting.

In our country the favourable planting season is during the south-west monsoon period. Planting with the advent of rains often results in better success. Late planting in August and September adopted in some cases, will succeed only if the north-cast monsoon is favourable. While planting it should be ensured that the stumps are put firmly in the pits without any air spaces between the roots and the soil.

Materials used for planting

Materials used in commercial rubber planting are mainly clonal seeds, clonal seedling stumps and budded stumps. Rubber seeds have very low viability and require certain special environmental conditions for satisfactory germination. Planting of ungerminated seeds straight into pits in the field is not recommended. It is advisable to plant only germinated seeds in the field. The process of planting seed straight in the field is termed 'seed at stake planting.'

The most common practice is to raise seedlings in the nursery and transplant them into the field after pruning the shoots and roots at specified lengths, as 'seedling stumps' after one year of growth. The green portion of the stem and the tip of the tap root are pruned and the lateral roots clipped 4" to 6" away from the tap root. Raising seedlings especially from off season seeds in polythene bags and planting them in the field without shoot and root pruning is also practised.

Budgrafting is generally done in the nursery and the stock is cut back, prior to planting. Stumps are planted in the field after trimming the tap and lateral roots. Budding on plants in the field is also practised, which is called 'field budding.' This has an added advantage in that the root system is left undisturbed, thereby ensuring better anchorage. In the conventional budgrafting process brown buds are grafted on to seedlings, having 1" to 2" girth. But of late, 'green budding' of 3 to 4 months old stock seedlings using green buds from tender budwood is also becoming popular. For such green buddings, seedlings could be raised in polythene bags, budgrafted and transplanted into the field after cutting back the stock. Here again planting of the young budded plants without disturbing the root system is

Maintenance

The critical period of rubber cultivation is the pre-tapping years. Proper maintenance of young plants during this period has a direct bearing on the immaturity period and the yield potential. Soon after planting, a leguminous ground cover should be established. The leguminous ground cover, in addition to adding large quantities of organic matter to the soil fixes atmospheric nitrogen. It also keeps down soil temperature, prevents soil crosion and smothers weeds to a great extent. Regular weeding, proper and adequate fertiliser application and timely plant protection operations are necessary for the healthy growth of rubber plants.

Tapping

A discussion on planting materials will not be complete without examining the reaction of different planting materials to various tapping systems and intensities in vogue. Tapping responses to different planting materials could be considered under two heads, viz., seedlings and buddings.

Monoclonal seedlings like Tjir I have been extensively planted, especially by the small growers of our country. Other types of polyclonal seedlings like the GG series from Prang Besar, Malaysia, are also very popular. But the experimental findings elsewhere and experience in our country indicate that these materials can stand only once in 3 days tapping intensity (S/2 D/3), at least during the initial 4 to 5 years, which is seldom practised by a large majority of our growers. Generally, daily tapping (S/2 D/1) or at the most alternate daily tapping (S/2 D/2) is being adopted for these materials in our country. As a consequence, a majority of high yielding individuals from the total stand 'goes dry' because of 'brown bast' incidence. Adoption of once in three days tapping, especially for small holders with only a block or two, may not be an economic and practical proposition. Moreover, under the climatic conditions

revailing in our country, the total number of tapping days in an year under this system the considerably less. Due to the inherent variability of seedlings a high population has to be planted for subsequent himing and so the initial cultivation and maintenance costs are likely to be higher. Also the yield from this material is not considered to be satisfactory, in comparison with budgrafts. Therefore, planting of clonal seedlings in extensive areas may not be to the best advantage of the industry.

In the case of budgrafts, all the clones could be tapped on half spiral alternate daily without any deleterious effects, except in a few clones highly susceptible to brown bast incidence. For example, GI I can stand only half spiral once in three days apping intensity. Other clones like PB 6/9, RRIM 628 are also slightly susceptible to brown bast disease and hence a lower tapping intensity is recommended during the initial years of tapping.

Buddings are suitable for high level tapping, making continuous tapping of virgin and renewed barks possible without the occurrence of bark islands. Moreover, the present tendency in technically advanced countries is to increase the per tap yield in tubber, thereby reducing the cost of production. In this connection the tapping systems with reduced frequency assume great importance. Buddings in general may respond well to double cut system of

tapping. Clones like PR 107 can withstand well to a full spiral tapping system also.

Conclusion

In a perennial plantation crop like rubber, the choice of planting material is therefore very significant. All other planting practices like optimum manuring, establishment of leguminous cover, regular rounds of weeding, timely plant protection operations, etc. will have very little effect if the planting materials do not possess inherent high yielding capacity.

There is no doubt that the progress of rubber plantation industry mainly depends on the planting of more and more high yielding budgrafts, suitable for particular agro-climatic zones. But, the usefulness of clonal seedlings as the planting material for problem areas like wind exposed hill tops, regions experiencing very severe drought and for experimental planting in new regions, is not to be overlooked. It is pertinent to note that countries like Malaysia with the highest per hectare yield, have about 80% of their planted area under budgrafts and only 20% under seedlings. In our country the earlier preference was for seedlings, but this tendency is slowly changing. This change will produce significant results by substantially increasing the unit production in our country at economic costs, which will benefit the planter and the

Commercial Rubber Yields in South India

P. P. Cherian*

Summary

The paper deals with the collection of commercial yields in South India from 1947 onwards. Yield variation from region to region and comparison with those in other countries inclusive of the latest materials are recorded. Yield comparison of ordinary seedlings and between the older proved clones and clonal seedlings derived from them and that between the new clones and their clonal seedling progenies are made from available data. When comparative performance of clonal seedling and budgraft is made, the quality of the parent strains should also be taken into consideration for evaluating the yield of the progeny.

The lifting of the International Rubber Control including restriction on new planting, consequent upon the Japanese occupation of Malaya and other eastern countries in 194?, spurted rubber planting in South India. But most of the materials planted especially by small growers comprised unselected rubber. At that period, no published information was available as to the experience of using improved planting materials. The necessity for a preliminary field survey to find out the commercial performance of various Hevea planting materials mooted* in 1942, however, failed to materialise. The scheme envisaged the popularisation of the most suitable buddings as evaluated from yield records and other factors and for locating the sources of good types of clonal seeds, then mostly unknown and wasted in this country though utilised for commercial planting in Indonesia especially by small growers on the basis of research trials carried out there.8 According to the official publication in 1947, the average annual yield in South India14

varied from 294 to 315 lb per acre during 1940 to 1945 against 350 lb in Ceylon and twice as much in Malaya and East Indies; the contributory factors for low yield attributed being poor soil conditions, adverse climatic factors and uneven distribution of rainfall as compared with other main rubber producing countries.

In another publication² of the same year (1947) the annual yields ranging from 787 to 1000 lb per acre for budded and clonal rubber in two estates in Kanyakumari district and one in Mundakayam were cited to substantiate the impact of improved materials on production, irrespective of the region and country. The apparent lower Indian average quoted earlier could be due to unequal comparison of yield of unselected rubber with high-yielding material in other countries.

A year later, the reported disproportionately higher yield in other countries was contradicted by the publication of authentic overall averages in India, Ceylon, Malaya and Sumatra (in both the latter countries pre-1941 figures) as 300, 350, 403 to 430

^{*} Development Officer, Rubber Board, Kottayam-9, Kerala State

and 400 pounds per acre respectively. According to the same source, the use of improved planting materials under suitable conditions accounted for the yield increase to 800 lb and over in India and Ceylon, to 1050 lb in Malaya and from 681 to 891 lb in Sumatra and not necessarily the dimatic and other factors.

First yield survey

The first survey and publication of commercial yields' of about 4,000 acres of budding and clonal rubber in South India took place in 1949. The results after discussions at the UPASI annual conference in 1951 published' subsequently disclose the following:—

- (a) All the improved pianting materials vogue in Malaya, East Indies and Ceylon had also been used in some of the large estates in this country.
- (b) The yield for the same material varied in the same and different regions.
- (c) Contrary to the general belief, the yield difference between the same variety of planting material in some regions in South India on one hand and the main rubber producing country on the other appeared to be insignificant, despite climatic and other factors.
- (d) Budding of the older clones in Kanyakumari district produced very satisfactory yields below an elevation of about 700 feet compared with any other rubber producing country. Few records of clonal rubber upto 11 years showed that though the initial yield exceeded budding, the position was reversed later to some extent in respect of one large area for which records
- (e) In wet districts, buddings of most of the clones produced comparatively much less yield than in Kanyakumari district. But limited areas under

isolated garden and other varieties of clonal rubber outyielded budding and the early yields seemed to be no the same order as that of budding in Kanyakumari district.

Plantation Commission enquiry

Five years later (1956) the Plantation Enquiry Commission recorded. the yields of selected estates in different regions as extracted in Table 1.

Citing estates in the South producing as much as 1067 lb per acre compared with much lower yields in the North, the Plantation Commission concluded that suitable lands for rubber cultivation in India are very limited and such areas are situated only in the Southern district. But the highest yielding estates in respect of which the average quoted, comprised exclusively of budded and clonal rubber and those with higher production had proportionately larger areas of improved planting materials under tapping. Apparently, the influence of planting materials was not linked up with the yield variation.

Rubber planting in northern districts

Doubts regarding the suitability of the northern regions for rubber planting persisted. The rubber planting scheme of the Kerala Government during 1953/59 near Kuttiyadi and Taliparamba was aban loned on this ground, though expansion in the private sector continued unabated on the basis of practical experience.

Survey of Malabar regions

During 1960, in accordance with the initiative of the then Chairman of the Rubber Board, Shri K. B. Warrier, I. A. S., the survey was extended to the Malabar districts. Yield data, among others, collected to evaluate how far the northern regions fared in rubber production compared with other regions in South India are furnished below:—

Average yield in lb of unselected rubber, budding and clonal of company estates

-	_			company estates			
		Unselect	ed	Bude	ded	Cle	onal
	ecation of Estates	Acres from which average worked out	Per acre	Acres from which average worked out	Per	Acres from which average worked out	Per
T P C C	Northern Egions Comprising Trichur, Calghat Calicut and Cannanore istricts	31,627	340	12,962	443	987	657
re co E K Q Ti	entral egions overing rnakulam, ottayam, uilon and rivandrum stricts	50,066	327	11,363	627	2,610	760
	anyakumari strict	2,960	553	5,490	856	180	883
	verage for }		338	(for bud	ding an	d clonal 607 lb)	

The average relates to production of four years from 1955 to 1958 inclusive, so that any temporary variation due to climatic factors, use of yield stimulant, change of tapping system or cut, labour strike, new areas brought under tapping etc. could be minimised and the figures arrived at would indicate a fair yield as far as possible-Table 2 summarises the region-wise yield of different planting materials of leading estates for 1958.

The average annual commercial production of 9,27,000 acres of unselected rubber and 5,55,000 acres of high yielding materials in Malaysian large estates during 1957 worked to 374 and 806 lb respectively. For further comparison, production estimated by the Mudie Mission of Enquiry¹² in respect of planting material then in vogue in that country is embodied in Table 3.

The following are the salient points revealed in regard to yield in South India.

- (a) Though the northern districts are characterised by prolonged dry and wet periods resulting in loss of comparatively more tapping days and greater damages due to leaf diseases, the average yield for unselected rubber in the estates covered by the survey seems to be in no way inferior but even superior to that in estates of central districts.
- (b) Even compared with Malaysian yield, the production for unselected rubber from the northern districts, despite the adverse climatic and other factors, appeared to be satisfactory.

The Indian average in respect of unselected rubber was compiled out of not less

than 20 and mostly of over 40-year old rubber for which yield above 300 lb per acre cannot be normally expected even in Malaysia according to the expert Mudie Mission of Enquiry cited.

- (c) Yields of improved materials, however. varied widely. Compared with Malaysia, both budded and clonal rubber in Kanyakumari district give satisfactory performance. On the basis of averages for four years, clonal rubber appears to have fared hetter, but as the extent tapped constitutes comparatively much smaller areas, no inference can be drawn. In Table 2, similar advantage is less marked possibly owing to new (clonal) areas brought to tapping in the same year.
- (d) In wet regions the main reason for initial lower yield of budding opens a very interesting line for investigation.

According to data collected by the Statistical Section of the Rubber Board, the yield of 50,665 acres of both high yielding and unselected rubber in estates during 1965/66 worked out to 624 lb per acre. Of these, 974 acres comprised units between 50 and 100 acres, 13,670 within 100 and 1000 acres and the rest above 1000 acres. averaging 448, 565 and 671 lb per acre respectively. Yields under different planting materials were not recorded separately.

Newer planting material

One of the most important planting developments during the last decade has been the mass scale use of clonal seedlings, some Prang Besar Clones and RRIM 600 series of buddings. Considerable areas under clonal seedlings, PB 86 and other buddings, in addition to older proved clones, have been brought under tapping. Table 4 summarises commercial yield data in respect of different clones and clonal seedlings other than RRIM clones which have been tapped only on small scale since recently.

Yield possibilities

For comparison, the yield improvements possible for different planting materials as worked out by the Rubber Research Institute of Malaya' are reproduced below:-

	Ordi- nary	Tjir 1 Clonal	Tjir I Budding	(CDE	86	501	513	RRIM 600 Series
Average yield of 6 years, in lb per acre	450	1048	931	1036	1189	1458	1478	1689*

*(Average of 5 to 6 years of RRIM 600, 605, 623 and 628)10

The following from the same source¹³ clonal seedlings along with control clone present the yields for longer periods in respect of Tjir 1 and Prang Besar CDE plot

		V	ears aft	er plan	ting clo	mal see	dling of	r after	oudding	
Variety		0	10	11	12	13	14	15	16	17
	8	-		1195	1157	1113	1138	1177	1178	1040
PBIG CDE	823	1131	1161	1193	1151					
Clonal		1140	1107	1141	1141	1160	1128	1061	1109	1075
Tjir 1	755	1140	110.					1016	957	896
Clonal Pil. B. 84	419	712	797	780	918	913	1068	1010	,,,,	
Budding										

During the initial six years, Tjir 1 clonal outyielded budding of the same clone and that between Tjir 1 and Prang Besar CDE seedlings, the yield difference appears to be negligible. The pronounced higher yields of RRIM 500 and 600 series of clones should be noted. Yields of clonal seedlings of RRIM 500 and 600 series are not available for six years. Mean yield trials over 2½ years since published disclose¹¹ increased yields over Tjir 1 monoclone family by 137, 146, 130 and 138 per cent respectively for illegitimate clonal seedlings of RRIM 501, 600, 623 and 628, indicating potentiality of the latest clonal seedlings.

Commercial yields

According to the Mudie Report, yields worked out from small and large scale trials tend to be higher than those obtained on commercial scale. Therefore, the actual commercial yields published in Malaysia by the RRIM in regard to the latest planting materials being used in South India have been reproduced below. The figures in brackets indicate the number of fields from which averages are compiled. The RRIM records that the mean yields calculated from fewer than five fields are less reliable.

Commercial yields in Malaysia of later materials, in pounds per acre per annum

Planting				Years of ta	pping			
Material	1	2	3	4	5	6	7	8
RRIM 501	561	886	1174	1324	1437	1472	1457	1383
	(115)	(145)	(173)	(187)	(195)	(200)	(197)	(175)
,, 600	771	1016	1302	1585	1689	2396		
	(24)	(17)	(10)	(5)	(2)	(1)		
,, 605	748	1040	1284	1434	1451			
	(72)	(65)	(43)	(20)	(7)			
,, 623	658	966	1146	1234	1134			
	(108)	(100)	(47)	(23)	(3)			
PR 107	406	643	866	1050	1186	1289	1379	1509
	(85)	(106)	(118)	(12)	(119)	(121)	(96)	(69)
LCB 1320	475	737	966	1092	1137	1214	1153	1263
	(49)	(57)	(48)	(39)	(25)	(21)	(13)	(6)
GT 1	546	816	1155	1262				
		(68)	(45)	(10)	(1)			
PB 5/51	617	919	1179	1388	1524	1611	1629	1623
	(99)	(88)	(55)	(38)	(28)	(22)	(7)	(10)
PBIG Clonal	592	892	1090	1293	1350	1353		
GG1	(93)	(90)	(68)	(47)	(18)	(13)		16 13

The following significant points emerge themselves from the yield records in Tables 3 and 4.

- (a) Commercial yields in India can reach the same standard as in the main rubber producing country in respect of the same clone, clonal seedling and ordinary rubber, despite the initial lower yield in general and adverse climatic and other factors.
- (b) Yields of older clones such as Tjir 1, PB 86, Pil. B. 84 etc. recorded in some Indian estates between 1,200 to 1,900 lb per acre stand fair comparison even with commercial yields of modern clonal materials and new clones including the RRIM 500 and 600 series. The yield pattern of the latter clones in the same estates in this country is awaited with interest.
- (e) Apart from planting material, cultural operations, plantingldensity, tapping system, disease, brown bast, interplanting etc. affect commercial yield. How far each of them either singly or in combinations along with implementation schemes for the wider use of best materials have been responsible for higher as well as lower production in South India may conveniently be studied from available data separately.

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Table 1

Vield per acre in different rubber growing districts in 1955

District	Estate	Tappable a cres	Average per acre in lb	District	Estate	Tappable acres	Average per acre in lb
Coorg				Meenachil			
	1	342	259		1	501	470
	2	493	360				1,0
	3	1237	204	Peerumade			
	4	109	193		1	1610	444
Malabar					2	754	263
Maiabai		220	240		3	619	387
	1	329	367	Kunnathur			
	2	229	320	Acumathur	1	1160	462
	3	813	272			1100	402
	4	550	269	Pathanapura	m		
	5	748	332		1	1107	339
	6	1909	400		2	1276	636
	7	1606	385		3	1296	604
	8	1095	270		4	323	440
Frichur					5	232	564
	1	1448	225	Pathanamthi	itta		
	2	2725	469		1	651	403
	3	1911	298		2	1276	636
	4	663	320		3	1089	598
	5	173	405		4	227	947
Thodupuzha				Shencotta			
	1	1177	343		1	806	307
Kottayam &				Nedumangad	1		
Kanjirapally					1	383	295
THE REAL PROPERTY.	1	1316	306	Vilavancode			
	2	2438	313		1	738	644
	3	448	263		2	447	801
	4	725	408		3	366	1067

Table 2
Commercial Production during 1958 in Large Estates

	Estate	Ordinary	rubber		dded	Clo	nal
Region	Nos.	Acres tapped	lb per acre	Acres tapped	lb per acre	Acres	lb per acre
1	2	3	4	5	6	7	8
Old Malabar	1 2 3 4 5 6	408	445	67	471		
regions and north	2	1341	356	265	644		
	3	675	332	1126	426		
	4	52	372	75	305		
	5	542	322				
	7	713	388	332	404		
	8	424 1718	279	244			
	8	708	426 340	244 173	576	5	000
	10	22	458	626	442 378	2	838
	11	100	316	020			
	12	424	274	23	280		
	13	1135	198				
		930	393	713	579	251	506
Trichur district	1	655	332	1127	425	231	300
	2 3	330	340		***	119	643
				120	575	***	
Muvattupuzha	1	395	224 170	140	588	20	766
region	2	544	196	27	789	30	769
	2 3 4	670 810	325	178	865	31	548
	4	598	314	580	645	173	712
	5	300	196	500			
			345	740	523	39	552
Mundakayam	1	905	281	95	610		
region	2	1090	277	221	525		
	2 3 4	1132 1824	348	195	550	60	745
	4	310	243	244	636		
	5	1193	324				
			264	105	647		
Punalur and	1	817 603	429	226	598		
Shencotta region	2 3	185	447			40	519
	3	313	421	36	411	48	319
	4 5	491	392	125	602 386		
	6	650	336	37	505		
	7	125	350	1039	595	14	381
Doth die		1393	411	262	578	327	884
Pathanamthitta	2	582	360	366	912		
region	1 2 3		***	9	986	16	625
V .		560	502	177	740		
Kanyakumari	1 2 3	180	520	305 321	957	45	919
district	2	100		555	1030	175	624
	4			419	926		
	5			354	614		
	6	***	***	001			
	0						

Table 3

Yield per acre as estimated by the Mudie Mission of Enquiry into the Malayan Rubber Industry

Calendar year from planting	Ordinary lb per acre		Improved materia clonal) lb j	uls (budding and
		Planted before 1942	Planted between 1945-'53	Planted 1954 or later
7	220	383	425	430
8	345	515	580	600
9	416	620	700	760
10	460	700	810	880
11	485	763	865	1000
13	533	880	1005	1100
15	545	920	1115	1190
17	540	920	1115	1190
19	510	880	1070	1155
25	420	755	950	1000
29	363	670	835	875
33	315	560	685	750
- 37	275	460	545	625
41	245	390	450	530
45	225	320	400	445
49	205	265	345	355
53	195	240	320	325

(Note:—Apparently, yields of improved materials of later clones and clonal seedlings such as those of RRIM 600 series, PB new clones and clonal seedlings were not included at the time of the report)

Table 4

Yield Averages for Different Varieties of Improved Materials

1	23									157		-
	22									694		
1	21								336	230		
	20									527 \$	818	
											825 8	
	61 8			573	50					712		
	18				1055				96	ilable	871	
-	11		630	492	958	953	650		966	not available	860	
201	91		592	514	1132	938	796 868		lable	u	998	
amme	15		614	512	1133 999 750	781	546		not available 996		not available	
Yield per acre in pounds in years affet platting - 143 concerns.	14		597	521	919	908	462	1060		314	not av	
years	13	655	NA	NA A	745 867 637	1022	346	1020		306		
inds in	12	185	NA	309 350 470 635	811 684 586	726	360 424 601	970		361		
od ut	11	546	ZA	492 130 303 400 658	790 834 486	922	220	016	450	455		
er acre	10	522	NA	445 160 144 159 279	723 696	906	334	890	1250	513		
Yield p	6	664	474	428	522	161	374	533	1196	218		11113
	00	313	435	468		504		323	751	299		1095
	1	1	151	64				550				514 1050
		-	-					403				183
	8	1	10	89610	111 63	09	36	67		122	16	27
	Varieties Acres	iir 1 & PB 25 47	Jir 1, 16, B84,	86, G11, B81 & AV 49 Tjir 1 budding 36 Tjir 1 budding 39 Tjir 16 37		PBIG clonal	ding	Tjir 1 clonal	budding and 2	PB 86 budding	PBIG CDE	
	Region	Northern	-		Trichur district				nodu- puzha regions			Kottayam

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25	420	755	950	1000
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(Note:—Apparently, yields of improved materials of later clones and clonal seedlings such as those of RRIM 600 series, PB new clones and clonal seedlings were not included at the time of the report)

Table 4

Yield Averages for Different Varieties of Improved Materials

	Varieties Acres 6	jir 1 & PB 25 47	45	86, GI 1, B8 1 68 & Av 4 9 68 Thir 1 budding 36 Thir 1 budding 39 Thir 16 " 9	PB 86 " 11 63 63 " 131 4		Tjir 1 budding 57 Tjir 16 ", 36 Gl 1 ", 5	al 67 403		PB 86 budding 12 Tjir 1 , 22	PBIG CDE 97	Tjir 1 clonal 3 183
	2 4	313	151 43	64 46		5		3 550 5				514 1050 10
Y			435 4	468 47	8	504 7		323 5	151 1	565		673
ield pe	6	499 5	474	428	522	191	+	533	1196 1	218		883
r acre	10 1	522 5	NA	160 160 179 279	723 696 8	906	248	890	1250	513		
ned ui	11	546	NA	130 130 303 558	790 834 486	922	299	016	150	455		
inds in	12	581	NA	309 309 470 635	811 684 586	726	424	948		361		
Yield per acre in pounds in years after planting-NA denotes not available	13	655	NA	NA	745 867 637	1022	346	1020		306		
after p	14		597	521	919	806	462	1069	•	314	not available	
lanting	15		614	512	1133 999 750	781	546		and catallakla		ilable	
-NA	91		592	514	894	938	962		hita	no	998	
denote	17		630	492	958	953	650		900	not available	098	
s not a	18			573	1055				690	ible	871	
vailab	61								7501	712	825	
e	20								1070	527	818	
	21								1036	530		
	22									694		
	23									4 757		

15																
33		840								078						
1	1			725 764 629			1176	551		978 10						
20)30	624 504 504		935	1187 11	532 5		1063	42			2	92	
19	7	9 059		577 616 616 723 5			1355 11	640 5				2			4 1139	
18	2101	988		687 5 687 6 658 7	986 7			9 095	3 977			0 962			3 1244 8 1576	
	918 1 763 1 542 5	8 084	-				6 1414		7 743		1352				1433	
17	780 7700 7666 598 6			7 730 3 796 4 924		616 4	-	059	927		1214				1299	
16		3 738 905 919	-	877 843 834	943		-	673	820		1610	947		1549	1355	
15	1044 934 637 625	788 1050 526	-		850			558	807	867	1557	086		1026	1218	
14	990 1028 763 635			727	960	626	1234	459	795	866	1600	1050		771	774	
13	777 736 644 510	780 1126 956	671	562 603 463	961	591	1226	370	701	875	1190	1801	1669	1016	761	
12	762 786 652 524 524 619	754 677 703	692	529 448 420	840	550 573 666	830	354	655	751	030	682	496	942	730	
111	442 699 462 534 534 545	538 626 637	455	509 442 442	818 953 731	NA 600 575	675	148	889		970 1			NA 520		827
10	344 323 435 435 704	575	420 504	465	786				465		696	094 1	940 1		515	443 8
6	308 485 381 382 513	490	482		715		420		533		539	NA I	933 1		355	207 4
00	237 350 273 382	408			398		7 097			5 862			145	70	21 28 4	2
7							,			7						
9																
Acres	26 24 115 36 51	26 16 16	91	323	74	629 38	13	43	03	36	37	29	16	93 00	400	20
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Termite Control in Rubber Plantations

K. Jayarathnam*

Termites are popularly known as 'white ants.' But this expression is a misnomer for the reason, that the termites are quite different from the true ants or Formicoidea. Also, their colour need not always be white. Nevertheless these two groups have certain common features such as the remarkable social or community life and the presence of Polymorphic species. In general, the termite community includes the reproductive castes comprising the queen and the king which are dealated individuals of fullywinged castes and sterile castes consisting of soldiers and workers, which are apterous males and females adapted for special nonreproductive functions. Termites feed on various kinds of food materials such as sound or decaying wood or other plant materials such as humus, grass, fungi etc.

The common species of termite found in the rubber growing tracts of South India is Odontotermes obesus, W. The nest of this species is subterranean and in order to reach the food materials found above the ground, they usually build covered passage ways of earth. This is necessary for them as they want to live concealed from the light and the sundry enemies and at the same time surrounded by required humidity. So, whenever they attack a rubber tree or any plant above the ground level, the mud galleries built by them can be seen clearly, as external symptom of attack. But when the termites attack the root system of young plants, the attack can be noticed only when the plant gets wilted and starts drying up. The external attack on the trees and plants

is mainly made by the workers and nymphal stages.

Because of the latex barrier in rubber plants, the termites usually attack the dead bark and also at certain regions, the adjoining live bark. At some points of attacked regions, slight exudation of latex is observed, occasionally. Reports have been received from some planters about the drying up of some young rubber plants due to the attack of termites. Very rarely termites attack the roots of young plants directly and kill the plants. But in general they feed on any part of the young plants which has got dried up, due to other causes. Termites attack the snag of young buddings and this results in a gaping wound at the point of union of stock and scion. This may facilitate the easy entry of fungal pathogen or damage due to sun-scorch. Because of the habit of termites to build covered passage ways of earth in all regions they move about, such earthen galleries can be noted to have been built on the tapping panel and collecting cups of some trees. This is often found to be a nuisance to the tappers as they have to clean the tapping panel and collecting cup before tapping the trees. Further, there is the possibility of incorporation of more dirt into the latex. The other damages caused by the attack of termites in rubber plantations are the destruction of dry mulch put in the nursery as well as young plantings, the destruction of baskets provided to protect the young plants from sun-scorch and the removal of

^{*} Research Assistant, Pathology Division, Rubber Research Institute of India, Rubber Board, Kottayam-9, Kerala State.

whitewash given on the trunk of trees to protect the trees against sun-scorch.

In Malaysia, Coptotermes curvignatius, one of the very rare species of termites in the world which freely feeds on the live plant matter, attack rubber plants both through the roots and the base of the stem. Especially newly planted stumps are quickly attacked and killed. This pest attacks the root system of young plants and trees and completely destroy them without any external symptom like the mudwork above the ground. So the damage caused by these pests to a large tree can be noticed only when the tree is blown over in a strong wind, revealing the hollowed out bole and trunk. This species of termite is not found in the rubber growing tracts of India.

Work on the control of termites in Malava was started as early as 1909. Sharples (1936) in his book 'Diseases and pests of rubber tree' summarises the different control measures tried by Pratt (1909), Green (1916), Richards (1917) and Corbett and Dover Cedric (1927). In the early days control measures such as (a) collection of queens of termite colony, (b) flooding of badly attacked areas, (c) selective removal of submerged timber, were tried and found to be ineffective. Fumigating the nest of termite with arsenic sulphur fumes, pumped with the help of universal ant exterminator was also found ineffective. During 1932, nearly 78% control of termites was achieved at the Rubber Research Experimental Station, F. M. S., by three treatments with paris green and 58% control by three treatments with perchloride of mercury. The chemicals were applied at the base of the trees. Beelay (1936) conducted certain field trials on the control of termites and found the effect of different methods of control in the following order of merit. (a) Opening up of root and applying insecticidal dust such as calcium arsenate, sodium silicofluoride, calcium cyanide, cyanomag dust, paradichlorobenzene crystal fumigant;

(b) dibbling in around the base of the tree a small quantity of fumigant rubber jellies such as seekay fumigant meal, carbon bisulphide rubber jelly, orthodichlorobenzene, trichloroethylene rubber jelly; (c) Castor seed meal placed in shallow trench around all trees; (d) use of explosive gases such as carbon bisulphide to kill termites by concussion and (e) digging to eliminate buried timber and nests. But these methods were found to be costly, time consuming and cumbersome. Further, the effective period of control by one treatment varied from 4 to 10 weeks only to the maximum. So to achieve the complete control, the treatments were to be repeated two or three times in a large area.

By 1954 it was found that Dieldrex 15 used at the rate of 1 part in 200 parts of water by volume, to be effective for the control of termites. The cost of this material for the control operation at this rate of dilution was calculated to be only 1/8th as much as the control measure with 1% solution of mercuric chloride hitherto recommended for the control of termites. Further, dieldrin was reported to have replaced sodium arsenite in injecting poison into the termite runs within the trunks. From the reports made in 1955 about the detailed work carried out on the control of termite9 it is seen that the liquid method of control by pouring round the base of the rubber tree 1 to 2 pints of 1% solution of mercuric chloride or bichloride or perchloride in water, to give good results. Further, Aldrex 20 (1 in 400), Dieldrex 15 (1 in 300) and Stex 8 (1 in 700) also were found to give good results and the cost of control operations with these chemicals was found to be much less than with that of mercuric This method of control was suggested for the superficial attack of termites on the trunk and roots. Another method of control known as the trail injection method was used for the control of termites that attack the bole of mature trees. White arsenic powder was found to

be more effective than mercuric chloride as the latter was found to cause bark burning. In 1956, the influence of soil type on the residual toxicity of insecticide10 was reported. Peaty soil was found to inactivate all insecticides and all other types of soils were found to have no significant effect on the residual toxicity of insecticides. Chlordane was found to be less persistent than aldrin or dieldrin. Results of the continued observation of the above work11 published in the year 1957. It is stated that among aldrin and dieldrin, the latter was found to remain active in the soil for longer. Aldrin, the cheaper material, was found to be satisfactory except on peat and coastal alluvial clay. It was recommended to treat the attacked trees in the clay soil with dieldrex 15 (1 in 300) and in peat soil, 4 times this concentration. Newsam and Sripathi Rao (1958) have reported the results of the field experiments on the control of termites conducted since 1950. They state that the insecticide chlordane and those related to it, aldrin, dieldrin and endrin can be said to have solved the long existing problem of termite control in rubber estates. By drenching one or two pints of insecticidal solution of chlordane 0.0375%, aldrin 0.05% and dieldrin 0.015% at the base of trees, they noted only a few cases of reattack of treated trees over a period of more than two years in most of the soil types. But they noted reinfestation quickly in areas of peaty soil. DDT, BHC and Toxaphane were found to be inferior to chlordane, aldrin and dieldrin, as reinfestation was noted in the treated plots after the fourth month.

Further, they conducted certain field tests to find the relative effectiveness of these insecticides in different types of soils and, the time they will remain in the field. The six soils tested were fine sandy loam, coarse sandy loam, laterite soil, volcanic soil, clay soil and peaty soil. The insecticides tested were 0.05% solutions of chlordane, aldrin, dieldrin and endrin. All these insecticides lost toxicity quickly in peaty soil and sooner

in clay soil. In all other soil types dieldrin was found to be active for more than 40 months, endrin upto 30 to 35 months, aldrin upto 25 to 31 months and chlordane upto 3 to 5 months. To be comparably persistent, the relative concentrations of dieldrin, aldrin, and chlordane were needed to be approximately 1: 2: 3. Endrin which persisted as well as aldrin was excluded from practical use by its relatively higher cost. In peaty soil aldrin was found to persist for longer if used in increased dosage. Further, they stated that the low cost of these insecticides, longer persistence and the low toxicity to mammals at the recommended dosage would enable to use the insecticide to treat every tree in the infested area.

The dosage of aldrin to achieve longer persistence in peaty soil was recommended18 in the year 1960 as 0.2%. Heptachlor, a chlorinated hydrocarbon insecticide was tested and found effective for the control of termite14 in the year 1961. 0.05% concentration solution of this insecticide was recommended for the control of termites. The latest recommendation on the control of termites15 was given in the year 1966. It is stated that to be equally effective, chlordane, aldrin, heptachlor and dieldrin are to be used in the relative dosage ratio of 4: 2: 2: 1. Chlordane 0.1%, aldrin 0.05%, heptachlor 0.05% and dieldrin 0.025% were found to effectively protect the trees for 2 or 3 years in most soils. But in peaty soils chlordane and dieldrin were found to be relatively less persistent than aldrin and heptachlor and these were recommended to be used 4 times the normal concentration.

Materials and Methods

Preliminary field tests on the control of termites infesting rubber trees in India were started in the month of March, 1966. The experiments were conducted in the Experiment Station attached to the Rubber Research Institute of India, Puthupally,

Kottayam. The type of soil of this estate is lateritic gravelly loam and it is highly acidic. The main aim of this experiment was to find out a cheap, effective and lasting control measure against termites.

The area selected for this experiment consists of trees of 6 to 10 years growth and in this area the infestation of termites was found to be high compared to other regions of the estate. From this area 27 plots of 50 trees each were selected. The intensity of initial infestation of termites in each tree. of all the plots was recorded. For the convenience of recording the intensity of infestation in each tree, the nature of infestation was divided into 5 different categories, viz, initial, slight, medium, severe and very severe, according to the area covered by the mud gallery of termites in the trunk region of trees. To each of these different categories, a score was allotted to convert the qualitative evaluation of the intensity of infestation of termites to a quantitative one.

By calculating the total score of the intensity of initial infestation in each plot, the 27 plots were divided into 3 blocks of 9 plots each with more or less similar initial intensity of infestation. By applying the scoring method, the total intensity of reinfestation in each plot can also be calculated and with this data the effect of each treatment can be evaluated. The categories of intensity of infestation, the score allotted for each category, and the kinds of earthen galleries included under each category are as follows:—

- (a) Initial—1—Earthen gallery built on the trunk to a height of 1 ft or below from the base of the tree, but not completely covering the trunk.
- (b) Slight-2-Above 1 ft and below 3 ft, but not completely covering the trunk.
- (c) Medium—5—Above 3 ft and below 5 ft not completely covering the trunk or upto 1 ft completely covering the trunk as a cylinder.

- (d) Severe -12—Above 5 ft, not covering the trunk or above 1 ft and below 3 ft, completely covering the trunk as a cylinder.
- (c) Very severe—20—Upto or above the forking region, completely covering the trunk as a cylinder,

Five insecticides viz. heptachlor, dieldrin. aldrin, chlordane and BHC were tried in this trial. In the case of the first 4, emulsion concentrate formulations were used and in the case of the last one wettable powder formulation was used. All these insecticides were tried in the concentration in which they are usually recommended for the control of soil insects. In the case of dieldrin alone, two other concentrations were also tested as this insecticide was reported to be most suitable for the control of termites in Malaya. Two controls were kept to increase the efficiency of comparison. So altogether there were 9 treatments (including two controls). Each treatment was allotted to 3 plots, one from each block.

Insecticide solutions were prepared in water in the following concentrationsheptachlor 0.125%, dieldrin 0.06%, 0.03% and 0.0125%, aldrin 0.0375%, chlordane 0.0125%, BHC 0.2% and the insecticide solutions were applied at the rate of 1 to 2 litres per tree. The soil at the base of each tree was completely drenched with insecticide solution using a water can. Particular care was taken to wet the soil all around the base of the tree completely with insecticide solution, without leaving even a small patch untreated. Before the application of insecticidal solution, the earthen galleries present on the trunk region of all trees of the experiment plots, including controls, were cleaned out. Only one application of insecticide was done, in the month of April, 1966. Afterwards reinfestation was recorded at intervals of 30 days. In those months when there was heavy rain, reinfestation was checked at intervals of 15 days, because the newly built mud gallery may be left

unnoticed by checking once in a month, as these would be washed away by rainwater.

Field observation

Reinfestation was noted in the control plot in the month of May 1965, one month after the insecticidal application. In the months of June, July, August and September, 1966, no reinfestation was noted in any of the insecticide treated plots or control plots. as there was intermittent rain. But in the month of October, 6 months after treatment, reinfestation was noted in control plots and also in plots treated with BHC 0.2%. This condition continued in the months of November and December, 1966. In January, 1967, 9 months after treatment, reinfestation was noted in plots treated with chlordane 0.0125%, aldrin 0.0375%, dieldrin 0.0125% and 0.03%. In the month of February 1967, two cases of initial symptoms of attack of termites was noted in plots treated with dieldrin 0.06%. Upto May, 1967, 12 months after treatment, no reinfestation was noted in plots treated with heptachlore 0.125%.

In table 1, details about the average number of cases of initial infestation noted and the average number of cases of reinfestation noted for a period of one year after the insecticidal treatment, are given for each replication, under the different categories of intensity of infestation. For the convenience of comparing the treatments, the total score of the initial infestation and of reinfestation of each replication was calculated and then the percentage of the score of reinfestation in relation to the score of initial infestation of each replication was calculated and the average of these percentages for each treatment is given in table 2.

Discussion and conclusions

By observing the data, it is found that out of the 7 insecticidal treatments, heptachlore 0.125% is the most effective one as it has totally controlled termites for a period of one year and its effect may prolong

further; whereas in the case of dieldrin 0.06%, except for the two cases of initial symptoms of termite infestation noted it is also seen to effectively control termite for a period of one year, in spite of its concentration being only half that of heptachlor.

In the case of the other treatments viz. aldrin 0.0375%, dieldrin 0.0125% and 0.03% and chlordane 0.0125%, reinfestation was noted in the 9th month, but among these the lowest percentage of reinfestation was noted in the treatment, aldrin 0.0375%. In the treatment dieldrin 0.03%, which is more or less of the same concentration as aldrin, reinfestation percentage is double that of the latter. Chlordane 0.0 5%, when compared to the treatment dieldrin 0.0125% is found to be having 12 32% more rei ifestation than the latter. Considering all these facts it can be stated that the treatment aldrin 0 0375% is the 3rd effective treatment and the order of merit of other treatments is-dieldrin 0.03%, dieldrin 0.0125% and chlordane 0.0125%.

The treatment BHC 0.2%, was found effective in controlling termites only for 5 months and further 55.82% more reinfestation was noted in the treated plots than the initial infestation. So BHC is of no use for the control of termites. The percentage of reinfestation in the case of this treatment is found to be higher than the two controls. This may be due to some natural causes. In the control 1, 25% more reinfestation was noted than the initial infestation and in the control 2, 93% reinfestation was noted and the average of these two controls is 109.31%, i. e. 9.31% more than the initial in estation. So these indicate that the termites were actively moving above the ground level in search of food during the period this field experiment was conducted.

Based on the results obtained in this preliminary trial, it can be concluded that effective control of termites can be achieved for a period of one year by drenching the soil at the collar region of rubber plants or trees with heptachlor 0.125% solution in water. Dieldrin 0.06% also can be as effective as heptachlor. The cost of insecticide required for treating 150 trees is approximately Rs. 8/- in the case of heptachlor, and Rs. 5.50 in the case of dieldrin.

Further studies are to be carried out to evaluate the effects of heptachlor, dieldrin, aldrin and chlordane in equal concentrations.

Acknowledgment

My grateful thanks are due to Dr. K. T. Jacob, Director, Rubber Research Institute of India, for his keen interest in this work and encouragements. I am thankful to Sri K. V. George, Dy. Director (Pathology) for his valuable suggestions and for a critical reading of the manuscript. Thanks are due to the Director and staff of Commonwealth Institute of Entomology, London, for having identified this termite.

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Average Number of Cases of Initial Infestation and Re-infestation noted in each Treatment under the Different Categories of Intensity of Infestation

			Z	ature of i	infestation	Nature of infestation and average number of trees infested	age num	ber of tr	ees infes	ted	
S. No.	Treatments	Initial	- IE	Slight	11	Medium	ш	Seri	Serious	Very !	Very Serious
		(a)	(b) .	(a)	(p)	(a)	(q)	(a)	(q)	(a)	(b)
1	Heptachlor 0.125%	4.33 (0.00	9.33	0.00	10.33	0.00	2.00	00.0	1.67	0.00
2	Dieldrin 0.06%	1.00	19.0	11.00	0.00	11.67	0.00	1.33	00.0	0.00	00.00
3	Aldrin 0.0375%	2.00	0.00	13.00	2.00	10.33	0.33	1.33	0.00	19.0	000
4	Dieldrin 0.03%	2.67	0.67	14.00	0.67	7.67	1.00	2.00	19.0	1.33	000
5	Dieldrin 0.0125%	4.00	19.0	89.6	4.67	8.67	1.33	2.67	000	0.33	0.00
9	Chlordane 0.0125%	8.67	0.33	13.00	3.00	19.9	2.33	4.33	19.0	1.00	19.0
7	Control -2	3.67	2.33	11.00	8.67	5.33	7.00	1.00	1.33	1.67	0.33
	Control -1	4.33	1 33	11.00	13.0)	19.6	10.00	1.63	3.33	19.0	0.67
6	B. H. C. (WP) 0.2%	3.33	2.67	11.67	15.00	00.9	8.00	1.67	2,67	0.33	0.33

Note:-(a) Initial Infestation

(b) Re-Infestation

Table 2

Average Percentage of the Score of Re-Infestation in Relation to that of
Initial Infestation of Each Treatment

S. No.	Treatments	Repli- cation	Total score for of infest		Percentage of re-infestation in relation to initial infestation	Average percentage of re-infestation in relation to initial infestation
1	Heptachlor	I	242	0	0.00	
	0.125%	II	73	0	0.00	0.00
		III	81	0	0.00	
2	Dieldrin	I	120	0	0.00	
	0.06%	II	125	0	0.00	1.17
		III	57	2	3.51	
3	Aldrin	I	149	7	4.70	
	0.0375%	II	97	15	15.46	6.72
		III	81	0	0.00	
4	Dieldrin	I	124	45	36.29	
	0.03%	II	132	0	0.00	12.09
		III	78	0	0.00	
5	Dieldrin	I	97	11	11.34	
	0.0125%	II	140	19	13.57	15.79
		III	89	20	22.47	
6	Chlordane	I	219	70	31.96	
	0.0125%	II	79	29	36.71	28.11
		111	122	19	15.66	
7	Control -2	I	157	84	53.50	
		II	96	102	106.25	93.53
		III	38	46	120.84	
8	Control -1	1	124	91	73.39	
		11	43	79	160.47	125.08
		Ш	157	222	141.40	
9	B. H. C. (WP)	1	249	70	28.11	
	0.2%	II	83	172	207.23	155 82
		III	38	92	242 11	

Extra-floral Nectaries in Hevea brasiliensis

L. Thankamma1 and K. V. George2

Hevea brasiliensis is monoecious with diclinous flowers arranged in panicles. According to Dijkman (1951), the plants are typically entomophillous cross pollinators. The studies of Mass (19'9), Morris (1929), Seibert (1947), Muzik (1943), Warmke (1951), Sripathi Rao (1961) and Javarathnam (1965), also show that insects play an important role in the pollination of Heyea brasiliensis. Various characters of the flower, viz., colour, fragrance, sticky nature of the pollen and stigmatic surface, further point to insects as the most favourable pollinating agents. Considering that Hevea brasiliensis is predominantly adapted for insect pollination, that various insects including honey bees have been observed to be active and numerous during Hevea flowering season and that bee hives kept in rubber gardens during flowering season, yield plenty of honey, it is to be expected that nectar is secreted by some part of the

While no floral nectaries have been observed in Hevea brasiliensis, two types of extra-floral nectaries have been reported. Martius (1873) in his "Flora of Brazil" and Delpino (1887) in his studies on extra-floral nectaries, mention about the presence of nectaries on the foliage leaves, viz. the petiolar nectaries. The structural details of

these petiolar nectaries are described by Daguillan and Coupin (1903). Parkin (1904) in his paper. "The extra-floral nectaries of Hevea brasiliensis," reports the occurrence of nectariferous bud scales, in addition to the petiolar nectaries and gives an account of their structure, possible evolution and functions. Bobilioff (1923), in his "Anatomy of Hevea brasiliensis," while describing the structure of the petiole, mentions about the presence of a small disc with several glands on the petiole at the point of insertion of the leaflets and these are reported to function only in the young stage, when they give off excretory products. He also reports presence of special openings, viz., hydathodes, seen as pin holes, on the lower surface of the leaves and states that these are of assistance in getting rid of excess water, in a liquid form, at times when the stomata fail to function.

In the present paper, the authors have attempted to give a detailed account of the extra-floral nectaries already reported by earlier workers, viz., petiolar nectaries and nectariferous bud scales. Further, occurrence of another nectariferous structure is also reported. These are the glands on the lower surface of the leaves and wrongly defined by Bobilioff (1923) as hydathodes.

Research Assistant, Pathology Division, Rubber Research Institute of India, Kottayam-9, Kerala State.

Dy. Director (Pathology), Rubber Research Institute of India, Kottayam-9, Kerala State, (Present address: Director of Cardamom Development, Cardamom Board, Ernakulam)

Observations

Three different glandular structures, all foliar in origin, were observed to secrete a colourless, sticky and sugary liquid, viz., nectar. These are the nectariferous bud scales, nectariferous glands on the petiole tips and the nectariferous glands on the lower surface of the leaf lamina. The morphology, anatomy and functions of these glandular tissues, observed to secrete nectar, are described.

Nectariferous bud scales

In young shoots of Hevea, a varying number of small, green, fleshy scales are seen developing on the stem, towards the terminal bud, below the whorl of tender flush (Fig. 1). Normally, these scales subtend an axillary vegetative bud, but during flowering season, the top most scales may subtend inflorescences. In young actively growing shoot, the transition from these fleshy scales to normal leaves can be clearly seen (Fig. II). The lower most scales are short, roundish, gradually tapering to a pointed tip and highly curved outwards. The outer convex surface is slightly raised, pale, yellow, made of glandular tissue and with a longitudinal median groove. At the pointed tip a number of trichomes are present. Towards the terminal bud, the scales gradually become more elongated and straightened. The glandular portion shows gradual reduction in size and gets confined to the middle region of the outer convex surface. Simultaneously, the longitudinal groove gets less prominent and in the top most scales they are not visible. Along with the elongation of the scales and simultaneous reduction in the glandular tissue, three abortive leaflets appear at the tip of the scale as thin bristles. The upper most scales are devoid of the glandular tissue and they carry at their tips three leaflets which resemble the normal leaflets in shape and structure, but much reduced in size (Fig. II, 7-8). Few such scales resembling typical leaves except for their reduced size, may be seen just below the whorl of true leaves. These as well as the glandular scales below are shed as the true leaves mature.

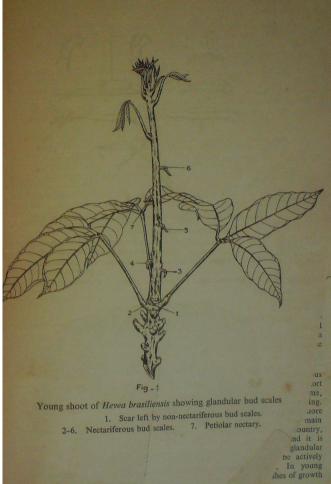
The glandular tissue on the lower fleshy scales secrete nectar profusely, during flowering season. The nectar secreted collects into small droplets which often coalesce and trickle down. The drops of nectar are large in the morning hours, slowly drying up in the sun.

A microscopic study of longitudinal sections of the glandular scales showed that they are fleshy structures, composed mostly of parenchymatous tissue and poorly developed vascular elements bounded by a cuticularised epidermal layer. The scale is bounded on all sides by normal epidermal cells, excepting the outer convex surface where the epidermal cells get modified into a glandular tissue, covered on the outside by thick cuticle. The glandular tissue is made up of thin-walled columnar or pappilose (shaped) cells and characterised by dense cytoplasm. Many of these cells are divided by tangential walls into two or sometimes three daughter cells. Due to pressure of nectar secreted by these glandular cells, the cuticle bursts. Just below the glandular tissue, a layer of compact isodiametric parenchymatous cells is noticed, beneath which normal parenchyma is seen. In the parenchymatous tissue, vascular traces are seen small branches of which end below the glandular region (Fig. III).

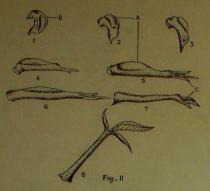
Apart from the nectariferous bud scales, a few basal scales, which are small, thin and non-nectariferous are also observed (Fig. I-1). These basal scales protect the dormant bud and as soon as the bud sprouts, they shrivel, dry up and fall off.

Nectariferous glands on petiole tips

At the distal end of the petiole, in the region of insertion of the leaflets, a varying number of glands one to seven—usually three—are noticed. These glands are circular to oval or even irregular in shape, with slightly raised margins. Quite often, two or more



2-6. Nectariferous bud scales.

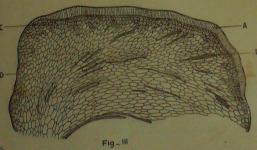


Nectariferous bud scales showing transition to foliage leaf 1-3. Highly curved lower bud scales.

4, 5, 6. Upper bud scales which are straightening out showing glandular area and highly reduced leaflets.

7 & 8. Upper most scales without glandular area and the leaflets more pronounced.

A-glandular area. B-median groove. C-reduced leaflets.



resemble ine no structure, but much

L. S. of nectariferous bud scale 7-8). Few such sca.

L. S. of nectariferous bud scale leaves except for their recretory epithelium consisting of modified epidermal cells. seen just below the who ular trace.

C. Chlorophyllated parenchyma.

D. Normal epidermis.

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ng irregular shapes (Fig. IV). The andular area is paler than the surrounding

In surface peelings, they appear as groups small, nonchlorophyllated cells. In ongitudinal section, the gland is seen to be ade up of a group of thin-walled columnar ells, nonchlorophyllated, rich in cytoplasnic contents, as seen in the case of the landular portion of the nectariferous cales. A cross-section of the petiole tip here the glands are situated, shows that he upper and lower epidermis are normal, went at the region of the glands, where he epidermal cells are modified to form the hin walled columnar cells. Many of these ells are divided by tangential walls forming wo or three daughter cells. Beneath this pithelial layer, a single layer of isodiameric, nonchlorophyllated, parenchymatous ells is noticed, beneath which normal arenchymatous tissue is observed. Small ranches of vascular traces arising from the entral vascular tissue are seen ending below he glandular layer (Fig. V). The indivilual glands are observed to secrete small rops of nectar which often run together orming bigger drops. These glands do not unction during the early stages of leaf ormation or long after the leaves have Ittained full maturity. The secretory funcion is predominant following refoliation when the leaves have turned green, fully xpanded and no more flaccid. Once the caves are fully matured, the glands become unctionless, the tissues shrivel and get discoloured.

Nectariferous glands on the lower surface of the leaf

These glands are seen as minute yellowish pots, numerous and irregularly distributed on the lower surface of the leaf. On micoscopic examination, in surface view, these are seen to be more or less circular in outne and slightly raised above the surroundng surface, the glandular area being omposed of small cells and delimited by a

of these glands are observed to unite attain-irregular shapes (Fig. IV) The the region of the gland, the leaf is slightly thick. The upper epidermis is normal. The depth of the palisade tissue is considerably reduced. Below this is seen a vascular trace, the end of which is towards the lower glandular portion. The region below is composed of compact parenchymatous cells, many of which are devoid of chloroplasts, in place of the normal chlorophyllated and loose spongy parenchyma. Below this, a compact layer of isodiametric cells, without this, is seen the glandular layer, composed of thin walled columnar cells, (devoid of ents. Some of these cells are divided by tangential walls into two cells. The lower surface of these cells is rounded and covered with a thick layer of cuticle (Fig. VII). The nectar secreted is seen as small droplets, suspended from the lower surface of the leaf, at the regions of the glands.

> A close similarity in the anatomy and functions of the three nectariferous glands described above is noticed. In all cases, the secretory epithelium consists of modified epidermal tissue in the form of thin walled, nonchlorophyllated and columnar cells, which by later tangential wall formation, forms two or three daughter cells in some cases. The glandular region is well supplied with vascular elements. Further, secretion of nectar has been observed in all the three

> In mature plants, these nectariferous glands normally function only for a short period, confined to the refoliation time, which significantly coincide with flowering. In Hevea brasiliensis refoliation and the more or less concurrent occurrence of the main flowering, normally occurs in this country. during January-March period and it is during this period, that these glandular tissues have been observed to be actively functioning, secreting nectar. In young rubber plants where several flushes of growth

are produced in an year unlike the mature trees, functional nectariferous bud scales and nectariferous petiolar glands are noticed with each new flush of growth, which after a certain period become functionless. It was however observed that the nectar secreted was considerably low compared to the quantities secreted by the nectariferous glands in mature trees during flowering season.

Discussion

Earlier workers have reported the occurrence of two kinds of extra-floral nectaries, viz., the nectariferous bud scales and the petiolar nectaries, in Hevea brasiliensis. In addition to giving a detailed account of the structure and functions of these two kinds of extra-floral nectaries, the authors report the occurrence of a third kind of extra-floral nectary, viz., the nectariferous glands found on the lower surface of the leaves. Describing the occurrence of hydathodes in Hevea brasiliensis, Bobilioff (1923) states: "On the lower side of leaves, besides the stomata, special openings are found whose function is analogous to that of the stomata. They may be seen as pinpoints on the lower side of the leaves. They arise as raised regions of the epidermis in which finally an intercellular opening is formed. The opening in the centre arises through the separation of cells and increases in size with the age of the leaf. Through this opening, the water exudes when transpiration through stomata does not take place." From the above description, it is clear that what Bobilioff has referred as hydathodes are the nectariferous foliar glands reported in this paper. Presence of one or more permanent openings is a characteristic of a hydathode. Though Bobilioff has reported the presence of such an opening arising by the separation of the cells, the authors could not observe any such opening in these foliar glands, even though leaves at varying stages of maturity were examined. Further, the secretion from these glands is a sweet and sticky liquid-nectar and not water as reported by Bobilioff. The absence of any opening. the presence of a secretory epithelium consisting of modified epidermal cells, simi to those noticed in the nectariferous be scales and petiolar nectaries, the compa parenchyma below the secretory epithelia and the sugary nature of the secretion, a all clear indications that what Bobilia described as hydathodes are really in hydathodes but nectariferous foliar gland.

Referring to the petiolar nectare Bobilioff (1923) states: "These glan apparently function in the young stage of the leaves. The openings arise through splitting of the epidermal cells of petiole." Contrary to the above observation, the authors could not find any opening in these petiolar glands, though several surglands at various stages of growth we examined. Further, these glands were no observed to function till the leaves we fully expanded and mature.

Parkin (1904) reports that the nectaries the foliage leaf are not prominent struct and that they do not differ as a rule colour from the surrounding surface. It present observations differ from the abovin that the petiolar glands are yellowis green in colour in contrast to the gree colour of the surrounding surface. The light colour of the glandular surface is due to the secretory epithelial layer.

Many entomophillous plants produc nectar, which attracts insects. Nectar secreted by specialised cells either on t floral parts or on other structures outside the flower. Definite and elaborate structure adapted to secretion of nectar, occur certain families e.g. Euphorbiaceae. Hevea brasiliensis, a plant typically adapt for insect pollination, the occurrence of the three kinds of extra-floral nectaries describe in the paper, could be considered as feature providing attraction to insect Parkin (1904) while describing the nectar ferous bud scales and its functions, states "The bud scale glands may be looked upo as attracting ants to keep off insec injurious to the developing foliage.

soon as the foliage leaves mature, their own nectaries become functional and the scale ones being no longer required, wither and drop off." Different types of ants have been observed by the authors feeding on the nectar from the bud scales of young plants. These may be keeping off insects injurious to the developing foliage. However, in the case of mature plants where refoliation and flowering are more or less simultaneous, it would appear that the extra-floral nectaries serve mainly a function of attracting insects, some of which at least aid in pollination. It has been observed that all the three kinds of nectaries function simultaneously during Hevea flowering season. The bud scale glands have been observed to continue secretion of nectar even when the petiolar glands have developed and are functioning. It has also been observed that the quantity of nectar secreted by all the three kinds of nectaries are considerably more during the flowering season compared to othe; seasons. Further, Jayarathnam (1965) observed Indian honey bees feeding on the secretion from the petiolar nectaries and Calliphorids were found to perch on the ventral side of the leaves, when not visiting flowers and they were also found to feed on the nectar.

Summary

A short review of two kinds of extra-floral nectaries of Hevea brasiliensis, reported by earlier workers is given. In addition to giving a detailed account of the structure and functions of the two kinds of extra-floral nectaries already reported, occurrence of a third kind of extra-floral nectary, viz., the nectariferous glands on the lower surface of the leaf, is also reported.

Nectariferous bud scales are a charactersite feature of the young expanding shoots and they are present on both young as well as mature plants. There is close similarity in the structure of the three kinds of nectaries. Each has a well defined secretory epithelium with a thick cuticle above. The secretory epithelium consists of modified epidermal cells, some of which may be two or three layered.

In young plants, these extra-floral nectaries could be looked upon as attracting ants to ward off insects injurious to the developing foliage, but those on mature trees, during flowering season, could be considered as providing attraction for insects for aiding in pollination.

Acknowledgment

The authors wish to express their gratefulness to Dr. K. T. Jacob, Director, Rubber Research Institute of India, for the kind encouragement given during the investigations.

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Studies on the Physiological Aspects of Rubber Production

Theoretical Considerations and Preliminary Observations

M. R. Sethuraj*

The normal physiological condition of a ober tree is disturbed as a result of tapp-Latex flow and subsequent rubber generation in the drainage area are two normal phenomena induced by tapping. is the yield from a tree per tap mainly pends on these two abnormal processes e study of the physiology of rubber production in Hevea brasiliensis would have to be centred round these wo factors.

In an analysis of the internal factors influencing yield, emphasis should be given to the processes leading to increase in the olume of latex produced per tapping and he dry rubber content. So it is obvious that the primary task of a physiologist is to ducidate the mechanisms involved in the atex flow and latex regeneration in the drainage area.

Though the yielding capacity of a tree is logy of the tree as a result of different methods of exploitation has a profound influence on the actual yield. It is needless to emphasise that the investigations on these aspects have great importance as that can build up a scientific basis for exploitation.

A short review of the work on the physiological aspects of latex formation and flow and a theoretical evaluation of the different iews held by various workers are given

Latex

The latex of Hevea is found in an anastomosing articulated latex vessel system in a series of concentric rings joined by frequent anastomoses, distributed in the phloem region.

Hevea latex is a hydrosol in which the dispersed particles are protected by a complex film made of protein and phospholipid. It contains more than one disperse phase. Frey-Wyssling30 identified a second type of yellow particles microscopically and named 'Frey Wyssling' particles. The yellow colour of these particles is due to carotenoid pigments. Later, presence of still another particle—'irregular shaped transparent islands with an irregular structure'-was reported by Homans and Van Gills33 which reported by Homans and 'val 'mistakingly were named 'lutoids,' by mistakingly were named 'particles to the walls and fixed relating these particles to the walls and fixed relating these particles to the walls and fixed relating these particles and fixed relating these particles are the particles and fixed relating the particles are the particles and fixed relating the particles and fixed relating the particles are the particl An alter fife possibility of the formation of some kind of matrix material by show colour.

By Verhaar87. Cook and Sekhar80 obtained four layers by centrifuging latex at 59,000 g, and more recently Moir51 using a fully refrigerated centrifugation technique obtained eleven resolvable zones, suggesting the presence of further particles.

The discovery of lutoids gave rise to speculation as to their origin and function. Schweizer" suggested that it originated from Sieve tubes. Ruinen and de Haan-Homans 72 and Ruinen78 refuted that hypothesis and demonstrated its presence in latex vessels.

^{*} Research Assistant, Agronomy Division, Rubber Research Institute of India, Kottayam-9, Kerala State.

Ruinen¹⁴ has also provided evidence for the occurrence of such particles in other latices as well. The function of lutoids had been considered to be that of a "polymerisation vessel" involved in final synthesis of rubber²⁶. Wiersum²⁶ however produced evidence to its vacuolar nature. Recent investigations show that the contents of lutoids are capable of destabilising rubber and bringing about coagulation. Recent conceptions about the function of lutoids are discussed elsewhere in this article.

Two principal theories were in vogue regarding the biological nature of latex and its relation to the latex vessel. The latex was considered by some investigators to be the discharged sap of a vacuolar system within the vessels (Schmidst75), and it has been assumed that the rubber particles are formed in the cytoplasm of the vessel before being ejected into the vacuole57,12. The alternate theory suggested first by Berthold17 and supported by Milanez49 regards latex as of cytoplasmic origin and not a vacuolar sap. Ample support for this theory comes from the reports of biochemical complexity of the latex^{50 3,47,48}. Electron microscopic observations have confirmed the cytoplasmic origin of latex2. However, it has to be stated that latex is a cytoplasm of an unusual specialised type2,81,

--- -- anular tapping

It seems likely that after research the cytoplasm remains concentrated at the wall but becomes more dilute and fluid towards the centre. Thus it can be expected that the outflow of latex would carry away large number of cytoplasmic particles from their reticular attachments²¹.

The locii of final biosynthesis of rubber and other particles are not known but the investigations so far, nevertheless suggest that it occurs within the cytoplasm, lining the latex vessel.

Latex flow
The mechanism of latex flow was studied
by Arisz⁴, and Frey-Wyssling³⁴ and the

latter attempted to give a mathematical expression to the principles governing latex flow. But it was soon evident that the flow rate does not follow any simple formula and is complicated by other factors. According to Frey-Wyssling, the initial part of the flow is the result of elastic contraction of the latex vessels and other tissues and the second part of the flow is of a capillary nature. A critical evaluation of the theories held by earlier workers was made by Riches and Gooding⁵⁰. They have shown that Frey-Wyssling's mathematical approach is inadequate and that further experimental work is warranted.

The mechanism of flow as explained by these earlier investigators34,70 can be summarised as follows: Latex vessels are filled with viscous latex under hydrostatic pressure. When the vessel is cut, the pressure at the location of the cut is released and the viscous latex exudes. This expulsion of latex would result in the displacement of latex along the length of the latex vessel owing to the strong forces of cohesion existing in the liquid phase. This would ultimately result in a fall of pressure in the latex vessels and consequently the water would pass from the surrounding tissue into the latex vessel under the influence of gradients of water activity. The dilution of latex, termed as 'dilution reaction' would make the latex less viscous resulting in enhanced flow rate. When the rate of flow decreases, the adjoining cells may amove water from the latex itself, thus increasing coasulation concentration to the point of coagulation so that the flow is stopped completely.

Except for the mechanism of cessation of flow, the ideas entertained by these pioneer workers about the process of latex flow are still valid. Recently, with the increasing knowledge regarding the complexity of latex and its physiology, attempts are being made to elucidate the flow ceasing mechanism.

Recent studies⁶¹ on the changes occurring at various points beneath the cut after tapping have indicated significant drop in turgor pressure, followed by dilution reaction in the immediate vicinity of the tapping cut. Data on the relationship between turgor pressure, changes in dilution and diffusion pressure deficit, at the earlier stages of flow confirm the postulated mechanism of flow. But it was soon evident that the applicability of this theory is limited to the earlier part of the flow only, as a few minutes after apping, other factors, such as the flow restricting process, starts operating.

By tapping, the turgor pressure suddenly falls to a low value but then increases gradually during flow, accompanied by a decline in dilution of latex. This indicates the possibility of involvement of some flow restricting process. Complete recovery of turgor and water status to the pre-tapping levels however, is attained only many hours after the cessation of flow. It appears that a complete recovery of turgor pressure by the time the flow stops, is delayed due to the water tension developed as a result of transpiration.

From the above studies it is evident that the effect of turgor pressure on flow is limited only to the earlier part and the later part is governed by the flow restricting processes. Even when the actual mechanism of this process was not known, the role of coagulation at the tapping cut during flow, in restricting the flow rate was generally Recent work62 however, indicated the formation of some barrier to the flow near the cut ends of the latex vessels. Opening the cut at fifteen minute intervals, six times during each tapping day resulted in increased total yield. The effect of this was ascribed to the delaying of the plugging at the cut ends of latex vessels. The flow rate measurements made after the first tapping and repeated tappings gave room to assume that the flow restricting mechanism begins to operate within a few minutes of tapping.

Optical and electron microscopic examinations confirmed presence of plugs of

coagulum in the vessels near their cut ends, as well as an external cap of coagulum on the surface of the tapping cutos. It was also observed that clumps of damaged lutoids are associated with the coagulum in the vessels. Southern⁸¹ has reported that many of the swollen vacuolar bodies seen in his preparations were big enough to block a latex vessel completely. It is assumed that the damaged and flocculated non-rubber 'bottom-fraction' particles which occur during flow contain lutoids that have suffered breakdown as a result of osmotic shock or shear thereby releasing destabilising substances to trigger of the formation of small flocs of rubber particles responsible for the blocking process of the flows. Normally only the latex samples from the initial flow contain a high proportion of the damaged bottom fraction particles. The possibilities suggested are that either the damage occurs mainly after the latex has left the tree or the initial flow rate is high enough to sweep the latex out of the vessels before flocculation occurs. During the later part of the flow, due to the slow flow rate, the flocs from the vessels accumulate near the cut ends and initiate the plugging Electron microscopy of the sections of latex vessels taken and fixed rapidly during the early stages of flow indicate the possibility of the formation of some kind of matrix material in the serum phase, to result in increased viscocity**.

On the basis of the indications so far obtained three hypotheses are proposed for the flow retardation mechanism⁶².

- 1. Collapse of latex vessels
- Coagulant released by cells exterior to latex vessels and its diffusion into latex vessel
- Aggregation or break down of lutoids by osmotic shock or shear, thereby releasing the coagulation factors to destabilise rubber.

Results obtained from the investigations designed to test the first hypothesis discount that possibility⁶⁵,²¹.

Obviously, there are many practical limitations for conducting experiments to test the second hypothesis. Schweizer17 suspected the origin of lutoids in the sieve tubes, actual demonstration of its presence in the latex vessels 72 eliminates. the possibility of any destabilising substances of the lutoids having their origin in sieve tubes. However, it is reported 1 in the case of squash plant, that phloem sap exudations from the cut end soon coagulate, thereby plugging the ends of vessels causing cessation of flow. By repeated cuttings the flow could be prolonged for 24 hours. This undoubtedly indicates the presence of some destablilising substances in the phloem sap. So the contention that coagulants released by cells exterior to latex vessels may also play a role in the flow restricting process, cannot be ruled out.

However, convincing proof in support of the third hypothesis is provided by the investigations carried out by the Chemistry Division of R. R. I. M.68 on the mechanism of destabilising system of the lutoid particles. The results indicate that the destabilising system is complex and that an enzyme system as well as electrostatic interactions between B-serum and C-serum play a part. Two enzymes involved are Phospholipase-D, which can digest the phospholipid moiety, and a protease. These enzymes together can destroy the protective coating of rubber and thus coagulation is effected. was also found that the lutoid contents can neutralise the electrostatic charge of anionic materials, on which the stability of rubber This provides an effective mechanism whereby the B-serum destabilises rubber dispersions. It is also assumed that an excess of C-serum can counteract the effect of B-serum as the proteins of C-serum are predominantly anionic. Most probably the electrostatic destabilisation precedes enzymic action. Fundamental studies on

the lutoid membranes and the factors which change its permeability properties causing it to burst in the latex vessel would ultimately unveil many unknown mechanisms governing the latex flow and stability. At least, the remote possibility of utilising such knowledge in increasing the flow rate and ultimately the yield has more than mere speculative value.

Drainage area

The bark area from which the latex flows towards the tapping cut during tapping is termed as drainage area.

Arisz®, Bobilioff12, Frey-Wyssling84 and Gooding85 have studied the effect of tapping on the dilution of latex in situ, contraction of trunk etc., and have given rough estimations of the area of the bark affected According to Frey-Wyssling, only a limited area, under the tapping cut spreading slightly to both sides from the extreme end; of the cut, functions as drainage area. Gooding⁸⁵, on the other hand, suggested that the bark area, covering 2' above the tapping cut also should be included. He has also recorded actual contraction of the trunk in the region below the cut using a sensitive dendrometer. Recent investigations" using radio-active techniques have established the flow of latex occurring from areas of bark, 40-50 cm above and below the tapping cut. In seedlings the flow area was found to be mainly below the cut.

Discrepancies in the results obtained by different investigators may be explained by assuming that drainage area would differ according to the yield of the tree. So different values would be obtained according to the material used for the study.

It is pertinent to state here that theoretically no limitation of flow area is possible as latex vessels form a continuous system throughout the tree. It is reported that when a tree is tapped for the first time or after a long period of rest, drop in pressure is transmitted throughout the tree²⁵.

Bloomfield^{19,20} has also provided indirect evidence that even the branches of the tree are affected as a result of tapping. He found that rubber of untapped trees is in a particular type of gel condition (microgel) and recorded a decrease in microgel latex at locations in the branches 30' distant from the cut after a period of tapping in the case of a high yielding tree. In the low-yielders the change in the latex property extended over a smaller area only.

This difference in the drainage area between low-yielders and high-yielders is an mportant aspect in the physiology of latex production. Gooding34 has also observed that the effect of tapping was not transmitted very far in a low yielding tree as in a high vielder. In day-to-day tapping the effect can be detected only in a limited area. It has to be assumed that either the techniques available are not sensitive enough to detect the effect at the sites, farther away from the cut, or the actual effect of day-to-day tapping is reflected only in a limited area near the cut. Evidently, the area of the bark in which the contraction of the trunk and greater dilution of latex are reported, represents the flow area wherefrom the maximum amount of latex is drained. So it follows that the detectable drainage area in day-today tapping would depend upon the volume of latex collected.

Schweizer78 coined the term "energy component" of the latex flow, for the flow of latex from the area wherefrom the maximum extraction of latex occurs. The latex regeneration is mainly confined to the latex vessels in this area. But a decrease in pressure, though slowly, would be extended far beyond this specific drainage area. Arisz⁶ introduced the terms "hydrostatic component" of the flow area for this phenomenon. This drop in pressure beyond the flow area spreads only very slowly and is not usually reflected in dayto-day tapping. Hence it may be assumed that no latex regeneration takes place in the

latex vessels beyond the actual drainage area.

Rubber biosynthesis and rubber regenerating capacity

From the foregoing considerations it is clear that the yield from a tree per tapping depends to a large extent on the factors governing flow. But equally important is the ability of the tree to regenerate the lost latex before the next tapping. The work on the biosynthesis of rubber have undoubtedly proved that the intermediate compounds of the respiratory pathway are the precursors of rubber biosynthesis. 1,54. It is beyond the scope of this article to review the work done on the biosynthetic pathways of rubber.

Efforts have been made to correlate the biochemical activity of latex related to the biosynthesis of rubber and the productivity. It was found that there is correlation between yield and rubber biosynthesis, glycolysis A.T.P. availability and the carboxylic cycle². Positive correlation between the biosynthetic output by latex, such as rate of conversion of labelled acetate to labelled rubber and the productivity were obtained by Auzac and Pujarniscle³.9. A close relationship between the availability of labile high energy P, the biosynthesis of rubber and the productivity of trees has also been demonstrated by Auzac³,11.

These observations have established the existence of an intimate relationship between rubber biosynthesis and the respiratory pathway. Under optimum intensities of tapping, utilisation of the intermediate compounds of the respiratory pathway for rubber formation, may not limit other vital processes of the plant. However, it can be assumed that the factors influencing the respiratory rate in the bark tissues would, to some extent, control the rubber biosynthesis also.

It appears that during flow, the tree looses not only rubber but also enzymes, co-factors and some of the specialised cytoplasmic bodies and the key to the control of yield may lie in the trees' ability to replenish such factors¹¹. So it follows, that the rate of enzyme synthesis and enzyme activity is of particular importance in determining the rubber regenerating capacity of the tree,

Some recent experiments⁶⁴ have indicated that the presence of bottom fraction enhances the conversion of acetate to rubber. But in the later stages of incorporation from isopentanyl pyrophosphate, lutoid contents exerted an inhibitory effect. Further evidence for the inhibition of rubber biosynthesis by the lutoid contents in vitro is provided by Pujerniscle and Rabaillier. Further work on the role of lutoids in the biosynthesis may reveal many aspects of rubber biosynthesis and its control.

Physiological effects of tapping

The aim of tapping is to cut open the latex vessels in the case of trees tapped for the first time or to remove the coagulum which blocks the cut end of the latex vessels in the case of trees under regular tapping.

History of scientific tapping begins with the work of Ridley⁷¹, Willis⁹² and Parkin⁸⁵, Later, important information was obtained from the work of de Jong⁸⁹ and Mass⁸⁵, Studies of Bobilioff¹², Frey-Wyssling⁸⁴ and later of Schweizer⁷⁷, ⁷⁸ however, provided a much better insight into the physiological basis of tapping.

When a tree is tapped for the first time, usually only a small amount of latex exudes. Each successive tapping produces more latex of lower rubber content until an equilibrium is reached. The following conclusions are drawn from the studies of Schweizer: The tapping dilutes the latex by the entrance of water from the surrounding tissues resulting in higher turgor pressure. d. r. c. decreases when tapping is continued until a certain balance is

reached between the loss and new formation of rubber. With heavier tapping the drainage area is extended, but the extraction from the area near the tapping cut is certainly greater.

In an untapped tree there is no movement of latex within the latex vessels. So the flow of latex induced by tapping is an abnormal phenomenon. Also, rubber biosynthesis in the latex vessels ceases after a certain level of rubber is formed. Following the loss of latex from the latex vessels, formation of rubber and other particles in latex is initiated. This is termed as the regeneration of latex.

The flow ceases a few hours after tapping due to the mechanisms explained earlier. The latex is drained from a limited area of the bark in the vicinity of the cut. The latex regenerated in this area would be less viscous and more dilute. A basic difference in the nature of this regenerated latex and the "original" latex in an untapped tree is given by Bloomfield. The drainage area and the rubber regenerating rate can be drastically altered by changing the tapping system and by adopting other methods of exploitation.

It is known that by increasing the tapping cut length, the drainage area and thus yield is increased. Mass¹⁶ investigated the yield ratio for various lengths of tapping cuts and has drawn the following conclusions.

- 1. Yield is not proportional to the total length of the tapping cut.
- An extension of the tapping cut results in an actual decrease in yield per unit length of the cut.
- An increase in tapping cut length gives better results with alternate daily tapping than with daily tapping.
- Shortage of the cut with high-yielding trees will have less effect on the production than with low-yielding trees.



Petiolar nectaries showing variation in size, shape and number

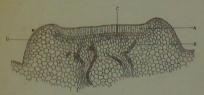


Fig-V

T. S. of petiole at the region of the nectary

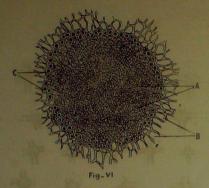
B. Vascular trace.

A. Secretory epithelium.

B. Vascular trace.

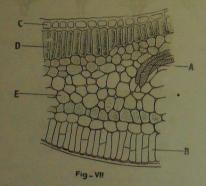
C. Chlorophyllated parenchyma.

D. Normal epidermis.



Surface view of a nectariferous foliar gland.

- A. Glandular cells. B. Normal epidermal cells.
- C. Lignified cells delimitting the glandular portion.



T. S. of leaf through a nectariferous foliar gland

- A. Normal upper epidermis. B. Vascular trace.
- C. Secretory epithelium consisting of modified lower epidermal cells.
- D. Palisade layer. E. Compact parenchyma.

Results from later investigations also ee with the above observations in general. e increase in the drainage area is not pportional to the length of the tapping This fact is more relevant in the case high-yielders on which the drainage area larger compared to low-yielders for the me length of cut. That explains why ger cut tapping systems perform better th lower frequency of tapping. While ngthening of the tapping cut extends the rainage area, increase in the frequency of pping brings about more effective drainage latex per unit area and such a system uld tax the tree more as the regenerating of latex may not be sufficient to replace latex that is lost. This would ultimately il to physiological disorders.

The fall in the d.r.c. is a good indican of the ability of the tree to stand a rticular tapping intensity. The most itable tapping system for a particular one is the one which maintains a proper ysiological balance between the loss of expertapping, drainage area and regeneting capacity of the trees. So physiolocath investigations on such aspects on different clones would be a guiding factor in evolving the best system of tapping.

As it is known that the drainage area is limited in extent, results from the double cut tapping systems are of physiological interest. Experiments conducted with two cuts either on the same side or opposite sides by many workers *18,88,78,78,18,48 have given varying results. But the highest extra roduction was always obtained when the distance between the two cuts was the reatest. Dijkman^{8,2} has reviewed the work in this aspect and has drawn the following mportant conclusions.

With two cuts, the total drainage area is atended and thus the production is increated,

The two cuts operate independently. his is shown by the fact that one cut may

get brown bast while the other cut may yield normally.

In high-yielders with a larger flow area, greater distance between the two cuts is necessary. The d. r. c. of latex from the upper panel is lower than that of the lower panel. Recently however, Tobins has reported a low d. r. c. content of the lower cut and a significant yield increase adopting s/2 d/2, (2×2 d/4) tapping system. But according to de Jong this system is no improvement over 2 s/2 d/4 system of tapping.

From these observations it is evident that provided the flow area of the two cuts do not interfere with each other, the two cuts are to be regarded as two independent cuts, and that total tapping intensities can be increased with less deliterious effect. But if the flow areas of the two cuts interfere with each other, it would result in excessive drainage of latex from certain areas of bark which might lead to physiological disorders.

A picture of the physiological effects of different tapping systems on different clones is far from complete. It is needless to emphasise that such studies would be most rewarding.

Yield stimulation

This review is not an attempt to cover all the investigations in this field, but rather examines the limited aspect of the physiology of yield stimulation. Even before 1930, scattered attempts have been made to induce increased yields by adopting various methods¹¹. Systematic research on yield stimulation was started in 1937 by Chapman¹⁴.

Compounds having auxin activity 41,74,15,90,91 as well as micro-nutrient elements 41,27,16,84 have been used as yield stimulants.

Consequent to the applications of yield stimulants the various primary effects reported are summarised below.

- 1. Associated with yield increase the d, r, c, is generally decreased 11,24,37.
- 2. Duration of flow is prolonged resulting in late dripping 41,24,37,70.
 - 3. The drainage area is extended²⁴, ⁹⁰, ³⁷, ⁷⁹.

It is generally reported that the d. r. c. of the latex after stimulation is decreased. However, Wiersum^{90,91} did not find any appreciable change in the d. r. c. and has suggested that the increased yield can be ascribed to an enhanced rubber regeneration rate. But the general trend of observations do suggest a decrease in the d. r. c. although the fall in d. r. c. is not as much, as would result from high intensity tapping. Recently, Allen and Rhines' have demonstrated with the aid of labelled compounds that neither the carbon atom of acetic acid chain in 2, 4-D nor the carboxyl carbon of 2, 4, 5-T participate directly in the synthesis of rubber, in Hevea. This however does not exclude the possibility of any indirect effect of these compounds on the biosynthesis.

On the other hand, it can be assumed, that with greater loss of latex per tapping as a result of stimulation, the trees' inherent ability to regenerate rubber is insufficient to replace the lost latex completely, resulting in a lower d. r. c. That this may be so is evident from the report that the drop in d. r. c. is more in the clones which respond well. With greater drainage of latex, the regeneration rate is insufficient to bring the d. r. c. level to pre-treatment values.

Larger drainage area in the stimulated trees^{41, 87} may result from the longer duration of flow. The fact that in high-yielders, even without any stimulation, the drainage area is comparatively greater, supports such a contention.

Wiersum has suggested that the viscocity of latex after stimulation may be reduced. But recent work using refined techniques

could not confirm this hypothesi Changes in latex viscocity were uncorrela with yield trends. But relaxation of restrictions to flow inside the latex vesselsone of the possible effects. But accordito de Jonge⁴² the number and size of t latex vessels are not affected. Boatmai could not find any difference between treated tree and control in the extent latex vessel collapse after tapping. So he a relaxation in the restrictions to flow cobe brought about by stimulation is far froclear.

Blackman18 has speculated that 2, 4, 5might operate by changing the plasticity the cell walls and thereby increasing t osmotic concentration in the latex vesse With a steeper pressure gradient thus de: loped, the initial surge of the latex may greater. But surprisingly, the acide measurements of the turgor pressure stimulated trees have recorded lower value. than that of the control trees61,25. appreciable change in the osmotic presch of the first latex samples during flow at obtained by Boatman21. But a cat increase in the osmotic concentration in the last sample of latex during flow was encountered in the stimulated trees. It is postulated that 2, 4, 5-T might promote either the inflow of solutes into the latex vessels after tapping or the release of solutes into the latex serum from the lutoids. Our knowledge in this field is so insufficient to make further comments on this matter.

It is interesting that despite greater dilution of latex, the turgor pressure is low in the yield stimulated tree⁸¹. While a more efficient flow restricting process operating at the cut end of the latex vessels in the uttreated tree contributes to the development of turgor pressure in the latex vessels, and enhanced flow rate of latex towards the cut in the stimulated trees may not facilitate any increase in the turgor pressure in the latex vessels, despite a greater dilution. Boatman³² has recorded a higher initial flow

during the period immediately after treatment and a larger duration of flow without any higher initial flow, a few days after stimulation, and he has suggested that two distinct mechanisms may be involved. But it is doubtful if the results are sufficient proof in support of that contention.

A few workers have turned their attention on the changes in the mineral content of latex as a result of yield stimulation. Regular but slight increase in the K content and a greater increase in the P content were reported both with stimulex and CuSO4 treatments. A general increase in the Cu content is also reported. Correlations between increases in Cu content and yield have also been obtained.

High negative correlation between response and the K content of latex before stimulation and a positive correlation between response and Mg/PO_c ratios before stimulation are reported. Clones with low Cu and high Mg are reported to respond better.

So it appears that K, P and Cu contents of latex may increase after the application of yield stimulants and that the clones with low content of these elements respond better to stimulants. High content of Mg in latex and a high Mg/PO, ratio is reported to be associated with frequent premature coagulation and coagulation at the tapping cut16. If relationship between the flow rate and the tendency of latex to precoagulate at the tapping cut, is recognised, then it follows, that latices with factors inducing a shorter duration of flow may respond well to yield stimulation. But, as many factors may operate side by side, undue emphasis should not be given to any one factor alone.

Our knowledge is imperfect as to how the mineral balance in latex is changed as a result of stimulation. More imperfect is our knowledge regarding the role a high content of K and Cu plays in the mechanism of yield stimulation. Two aspects which

are worthwhile to study are the effects of stimulants on the membrane permeability and the possible role of the mineral elements on the lutoid stability.

In spite of the above investigations, growth of our knowledge regarding the mechanism of yield stimulation was rather slow. Professor Blackman¹⁹ has speculated many possible mechanisms on theoretical grounds. Recently Boatman¹¹ has tried to explore the mechanism involved and has obtained valuable information.

It is clearly shown that in normal trees the flow may be severely restricted within minutes after tapping, by some flow restricting processes occurring at the cut ends of the latex vessels. With repeated cuts ten and twenty minutes after tapping this restriction could be removed, resulting in higher rate of flow. In 2, 4, 5-T treated trees, the effect of repeated cuts was not pronounced in the flow rate, presumably because stimulation treatment, by some mechanism, might have delayed the flow restricting processes. In other words, the flow restricting processes in the yield stimulated tree were less efficient. information is of immense interest and importance. The rapidity with which the flow rate decreases within minutes after the first tapping and even after the repeated tappings does not suggest any involvement of bacterial action as Taysum82 has suggested. Moreover, reports that growth regulators tend to cause an increase in the bacterial population52,83 discounts the possibility of bacterial action in the flow ceasing

Although it can now be accepted that yield stimulating substances might exert their influence by delaying the flow restricting processes, the actual mechanism by which this is effected is not clear. Chua³⁶ has suggested that the greater dilution in stimulated trees during early flow, by reducing the viscocity, enables a greater rate of flow to sweep the flocculating material

out of the tree, thus delaying the sealing process. But evidence for a lowering of viscocity is lacking and considering the prolonged duration of flow, there is little difference in dilution during flow in the treated tree as compared to control. Apart from this, inhibition of flow restricting process itself may result in an enhanced flow rate. C-Serum is reported to exert a counteracting effect on B-serum and the possibility of yield stimulants exerting their influence via enhancing this property of C-serum is should be considered. At present, one has to be content with the fact that the mechanisms involved are complex and further work is necessary to understand this phenomenon.

Brown bast

Despite many approaches that have been made into the cause and effect of brown bast, we have a long way to go before we understand the complex sequence of events that culminate in the syndrome. Rands⁴⁰ has made histological studies on brown bast and considered it as a physiological reaction to being tapped. Rhodes⁶⁰ has also related this phenomenon to the trees' reaction of wound healing.

Much confusion has crept into this field of research mainly due to lack of discriminative description of the nature of physiological disorder being investigated. Compagnon, Tixier and Roujansky. have classified the various forms of physiological disorders commonly considered as 'brownbast' into five classes.

- B₁—Abnormal colour of the cut, brown spots and cracks in the bark with eventual necrosis and stoppage of flow.
- B₂—Partial dryness without brown colour or necrosis.
- B.—Deformation on the panel.
- B.—Coagulation of latex on the tapping cut with no flow of latex.
- B_s—Total dryness without brown colour, or necrosis.

Usually, the actual onset of brown bast is preceded by an excessive dilution of the latex with late dripping. Whether this is a general rule for all the above classes of brown bast is doubtful. It has been noticed that certain trees go dry with no earlier late dripping.

It is possible that, certain contradictory results obtained by different workers may be due to the fact that they might have been dealing with different types of brown bast.

Probably due to the practical difficulties in studying the progressive stages of brown bast, most of the investigators have preferred to confine their study on the effect of brown bast. Schweizer77 associated brown bast with lack of organic reserves while Beaufils 16 considered mineral metabolism to be the causative factor. In support of his view, Schweizer induced conditions similar to brown bast by ringbarking above the tapping cut followed by intensive tapping. This cannot be considered as direct evidence for his view, as the physiological exhaustion and the abnormal metabolism forced upon the tree with such treatments need not be the same as those which predisposes brown bast under normal conditions. this, the results of recent work stand against this contention as no evidence of starch depletion in the bark or lowered sugar content in latex during the onset of dryness could be obtained 16,65. The dry bark contained almost the same amount of total soluble sugars as that in the normal barkes.

Efforts to correlate mineral content with the brown bast incidence have not so far yielded any convincing results. However, a significant inverse correlation was obtained by Beaufils¹⁸ between the K₊O/CaO ratio in leaves and the percentage of brown bast (coagulation at the tapping cut). Incidence of such conditions could be reduced by potash fertilizers. He has also recorded a higher Mg/P ratio in latex in the susceptible clones (Avros 308 and G11) compared to resistant clones (PR 107). It is assumed

that the above mentioned tapping accidents (coagulation at the tapping cut) is an extreme case of latex instability and in this respect, Mg could be a determining factor. It has also been observed recently that conditions similar to brown bast, induced hy surgical treatments resulted in very low flow rate of dilute latex containing damaged bottom fraction particles and it is suggested that such extreme rate of flocculation deep in the latex vessels may impede the flow, eventually inducing dryness26. Role of divalent cations in promoting the distabilising effect of lutoids is also knownes. In the majority of cases of brown bast, however, a low d. r. c. of latex with late dripping, precedes the onset of dryness. Dilution of latex can cause osmotic shock to the lutoid particles causing it to swell and burst. But the mechanism by which a reduction in the rubber content is caused is far from clear. None of the above factors reported can be considered respon-

It is reported77 that by drastic tapping, the phospholipid complex and K percentage increase with a simultaneous reduction in the protein complex and Ca content. A marked positive correlation between the stability of latex and potassium content has been obtained 80. A high content of K in the latex of brown bast affected trees is also reported. On the other hand, a high Mg content of latex is reported to be associated with precoagulating tendency of latex at the tapping cut18. So, theoretically it can be speculated that the reported brown bast conditions with high Mg content and coagulation at the tapping cut may well be distinct from the conditions of brown bast reported to be associated with a high K content. Some clonal variations in the nature of brown bast symptoms is also reported 29. On the other hand, results from recent work in Malaya do not indicate any relationship between brown bast incidence and soil type or soil and tree nutrient status ".

Some biochemical studies have indicated some difference in the organic acid content of the bark in which dryness was induced by ring barking28 But the value of such information collected from trees in which dryness was artificially induced, in elucidating the mechanisms of brown bast would certainly be limited. With increasing awareness of the fact that causes of different types of physiological disorders usually grouped under the term brown bast may be diverse, it is worth taking the laborious course of keeping case histories of each tree with different stages of brown bast and study the possible causes and the physiological and biochemical changes occurring in the tree.

It is well known that more frequent tappings with shorter cut is physiologically less favourable for the tree than less frequent tappings with a longer cut, but with the same intensity of tapping. Induction of brown bast by tapping several times per day is reported by Schweizer80. On the other hand, in a recent experiment in Malayaer with intensive tapping (covering the total number of tapping equivalent to four years in three months time) no complete drying was encountered. However, they recognise that a reduction in tapping intensity often alleviates the incidence. Using different tapping systems, it was confirmed that lengthening the cut had comparatively less effect than increasing the frequency. The explanation given by Schweizer" that a short cut has a smaller area of flow and that by increasing the frequency of tapping, the balance between the length of the cut, flow area and latex regeneration is upset, is physiologically sound. With a longer cut the drainage area is extended and the drain of latex from unit area may be within the limits the tree can stand.

It is suggested that too frequent tapping leads to loss of enzymes affecting the metabolic efficiency of the tissues. In this respect, it is interesting to note that a low

percentage of protein was recorded in dry bark than in normal bark®. It has also been observed that the latex of brown bast affected trees (partial dryness with late dripping) contains compared to the latex amount of carotene compared to the latex from the normal tree®. These observations suggest a general weakness of the biosynthetic activity in the affected latex vessels.

Preliminary studies conducted at the Rubber Research Institute of India

While the rubber biosynthetic efficiency of a tree is mainly a genetic factor, the flow of latex is a physiological response. Although studies on the latex flow began more than three decades ago, our knowledge on the factors controlling the flow is still incomplete. But the increasing awareness of the involvement of a flow restricting process has introduced a new concept in the latex flow physiology. The basis of the present work is this new concept. Studies envisaged include the evaluation of the influence of this flow restricting process on yield and the factors affecting the efficiency of this process.

The first phase of the programme consisted in conducting preliminary investigations on the relationship between the flow pattern and yield of high and low yielding trees of different clones. Effect of wintering on the flow pattern was also studied in a few clones. Studies were also extended to the flow pattern of the brown bast affected trees (late dripping and partial drying).

Only a few observations of interest are reported in this communication.

I. Relationship between the flow pattern and yield

The rate of flow at different intervals after tapping was recorded and graphs of flow rate against time after tapping were plotted to illustrate the flow pattern. The rate of flow was estimated by counting the number of drops per 30 seconds. Although

the rate of flow of two different trees for a given moment could not be strictly compared by this method, to compare the trend of flow, this method was found to be quite satisfactory.

It was observed that the duration of flow is not always related to the initial rate of flow and that the yield depends more on the total flow pattern of latex rather than on the initial flow rate. (Figs. 1a, 1b, and 1c).

It has already been demonstrated that the effect of turgor pressure is limited to the initial flow only. Boatman has demonstrated that the yield of latex can be remarkably enhanced by removing the restrictions on flow occurring at the cut end of the latex vessels. By examining the flow pattern of different trees, it appears that with an increased rate of flow restricting activities inside the latex vessels the rate of flow falls steeply and the stoppage of flow is hastened. The present results give further emphasis to the importance of such factors in limiting the latex flow and thus yield.

2. Effect of wintering on the flow pattern

Effect of wintering on different clones was studied by the Botany Division of R. R. I. I. The clone LCB 1320, which was found to be affected only slightly and RRII 5 which was affected significantly, were chosen for the study. The flow patterns of LCB 1320 before and after wintering did not show any marked variation (Fig-3b). On the other hand, the steep fall in yield in the RRII 5 (clone under trial) trees was also reflected in the flow pattern (Fig-3a), with much shorter duration and a steep fall in the flow rate. Possibly, the flow restricting processes became more efficient in this clone during wintering. Further explanations should await the result of further study.

3. Flow pattern of brown bast affected trees (late dripping and partial drying)

Two brown bast affected trees belonging to different clones (H. P. clone-7 and H. P.

clone 226; clones under trial in RRII) were chosen to study the flow pattern and was compared with that of the normal trees of the same clones.

It was found that the flow rate in these trees, after the initial fall, remained almost constant for a considerable time, while in the normal trees there was gradual decrease in the flow rate. The flow curves obtained are suggestive of a less efficient flow restricting mechanism in the brown bast affected trees (Figs. 4a and 4b). Besides this, during routine examinations of the flow pattern of four trees of RRIM 501, a few days after the wintering period, it was observed that the duration of flow of one tree was comparatively longer and that the flow curve was not as steep as in the other the flow rate of this tree remained constant for a considerable time although the rate of flow was slow. Within a month of this observation, the tree showed signs of brown bast as manifested by partial dry patches in the tapping cut (Figs. 4c and 4d). This again confirms that during the early stages of brown bast, (late dripping stage) the flow restricting mechanism is in some way affected. However, it has to be stressed, that further work is necessary as the events that culminate in a brown bast condition is by no means simple. Caution in making any hypothesis is warranted as in the brown bast affected trees with coagulation at the tapping cut, the picture may be entirely

General discussion

From the investigations carried out here and elsewhere it is increasingly becoming evident that yield may, to some extent, be influenced by the flow restricting processes operating in the latex vessels. But our knowledge of the physiological and biochemical processes that culminate in the formation of barriers to flow is still enveloped in haze.

The mineral elements related to the stability of latex is also reported to have increased in trees with late dripping 16,2°. On the other hand a high Mg content which is usually associated with unstable latices has also been found to induce precoagulation in the tapping cut¹⁰. However, convincing proof for any relationship between the mineral balance in the latex and the flow pattern is still lacking.

Recent investigations have however provided evidence for the involvement of lutoid particles in cessation of flow63. The sequence of events that results in the formation of a barrier to flow is still not very clear. Especially, our knowledge regarding the factors influencing such a process is meagre. Enhancement of latex flow can be achieved by the application of yield stimulants and it has been suggested that this is brought about by delaying the operation of flow restricting processes 1. But the actual mechanism involved is not known. It is reported that the activity of the B-serum in latex in destabilising rubber dispersions would be damped out in an excess of C-serum. Metal ion content, pH and water content seem to have profound influence on the balance of activities of B-serum and C-serum, suggesting the possible influence of these factors on the efficiency with which the destabilisation of latex inside the vessels is effected. Dilution of latex as a result of tapping may cause the swelling and bursting of lutoids within the vessels. It is interesting that clonal variation in the extent of bottom fraction damage for the same osmotic decrement was observed sa. This differential sensitivity is tentatively ascribed to the differences in the surface structure of particles and the ion atmosphere or the availability of an effective lytic enzyme system. It is hoped, that this finding may lead to further elucidations of the factors controlling the picture of physiological and biochemical processes involved in the flow restricting process would come to light.

The present results indicate how far the flow retarding process would influence yield by controlling the flow rate. Once all the factors involved are known, it may be possible even to suggest methods of increasing flow. Exposition of the mechanism of yield stimulation may be a valuable tool in the study of latex flow physiology. Although Chapman²⁴ obtained indications of variations in hormone content in trees of divergent yield capacity, convincing evidence could not be obtained by later workers²⁵. Further studies on the role of natural hormones in the laticiforous tissue on latex production would certainly be interesting and rewarding as the presence of such substances in latex has already been established.

One important question that confronts us is, how much loss of latex a tree can stand without any physiological disorders. This would mainly depend on the trees' ability to regenerate latex at a rate that would compensate the loss before the next tapping. As there is relationship between the respiratory pathway and biosynthetic pathway of rubber the question of availability of the intermediate compounds of the respiratory pathway in the site of rubber biosynthesis and the factors controlling it should be examined. As the latex flow can be controlled by adopting different methods of exploitation, a better knowledge of the biosynthetic capacity is most essential. Once our knowledge on this field is developed, that may provide a scientific basis for evolving suitable methods of exploitation by which maximum yield without any deliterious effect on the physiological condition of the tree can be obtained. Studies on the cause and effect of brown bast might provide valuable information in understanding the physiology of rubber

As yet, we do not know of any device in the latex vessels capable of maintaining the balance between latex flow and latex regeneration. In this respect, it is interesting to note, that function of the contents of lutoids is related both to the flow restricting processes. and to the inhibition of rubber biosynthesis. ••

Our knowledge of the physiology of latex formation and flow is still clouded with confusion; but what shines through is exciting.

Acknowledgment

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NEWS AND NOTES

The Fifty Eighth Meeting of the Rubber Board

The fifty eighth meeting of the Rubber Board was held on the 21st December, 1967, at the office of the Board under the presidentship of Shri P. S. Habeeb Mohamed, Chairman. Eleven members attended the meeting.

The late Mr. Kershaw

The Chairman welcomed the members, and before proceeding to the day's programme, paid a tribute to Mr. K. L. Kershaw, who died in London on the 21st October, 1967. Mr. Kershaw was a member of the Board and had taken active interest in its affairs. Being the first man to think of the idea of introducing aerial spraying in rubber and popularising it, he was generally known as the "father of aerial spraying." His services had been of considerable assistance to the Board.

The assembly stood up in silence for two minutes to pay homage to the departed soul and passed a resolution placing on record the Board's deep sense of sorrow on the sad demise of Mr. Kershaw and acknowledging his services.

Rubber price

In his opening remarks the Chairman said that the meeting had to be called at short notice because the planting public had been considerably agitated over the non-receipt of the notified price for rubber. There was considerable pressure that the Board should take some initiative in the matter and see that something was done so that the producers got at least the price notified by the

Government. The Chairman said that he would like to place on record the Board's appreciation of the services rendered by the members who had demitted office and hoped that if not all, at least some of them might come again on the Board when it was reconstituted. (The full text of the Chairman's address is published elsewhere in this Bulletin).

The meeting then took up the items in the agenda for discussion. Some of the most important decisions taken by the Board are detailed below.

Rubber market

The Board resolved to recommend to the Government that an agency under the Government or the Rubber Board may be entrusted with the regulation of market mechanism in rubber. The Government was requested to approve the scheme submitted by the Board for purchasing 6,000 tonnes of rubber. The Government was also requested to approve for immediate implementation the scheme submitted by the Board for grant of additional working capital loans to co-operative rubber marketing societies.

Rubber position

The Board resolved to recommend to the Government that there should be no import during the period up to March 31, 1968 and also during the period 1968-69, since the production of all rubbers in the country coupled with an estimated import of 5,000 tonnes of rubber through export incentive scheme and the additional rubber that would

be available from areas newly put under to meet the entire requirements of the indutapping during 1968-69 would be sufficient stry.

Third Technical Seminar by IRMRA

A three-day technical seminar, organised by the Indian Rubber Manufacturers Research Association, was inaugurated in Bombay on the 11th December, 1967. An outstanding feature of this seminar was the presentation of papers by the foreign delegates from the U. S. A, the U. K. and Germany. The seminar may be said to have helped accelerate the tempo of research activities by bringing together the Indian scientists and technologists conducting research in different parts of India and thus providing them with an opportunity to present their work on rubber and other raw

Mr. J. Vyoral, president of the IRMRA and managing director of Bata-India, inaugurated the seminar. In his inaugural address Mr. Vyoral appealed to the rubber manufacturers to face the present difficulties in a spirit of challenge.

Mr. L. M. Jamnadas, chairman of the reception committee of the seminar, while welcoming the president and delegates traced the growth of the industry.

Dr. K. N. Modak, joint secretary of the committee and Mr. K. M. Philip also spoke. Mr. V. C. Nanavati, vice-chairman of the reception committee proposed a vote

The seminar was held in five sessions and in all 20 papers were read, excluding the papers presented by the foreign delegates.

One hundred and seventy one delegates, including eight delegates from the UK, the USA, Germany and Cevlon attended the seminar. Dr. John Jacob, Assistant Rubber Chemist, represented the Rubber Board at the seminar.

Visit of Dr. B. P. Pal

Dr. B. P. Pal, Director General of the Indian Council of Agricultural Research, along with Shri K. P. A. Menon, Secretary, and Dr. Joshi, Deputy Director, I. C. A. R., visited the Rubber Board and the Rubber Research Institute of India on the 20th January, 1968.

Addressing the research personnel of the R. R. I. I and the officers of the Rubber Board, Dr. Pal said that the duties and responsibilities of research scientists in India had increased considerably since the attainment of independence and that the

alround progress of the country was related to the success of the scientific research activities in various fields. He wanted the research councils and research scientists to be given more freedom and more powers so that research programmes could be taken up and executed with the least possible

Shri V. K. Bhaskaran Nair, Deputy Director, RRII, welcomed Dr. Pal and other guests. They were taken round the various research divisions of the Institute and the work done at each division was explained to



Dr. B. P. Pal addressing the gathering. Shri V. K. Bhaskaran Nair, Dr. Joshi and Shri K. P. A. Menon are also seen in the picture.

Better Scope for Indian Natural Rubber Industry

-B. C. Sekhar

From the point of view Malaysian natural rubber industry, the Indian natural rubber industry had got better scope than the synthetic rubber industry, observed Shri B. C. Sekhar, Director, Rubber Research Institute of Malaya, while addressing the officers and staff of the Rubber Board on the 17th January, 1968.

Shri Sekhar said that most of the rubber produced was consumed by the developed nations. The world demand for rubber was going up and in the total world demand for rubber, natural rubber had a definite place. The developed nations of the west were sympathetic to the countries of the East. They recognized that without natural rubber the wheels of industry would not run.

Shri Sekhar dealt with the competitive position of natural rubber and said that it could not be replaced from many uses. He said that the rubber price situation had caused serious concern in the world market and hoped that it would improve in the near future as the economic situation improved.

Shri Sekhar said that he was optimistic about the future of natural rubber in India and he complimented the Rubber Board for its efforts to increase production to meet the requirements of the country. He said that India and Malaysia could usefully cooperate in the field of rubber research with mutual advantage.

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, welcomed Shri Sekhar.



Shri B. C. Sekhar speaking to the officers of the Rubber Board. Shri P. S. Habeeb Mohamed and Shri Chacko A. Kallivayalil are also seen.

Nominations to the Rubber Board

The Government of India have nominated the following persons as members of the Rubber Board for a period of three years from the 22nd February, 1968.

- (1) Shri T. V. Swaminathan, Additional Secretary, Agriculture Department, Government of Kerala, Trivandrum.
- (2) Shri S. Ananthakrishnan, Managing Director, Plantation Corporation of Kerala Ltd., Kottayam.
- Shri T. Jayadev, Chief Conservator of Forests, Madras.
- (4) Shri K. M. Chandy, Kizhakkeyil, Palai.

- (5) Shri T. O. Abdulla, Tharakandathil, Thottackattukara, Alwaye.
- (6) Shri Joseph Mankara, Vice—President Thadikadavu Panchayat, Chepparapadavu, Cannanore Dist.
- (7) Shri A. T. Mathyoo, Secretary, Association of Rubber Manufacturers in India, 57—B Free School Street, Calcutta—16.
- (8) Shri K. M. Philip, C/o. Madras Rubber Factory Ltd., Jeevan Udyog, Dr. D. N. Road, Bombay.

- (9) Shri C. H. S. London, C/o. Harrisons & Crosfield, Ltd., Quilon.
- (10) Dr. A. Seetharamayya, Senior Industrial Advisor, Directorate General of Technical Development, Udyog Bhavan, New Delhi,
- (11) Shri M. M. George, Omanapuram Estate, Kulasekharam, Kanyakumari Dist,

- (12) Shri Michael Kallivayalil, Mundakayam.
- (13) Shri Joseph Jacob, Advocate, Kozhikode—1.
- (14) Shri K. T. Thomas, Managing Director, Manaloor Rubber Company, Kozhikode—1.

Ceiling Price a Disincentive

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, expressed his doubts about achieving the Fourth Plan target for bringing 85,000 acres more under rubber as the rigid imposition of the maximum price for natural rubber was a disincentive to the producers. He was speaking to newsmen at a Meet the Press programme arranged by the Press Club of Trivandrum on the 17th March, 1968.

Shri Habeeb Mohamed said that the bulk of the proposed additional acreage was to be found in Kerala and the balance in Madras, Mysore and Andamans. But such factors as the cost of land and the competing claims of eash crops on the limited land available in Kerala had not been taken into account in assessing the cost of production for fixing the maximum price. He feared that the rigid ceiling price might also affect the working of the 20 rubber marketing societies.



Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, speaking to newsmen at the Trivandrum Press Club

Increase in Rubber Production

Addressing a press conference at Calicut on the 8th May. 1968, Shri Habeeb Mohamed, Chairman, Rubber Board, said that production of natural rubber in the country had almost doubled during the past five years. Production in 1957-68 was 64,500 tonnes as against 32,000 tonnes five years back.

Shri Habeeb Mohamed said that the Rubber Board had recommended to the Union Government not to allow any import of rubber during 1968-69. He said that this year they were in a position to meet the internal demand in full.

The Chairman said that the cost of rubber production was increasing and the smaller cultivators who were enthusiastic about rubber cultivation might turn to production of other crops. He said that there was no alternative to an incentive price for rubber for the continued progress and expansion of the rubber plantation industry.

Rubber Board News

Dr. K. T. Jacob

The Government of India have appointed Dr. K. T. Jacob, Director of Research and Rubber Production Commissioner, Rubber Board, as Chairman of the Cardamom Board, Ernakulam. He will also be Chair-



man of the Cashew Export Promotion Council and the Spices Export Promotion Council, Ernakulam.

Dr. Jacob joined the Rubber Board as Director of Research in May, 1964. Before coming to the Board, he was the Director of the Jute Agricultural Research Institute in West Bengal from 1960—4.

As the first Director of the Rubber Research Institute of India, Dr. Jacob has been responsible for organising the various research divisions and for drawing up a programme of research to benefit the rubber plantation industry in the country. He has also been the member—secretary of the Smallholdings Economics Enquiry Committee constituted by the Government of India in 1967 to enquire into the economics of smallholdings and to suggest measures to improve their efficiency.

Shri A. K. Rajapadmanabhan

Shri A. K. Rajapadmanabhan, Development Officer, Rubber Board, left the service of the Board in January, 1968, to join the CIBA of India, Ltd., as Chief Executive.



Shri Rajapadmanabhan first joined the service of the Rubber Board in 1960 as Deputy Rubber Production Commissioner and in 1966 he was appointed Development Officer. During his tenure he had contributed much for the success of the various development schemes of the Board.

Appointments and promotions

Shri P. P. Cherian, Deputy Rubber Production Commissioner, has been appointed Development Officer of the Rubber Board in the vacancy caused by the resignation of Shri A. K. Rajapadmanabhan.

Shri R. Thankappan Pillai, Assistant Development Officer, has been appointed Deputy Rubber Production Commissioner vice Shri P, P. Cherian. Shri K. M. Joseph, Officer on Special Duty, Research—cum—Development Station, Andamans, has been promoted and posted as Officer on Special Duty in charge of the rubber plantation project to be started by the Ministry of Rehabilitation, Government of India, in the Katchal Island of the Andaman and Nicobar group.

Shri M. G. Jagadish Das, Deputy Rubber Production Commissioner, has been promoted and posted as Officer on Special Duty, Research—cum—Development Station, Andamans vice Shri K. M. Joseph.

Shri P. Mukundan Menon, Deputy Development Officer, has been promoted and posted as Deputy Rubber Production Commissioner vice Shri Jagadish Das.

Shri V. Haridasan, Market Intelligence Officer, has been appointed Economic Research Officer. Shri J. I. Chandy, Superrintendent, has been promoted and appointed as Cess Collection Officer.

Sri. P. N. Radhakrishna Pillay, Research Assistant, has been appointed as Mycologist, Rubber Research Institute of India.

Shri C. Jacob, Deputy Registrar of Cooperative Societies, Government of Kerala, has been appointed as Officer on Special Duty (Co-operation) in the Rubber Board.

Shri C. M. George, Assistant Soil Chemist, has been appointed as Agronomy Expert (Rubber Production) under the UNESCO, with his headquarters in the Philippines. Shri George left India to join his new post, on the 11th January, 1968.

Hosdurg Seminar

Under the joint auspices of the Rubber Board and the Hosdurg Taluk Rubber Planters' Co-operative Society a one day seminar of rubber growers was held at Chittarikkal on 3rd February, 1968. Discussions at the seminar were led by technical experts of the Rubber Board. Over 200 rubber growers had participated in the seminar.



Shri T. V. Joseph, Secretary, Rubber Board, addressed the concluding session of the seminar as chief guest.

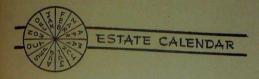
Shri T. V. Joseph speaking at the concluding session of the Rubber Growers' Seminar at Chittarikkal.

Kalloorkad Smoke House

Shri P. S. Habeeb Mohamed, Chairman, Rubber Board, inaugurated the smoke house built by the Kalloorkad Service Cooperative Bank with the aid of the Rubber Board, on the 20th April, 1968.



Shri P. S. Habeeb Mohamed inaugurating the Kalloorkad Smoke House by lighting a bhadradeepam.



For Rubber Growers

January

In the northern regions wintering may commence. This is the time when annual tapping rest is to be adopted and the panels protected with prowax or rubber kote-prowax mixture. Felling and clearing for newplanting or replanting is done at this time. This is also the time to start collection of Purearia seeds.

February

Wintering spreads effectively in most of the areas. The trees wintered earlier will start to refoliate. This is the time when sulphur dusting against powdery mildew has to be commenced. Many of the estates are allowed to enjoy tapping rest. Marking for the next season tapping can be done. Preparation of the land for planting is continued. Collection of cover crop seeds can also be continued.

March

Tapping rest can be discontinued and tapping commenced. Young areas are opened for tapping. Sulphur dusting rounds against powdery mildew is to be continued. Weeding is done in immature areas. Manuring can be started. In nurseries budding is done. Towards the end of the month spraying of fungicides against abnormal leaf-fall is started in large estates. In areas where planting has to be done, terracing, lining, pitting etc. should be done. Stimulants may be applied on trees 20 or more years old.

April

Weeding and manuring are continued. Spraying against leaf-fall also is continued. Budding in nursery and field is carried on. Preparation of land for planting is continued. The natural undergrowth is slashed. Dead woods are removed from the garden.

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Spraying is continued. Treatment to prevent pink disease is done. Budding can be continued if necessary. Slashing of undergrowth is carried on. Sowing of cover crop seeds can be commenced.

June

New flushes of young plants have to be given spraying. Nurseries are to be sprayed. The pits are filled and planting started. The tapping panels are disinfected with fungicides and water proofing with prowax or wax rex treseal done. If needed, the beds for sowing seeds can be prepared. Cover crop seeds are sown or cuttings planted.

July

New flushes in nursery and young plants are sprayed. Planting is continued. If trees are tapped during this month panel protection should be given. Seed collection is done if available.

August

New flushes in nursery and young plants, in regions where shoot rot is prevalent, are sprayed. Treatment against pink disease is done. Seed collection is continued. Panel protection is given in areas where tapping is done. Rubber seeds are sown.

September

This is the time for weeding and manuring. Sowing of seeds can be continued. Repeated inspection and treatment of pink disease should be done. Young rubber buddings planted out during June-July should be given shade. Yield stimulants may be applied on trees 20 or more years old.

October

Weeding and manuring may be continued. Dead woods should be removed. Tapping panel should be given protective treatments.

November

Mulching should be done in nurseries and round young plants. Young plants should be guarded against sun-scorch. Stems of young plants 2-7 years old and of older plants should be lime-washed if exposed to sun.

December

Lime-washing and mulching is continued if found necessary. Calopogonium seeds are collected during this month.

