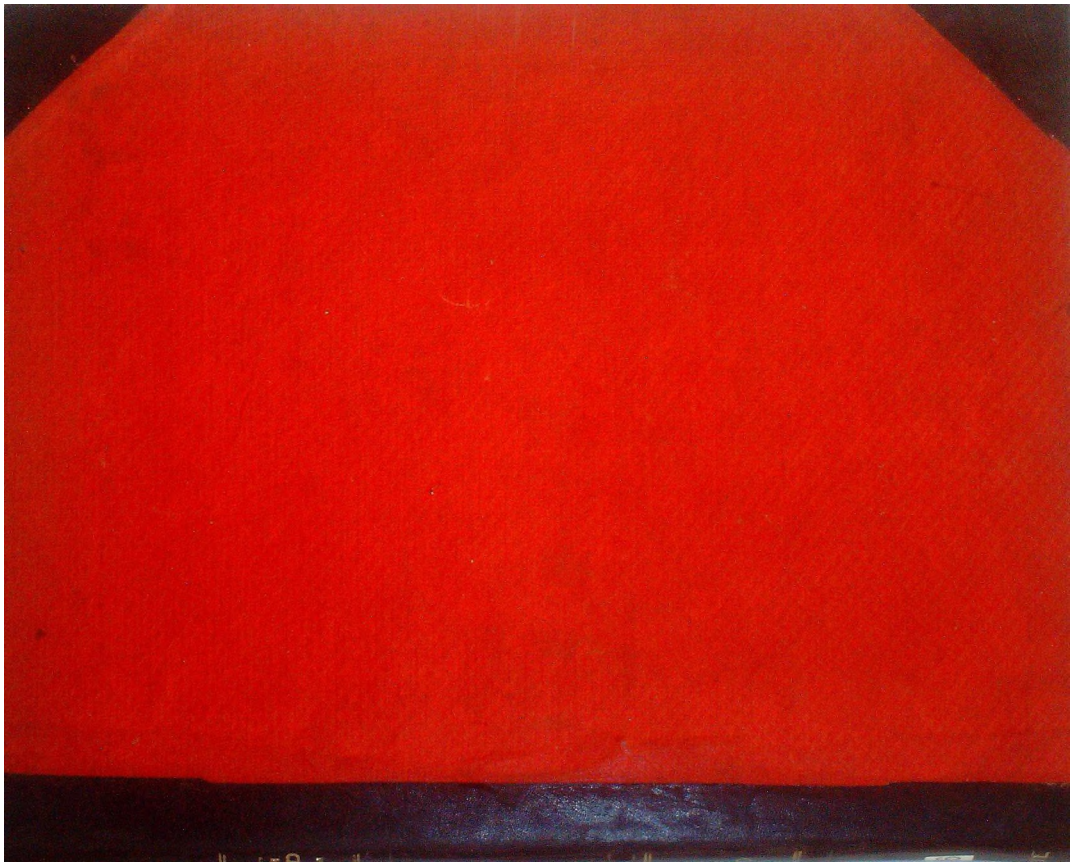


RUBBER BOARD BULLETIN

ISSN. 0970-4124

RUBBER BOARD BULLETIN

Vol. 26 Number 1 July - September, 1990

Chairman
(Smt.) **J. Lalithambika I.A.S.**

CONTENTS

Published by
THE RUBBER BOARD

Editor
P.K. Narayanan
Jt. Director
(Rubber Promotion)

Asst. Editor
K.A. Aravindakshan Nair
Asst. Director (Publicity)

Cover: **Somu**

QUARTER

In almost all the national and international forums on natural rubber much stress is being laid on improving the quality of rubber. A meeting of the Association of Natural Rubber Producing Countries focussed its attention on the same point. The Chairman, Rubber Board also attended this international meet. Everywhere, similar meetings highlight the theme that quality is to be upgraded using appropriate technology. This is one of the main reasons why the Board intends to train a lakh of rubber growers the method of producing good quality rubber sheets. About 4000 centres have been identified for group meetings where the actual sheet making process will be demonstrated. Chairman, Rubber Board has recently remarked that this unique campaign would serve as a catalyst in disseminating technical knowhow for preparing good quality rubber sheets. The campaign, which is the first of its kind in any plantation sector, would commence on April 22 and conclude on 17 May, 1991. With the active support and co-operation of about 1200 Rubber Producers Societies spread over different rubber growing tracts, the Campaign would be instrumental to good outflow of information to those who really need it.

Some of the Rubber Producers Societies have been successful in upgrading sheet rubber of their members to grades RMA 2 to 5, who were until then selling their crop as lot rubber. The grade differential realised is substantial compared to the expenditure in quality improvement. The campaign will defenitely create more awareness to adopt improved processing techniques.

All members of Rubber Producers' Societies, who have mature rubber holdings and the tappers or workers being deputed by them would stand to benefit immensely from the quality upgradation campaign. This interaction between the experts and the growers will, no doubt, result in improving the lot of a lakh of rubber growers whose views on making sheets would be more precise from the experience gained during this period. Ultimately when the whole knowledge gets transferred to the field, the objective for which the campaign has been launched will be fully realised.

Opportunities for the rubber industry

The expertise brought together for two key events for Europe's rubber industry are now being made available to companies which were unable to be represented at the meetings.

The first event, the **EASTERN PROMISE** conference, detailed the opportunities fast-developing in Eastern Europe's Rubber Industry as a result of the breaking down of barriers with Eastern Europe: the biggest shift in the European and global trade map since the Second World War.

This unique event, organised by the *European Rubber Journal* and First Europe Communications, gave delegates from across Europe valuable information on the business and trading opportunities now opening up in this hitherto restricted region.

Now you, too, can benefit from the expertise which was brought together at this important conference: the papers presented and tape recordings made during the meeting are now available. These give detailed insights into the practicality of operating in the region, including vital information on the financial assistance available as well as the legal framework and the rapidly changing business practices in the former East Bloc countries.

NON-TYRE RUBBER APPLICATIONS TOO

The second key event for the European rubber industry was the **Rubber in Non-Tyre Automotive Applications** conference, which resulted from the combined forces of the *European Rubber Journal* and Rubber Consultants, a UK-based specialist consultancy group.

This conference was addressed by experts from the automotive industry and from leading component manufacturers in Europe, as well as companies supplying materials for this vital market segment. Observers of the automotive business were also present, discussing some of the probable business and technical developments in this vital sector.

In just one day, delegates to the conference heard of the automotive industry's changing demands, the latest developments in high performance elastomers and some of the newer processing techniques developed by some of Europe's major rubber product manufacturers. Now you, too, can benefit from the assembled expertise.

The papers presented at the **Rubber in Non-Tyre Automotive Applications** conference, containing detailed information on this important technological business, are now available for £42.50 including postage and packing, from the address below.

Crain Communications Ltd., European Rubber Journal 20-22, Bedford Row, London WCIR 4EW; tel. +44.(0)71.831.9511; fax +44.(0)71.2176; telex 28544 CRAINS G.

TyreTech '91 set for Berlin

Following the success of Tyre Tech '90 held last November in Brighton, England, the organisers have selected the Berlin Congress Centre as the venue for TyreTech '91. Oct. 24-25, 1991.

This second Conference will be organised by *European Rubber Journal* and Rapra Technology Ltd in conjunction with **MMS GmbH,** a specialised consultancy group based in Germany, and will again detail all aspects of technical and commercial development in this vital industrial sector. The Berlin location was chosen in recognition of the massive developments now taking place in the former East Bloc countries, and will enable delegates to appreciate the opportunities opening up across that whole region.

Several key speakers from the automotive and tyre-making industries have already been asked to present papers at the two-day meeting, and the organisers are now prepared to consider additional papers addressing any of the major themes of the meeting, such as:

Manufacturing machinery and technology. Including all parts of the production process and topics such as quality assurance, automation, control systems and flexible manufacturing;

Materials, from base rubbers through all major ingredients including processing aids, steel or polymer-based reinforcements and ancillary chemicals such as antioxidants and other protective agents;

Design and testing of tyres, with a special emphasis on computer-based systems and the latest developments on the engineering of tyres and the tyre/automobile interface;

Legislation, standards and harmonisation, including product liability aspects, factory health & safety matters and the problem of disposal of tyres.

In addition, the organisers have decided to create a session highlighting some of the most recent Innovations of relevance to this sector. Such innovations could relate to any aspect of tyre technology, from raw materials through to design and testing.

POLYCLONAL SEED GARDENS : THEIR ROLE IN RUBBER IMPROVEMENT & PRODUCTION

KAVITHA K. MYDIN,
RUBBER RESEARCH INSTITUTE OF INDIA

The term 'polycross' refers to random open (cross) pollination of a group of selected genotypes/clones in isolation. Such polycrosses can be effected in polyclonal seed gardens. In rubber (*Hevea brasiliensis*), the prevalence of a high degree of outcrossing enables the production of hybrid seeds of polycross origin.

Polycross seed materials obtained from specially designed polyclonal seed gardens have significance in that they are made up of a wide array of gene combinations derived from superior, selected clones. The heterogeneity in such seed lots guarantees wide adaptability even under adverse environments. As compared to monoclonal stands such seedling populations face less risk of a total damage in the event of stress calamities. However, on account of the highly variable yield performance and lesser production compared to modern clones, seedlings have been relegated to category II planting recommendations in India. On an average, polyclonal seedlings have given a commercial yield of only 1100 kg $^{ha\text{-}year}$ in the conventional rubber growing tract of India (Anon., 1988).

Polyclonal seeds have special significance in problem areas. They can be used for raising plantations in non-conventional areas of rubber cultivation subjected to biotic as well as abiotic stresses and also as superior root stock material. These seedling stands can yield superior 'ortets' which could be identified and cloned. An 'ortet' or 'plus tree' refers to the original desirable tree from which a clonal population has descended.

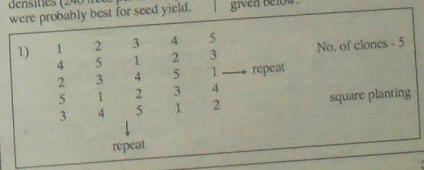
The number of clones planted in a polyclonal seed garden usually ranges from five to ten. The polyclonal gardens established in 1963-'67 in Kanyakumari District (Joseph etal, 1980) have been laid out with clones selected according to the following criteria:

1. High yield, disease resistance and vigour.
2. Synchronous flowering to provide adequate chances for cross pollination among them.
3. Comparatively high seed bearing capacity (Not less than 150 seeds/tree)
4. Capacity to produce good seedling families.

To enable profuse flowering and fruit set, a wider spacing is usually adopted. Wycherley (1971) reported that fairly low planting densities (240 trees per hectare) were probably best for seed yield.

Possibility of contamination with pollen carried by insects from outside the seed garden is avoided by leaving an isolation belt of 100m. width around the seed garden. The isolation belt could either be left with natural vegetation or could be planted with some other crop.

Apart from these essential pre-requisites there are certain genetic principles underlying the establishment of polyclonal seed gardens, observance of which could ensure production of quality seeds. In rubber, knowledge of seed garden genetics is meagre. Seed gardens have been planted with mixtures of superior clones in the hope of random inter-pollination and production of vigorous seedlings. It is likely that outcrossing rates of clones vary and that parents are unequally represented among progeny. Some amount of inbreeding could also occur. Inbreeding or mating among trees of the same clone could be reduced by paying more attention to seed garden layout. Some suitable layouts depending on the number of clones, as proposed by simmonds (1986) are given below:



2)	1	2	3	4	5	6	7	No. of clones - 7
	6	7	1	2	3	4	→	Contd.
	3	4	5	6	7	1	2	triangular planting.
	1	2	3	4	5	6		
		↓						
		Contd.						

The first set is similar to the design employed for seed gardens in India. The second design with seven clones enables each clone to be surrounded by the remaining six, thus ensuring chances of pollination in all possible combinations. Proximity of trees belonging to the same clone is avoided by increasing the effectiveness of the layout through reduced plot size and increased number of replications.

In addition to the choice of proper design for the seed garden certain genetic parameters have to be determined for selection of the component clones. They are (1) Genetic divergence (2) Prepotency and (3) Inbreeding depression.

Genetic divergence refers to the genetic distances among clones. This could be determined by various multivariate approaches based on morphological traits, yield and yield components. An alternative and more sophisticated approach where environmental factors are less likely to vitiate results is electrophoretic analysis of isozyme patterns. The more divergent the clones, the greater are the chances of obtaining superior progeny. Genetic divergence among component clones therefore determines the effectiveness of seed gardens. Markose (1984) identified certain genetically divergent clones and efforts are on for determining genetic distances among more of the popular clones.

Prepotency is the capacity of a parent to produce superior offspring irrespective of the nature of the male parent. The prepotent ability of a clone to produce high quality seedlings could be determined by systematic and planned experiments like seedling progeny analysis. Attempts in this direction are also in progress at the RRII and early results are promising. From among twenty clones investigated, some likely prepotents were identified (Kavitha *et al.*, 1990)

Inbreeding depression is the reduction in vigour apparent in the progeny when cross fertilizing species like rubber are subjected to selfing or inbreeding. Inbreeding could occur by pollination off female flowers with pollen from male flowers on the same tree or from other trees belonging to the same clone. This could lead to deleterious effects; hence the necessity for identifying clones with low rates of selfing and high inbreeding depression. High inbreeding depression facilitates elimination of selfs in the early stages of development.

The existing seed gardens have been planted with selected clones, some of which are becoming obsolete. It is essential that newer clones be tested for identifying components for inclusion in polycross gardens. There will be a continuing need for high quality seed gardens to produce planting materials and root stocks and also generate gene reservoirs for future selection. In India, rubber cultivation is being extended to marginal areas having environmental stress where superior polycross seedlings are likely to perform better than clones, even under poor management. New polyclonal seed gardens would go a long way in providing the *Hevea* breeder with base material for further improvement programmes and the rubber cultivator of less favoured environments with planting material of greater potential and performance.

Acknowledgement

The author is grateful to Dr.V.Gopinathan Nair, Professor & Head, Department of Plant Breeding, Kerala Agricultural University for valuable suggestions and to Dr. M.R. Sethuraj, Director of Research, RRII for facilities provided.

References

Anonymous (1988) Clone-wise yield statement upto 1986/'87. Harrisons Malayalam Ltd., Cochin, India.

Joseph G Marattukalam, Saraswathyamma, C.K. and Premakumari, D. (1980). Methods of propagation and materials for planting. In Handbook of Natural Rubber Production in India (Ed. P.N.Radhakrishna Pillay). The Rubber Research Institute of India, Kottayam.

Kavitha K.Mydin, Gopinathan Nair, V.Panikkar, A.O.N. and Sethuraj M.R. (1990). Prepotency in Rubber, I. Early estimation through juvenile traits. Paper presented at the National Symposium on New Trends in Crop Improvement of Perennial Species, RRII, Kottayam, 31st August, 1990.

Markose, V.C. (1984). Biometric analysis of yield and certain yield attributes in the para rubber tree, *Hevea brasiliensis* Muell. Arg. Ph.D. thesis submitted to the Kerala Agricultural University. pp. 113-114.

Simmonds N.W.(1986) Theoretical aspects of synthetic/polycross populations of rubber seedlings. Journal of Natural Rubber Research, 1 (1), 1-15.

Wycherley P.R. (1971). Hevea seed. Planter, Kuala Lumpur, 47,291.

PROSPECTS FOR RUBBER CULTIVATION AND IMPROVEMENT IN THE KARNATAKA AND KANYAKUMARI REGIONS

M.A. NAZEER
RUBBER RESEARCH INSTITUTE OF INDIA, HEVEA BREEDING SUB-STATION, NETTANA, D.K., KARNATAKA.

India stands fifth in production among the world's natural rubber producing countries. The natural rubber produced in India is from 4,15000 ha of rubber plantations distributed in traditional areas like Kerala and Tamil Nadu and non-traditional regions such as Karnataka, Goa, Andamans and Nicobar Islands, North Eastern states like Tripura, Assam, Meghalaya etc. (1). Towards the end of 1989, the mature area under production extended over 64 percent of the total area, i.e. 2,60000 ha. Seventy five percent of the total area under production in our country falls in the category of small holdings and about 80 percent of the rubber produced is consumed internally. During 1989-90, the total production of natural rubber was 2,97300 tonnes with a national average of 1030 kg/ha while consumption was 3,41840 tonnes (2). Inorder to bridge the gap between production and consumption, 44,871 tonnes of natural rubber was imported (3). The growth rate for production, consumption and import of natural rubber for the past decade is presented in Fig.1. The projected demand for natural rubber during 2000 A.D. in our country is around 5,75000 tonnes, which is almost double of what is produced today.

Due to limited land resources in the traditional rubber growing regions along the south west coast of India, there is no further scope for expansion of area under rubber cultivation. Inorder to achieve self sufficiency, it has become essential to expand rubber cultivation to the non-traditional zones where different types of environmental constraints affect growth and productivity. In the eighth five year plan, it is expected to plant rubber in 80,000 ha, of which 65,000 ha will be in the non-traditional region(2). Replanting old and unproductive plantations with high yielding planting materials is also essential to boost production. An attempt is made here to examine the problems and prospects for rubber cultivation and improvement in the Karnataka and Kanyakumari regions.

KARNATAKA REGION

Karnataka is one of the non-traditional areas where rubber cultivation could be expanded. Traditionally, rubber cultivation is limited to the humid tropics within 10° north and south of the equator where, total rainfall, distribution of rainfall and ambient temperature are suited for growth of rubber. The area under rubber in the Karnataka region falls between latitudes 12.06°N to 15.16°N and elevation ranges from 27 meters to 1182 meters above MSL. Table 1 depicts the districtwise distribution of rubber plantations with other details like elevation, rainfall etc. The taluk wise distribution of rubber in the Karnataka is depicted in Fig.2. Total area under rubber as on 1990, is around 13,350 ha, of which 78 percent of the area is located in the Dakshina Kannada district alone, with 50 percent of the area belonging to large estates. The area is characterised by severe summer which affects the growth of rubber and annual rainfall varying from 1100 mm to 5600 mm (Table 1). South west monsoon contributes the major part of the rainfall with july as the wettest month having nearly 1000 mm or more rainfall (4). North east monsoons are very weak. Incidence of pink disease and Phytophthora leaf fall is very high due to continuous heavy rain. However, powdery mildew is of very low frequency which may be due to high summer temperatures and low relative humidity. Soils are highly weathered, acidic and poor in available nutrients except magnesium (4). Per hectare yield of rubber in this region is only 818 kg (5), which is below the national

average. This could be mainly due to planting of a few selected old clones and also unselected seedlings in most of the area. interest among people to expand rubber cultivation to high elevation areas also, though there is general reduction in growth mainly due to high incidence of leaf diseases like powdery mildew. During the eighth five year plan, it is proposed to plant rubber in 5000 ha. in the Karnataka region.

KANYAKUMARI REGION

The traditional area of Kanyakumari region presents a different picture in respect of weather conditions and rubber production. Rainfall is moderate and more or less evenly distributed with an average rainfall of 1900 mm, which does not exceed 350 mm in any month (4). Both south west and north east monsoons are equally important for this region. The temperature variation is not marked. Laterite or lateritic red soils are encountered in this region. These soils are generally deep, less weathered and comparatively more fertile. This area occasionally has very mild incidence of abnormal leaf fall, which is considered to be the most damaging disease prevalent in the rubber growing areas of our country. However, the incidence of powdery mildew disease is severe here. The total area under rubber planting as in 1990 is 17,085 ha which falls in three taluks (Table 2). This region gets the highest yield per hectare (1071 kg) (5), which is above the national average. During the eighth plan period, it is envisaged to plant 1500 ha in this region, which includes both replanting (one third area) and new planting.

HEVEA BREEDING SUB-STATIONS (H.B.S.S.)

The Rubber Research Institute of India has established two Hevea breeding sub-stations during 1986, one in Nettana (Dakshina Kannada District of Karnataka) which is 94 km away from Mangalore and the other in Paraliar (Kanyakumari district of Tamil Nadu) which is 35 km away from Nagercoil, with an aim to conduct breeding research in these regions and evolve new Hevea clones suited to the localities. HBSS Karnataka lies in the latitude of 12.45°N and longitude of 75.32°, at an elevation of 110 meters above MSL. The station has an area of 50ha. The substation Nettana lays emphasis on evolving new rubber clones suited for the area by adopting various plant breeding methods and also field testing existing modern cultivars. It is proposed to study various breeding problems of Hevea.

Analysis of soil samples from representative areas of the station has shown that the soil is deficient in phosphorous and a modified fertilizer recommendation suggested by the Rubber Research Institute of India was adopted. The station is equipped with an agrometeorological observatory for regular recording of weather date. The mean annual rainfall is 4633 mm, the wettest months being July (1141.85 mm) and August (1213 mm) (Fig.3). The mean maximum temperature ranged from 26.72°C to 36.07°C (Fig.3). The minimum temperature ranged from 15.25°C to 23.37°C. At the HBSS Nettana, there are six ongoing field trials which cover the study of clonal performance in the region, evaluation of ortet clones, estimation of genetic parameters and study on exploitation systems in relation to various clones.

The Hevea breeding sub-station Paraliar is located in the traditional belt, in the Paraliar Division of the Tamil Nadu government rubber plantation and has an area of 23.1 ha. This region is ideally suited for rubber cultivation, with distributed rains and high per hectare yield of dry rubber. Figure 4 shows rainfall pattern and maximum and minimum temperature for one year. The maximum temperature ranged from 17.9°C to 23.66°C. Table 3 shows per hectare dry rubber production from commercial plantings. At the HBSS Paraliar, two breeding orchards comprising 51 clones and a large scale clone trial have been established.

FUTURE PROSPECTS FOR HEVEA BREEDING

In the Karnataka region, till date the planting materials used by the plantation sector are a few old clones like RRIM 600, GT1, PB 86 etc. It is only in recent years that high yielding clones like RRII 105 have been popularised. Clone evaluation in different agroclimatic situations is one of the major areas to be given importance. In this connection, newly evolved indigenous clones as well as imported clones in the pipe line have been established as source bush plants at the HBSS Nettana and selected clones have been vegetatively multiplied for distribution among progressive planters for block planting. It is intended to evaluate the clones under d/2 and d/3 systems of tapping for obtaining information on susceptibility to tapping panel dryness and also for identifying the most suitable tapping system. A similar programme of clone

TABLE - 1

Details of area under rubber, elevation, rainfall etc. in various districts of Karnataka

District	Taluk	Latitude ON	Elevation from MSL (metres)	Rainfall(mm) 5 years mean	Area under Rubber (ha)	District total
Dakshina	Bantwal	12.52	26.80	4614.28	196.82	
Kannada	Belthangady	12.59	106.68	4966.72	1362.18	
	Coondapur	13.38	NA	3648.28	913.89	
	Karkala	13.13	73.45	5671.92	221.68	
	Mangalore	12.53	114.00	4429.16	66.05	
	Puttur	12.42	106.68	4410.62	2957.14	
	Sullia	NA	NA	3925.97	4110.79	
	Udipi	NA	NA	3806.33	30.45	
	add 5% of the district total for unregistered area being given permit.				492.95	10351.95
Uttara	Karwar	NA	NA	3350.46	4.80	
Kannada	Kumta	14.26	30.50	3412.30	1.80	
	Supa	15.16	508.10	2251.13	34.60	41.20
Chigmagalur	Mudigeri	13.38	932.00	2348.21	2.00	
	N.R.Pura	13.25	693.11	1524.08	302.36	
	Koppa	13.33	805.81	2981.12	37.07	
	Sringeri	13.25	634.28	3801.96	30.02	371.45
Kodagu	Coorg	12.29	750.00	4445.35	550.12	
	Mercara	12.25	1182.72	3287.92	861.08	
	Virajpet	12.10	750.00	2737.74	603.21	
	Somavarpet	12.36	1131.00	2199.20	61.20	2075.61
Shimoga	Sagar	14.10	596.79	1846.22	182.51	
	Sorab	14.25	571.10	1296.70	87.70	
	Tirthahalli	13.41	600.00	2867.84	67.61	
	Hosanagara	NA	NA	NA	149.69	487.51
Mysore	H.D.kotte	12.05	NA	1170.00	10.45	
	Piriapattana	12.06	848.40	785.00	0.74	11.19
Bangalore	Nelamangala	13.06	883.92	1111.75	11.64	11.64
				State Total :		13350.55

Data source : Rubber Board Regional Office, Mangalore.

TABLE - 2

Area under rubber in the Kanyakumari region

Sl.No.	Taluk	Registered area(ha)	Unregistered area (ha)	Total (ha)
1.	Kalkulam	7483.00	1500.00	8983.00
2.	Vilavancode	5193.00	1000.00	6193.00
3.	Thovala	1409.00	500.00	1909.00
4.	Agasteswaram	NA	NA	NA
	Total	14085.00	3000.00	17085.00

TABLE - 3

Per hectare yield of dry rubber in the Kanyakumari region

Sl.No.	Year	Yield(Kg/ha)
1.	1980-81	1910.40
2.	1981-82	1195.70
3.	1982-83	836.20
4.	1983-84	1613.80
5.	1984-85	1064.00
6.	1985-86	719.70
7.	1986-87	855.40
8.	1987-88	1008.30
9.	1988-89	1122.00
10.	1989-90	1251.10

Data source : Table 2 - Rubber Board Regional Office, Nagercoil.
Table 3 - Arasu Rubber Corporation Ltd., Paraliar Dn.

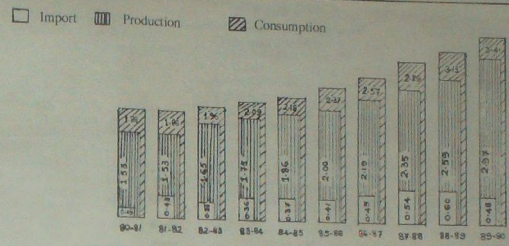


Fig. 1
Production, consumption and import of natural rubber in India
(in lakh tonnes)

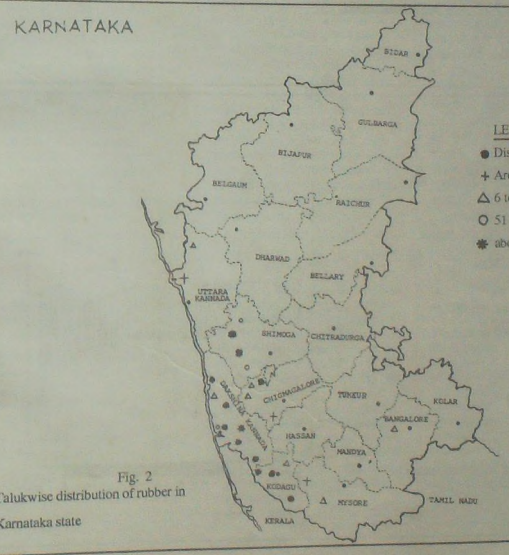
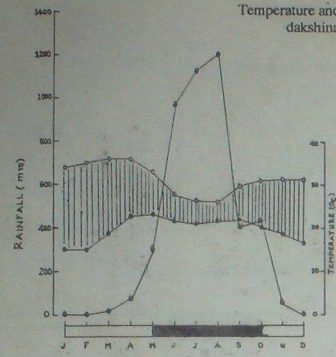


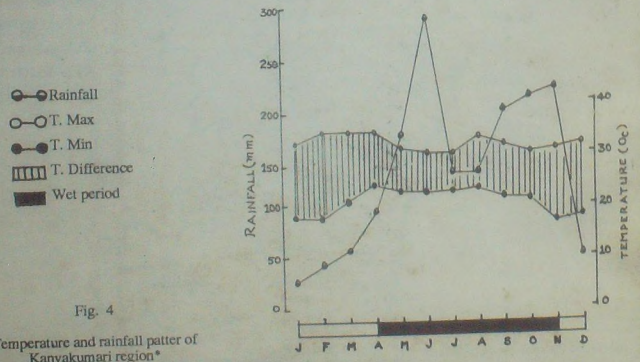
Fig. 2
Talukwise distribution of rubber in
Karnataka state

Fig. 3
Temperature and rainfall pattern of dakshina kannada*



Rainfall
T. Max
T. Min
T. Difference
Wet period

*Mean data over two years



Rainfall
T. Max
T. Min
T. Difference
Wet period

Fig. 4

Temperature and rainfall patter of Kanyakumari region*

*Data for one year

evaluation is envisaged for the Kanyakumari region also. Ortet selection is another priority area in both regions. Since sizable area under mature and yielding seedling populations with immense genetic variability is available and they are being replanted with clonal stands, it is essential that the ortet selection programme be initiated at the earliest. Plus trees having tolerance to drought and diseases like powdery mildew, abnormal leaf fall, pink disease etc. could be selected, cloned and established for incorporation in future breeding programme, in addition to selection of high yielders from seedling populations. Basic studies like floral biology have to be taken up for the utilization of the information in breeding programmes. In the Karnataka region, since the main constrains are drought, leaf and stem diseases like Phytophthora, pink etc. adequate emphasis is being given for these problems in the breeding objectives. The ongoing field trials at the Hevea breeding stations will help in identifying clones tolerant to these maladies. Among the future projects is a germplasm garden at Karnataka for a small scale evaluation of all available clones of exotic and indigenous origin. The breeding orchards established at the HBSS Paraliar, will be utilized for future hybridization programmes to generate hybrid seedlings for clonal selection. In the Karnataka region, rubber cultivation is expanding to high elevation areas also. Hence, evaluation of clones with built in tolerance to cold and other climatic situations in such regions is another priority area.

There is good scope for expansion of rubber cultivation in Karnataka. In Dakshina Kannada district alone, out of the total geographical area of 8.34 lakh ha, forest land is around 2.26 lakh ha and nearly 3.51 lakh ha land is either revenue land or unutilized area(6). In such marginal lands, direct planting or polycross seeds could be attempted. At present, there is no polyclonal seed garden in the Karnataka region. It is intended to establish a polyclonal seed garden in this region, in collaboration with the Karnataka forest development corporation. Superior synthetic populations derived from these gardens could also be used as promising root stock material.

REFERENCES

1. Mukundan Menon, P. 1989. Short term techniques for boosting rubber productivity. Rubber Board Bull. 24(4):3-4.

2. Mukundan Menon.P. and R.G.Unni, 1990. Natural rubber production: Prospects on a long term basis. Rubber Board Bull. 25(4): 7-15.

3. Anonymous, 1990. Seminar on "Modern trends and growth opportunities in rubber industry". Rubber Board Bull. 25(3): 2-3.

4. Pushpadas, M.V. and Karthikakutty Amma, 1980. Agro ecological requirements. In: Handbook of Natural rubber production in India. Edt. P.N. Radhakrishna Pillai, Rubber Research Institute of India. PP: 100-107.

5. Indian Rubber Statistics 1987-88. Compiled by the statistics and planning division, the Rubber Board, Kottayam. PP:8-9

6. Dakshina Kannada at a glance - 1988-89. Government of Karnataka. Compiled by the District statistical officer, D.K. District, Manglore. P-10

HOW PLANTS INFLUENCE TEMPERATURE

Scientists say they have confirmed on step in a chain of events by which microscopic ocean plants may influence the earth's temperature.

The hypothesis suggests that the plants affect the amount of solar energy that warms the Earth by influencing how clouds reflect that energy.

The thermostat hypothesis starts with the fact that the plants, called phytoplankton, produce a gas called dimethyl sulphide. Part of this gas is turned into sulphur-bearing particles in the air. Eventually cloud droplets form around the particles. The number of these droplets in clouds strongly influences how much solar energy the clouds reflect away from the Earth. And that influences how much energy the globe receives.

The series of links may produce an effect like a thermostat. If the Earth cools, dimethyl sulphide production may fall, decreasing the number of cloud droplets and so reducing the reflectivity of clouds, leading to a warming of the Earth.

In a *Nature* article, Australian scientists said that weekly observations over 20 months at Cape Grim, TAsmania, showed that atmospheric concentrations of dimethyl sulphide and sulphurbearing particles rose and fell together. That confirms one connection in the thermostat hypothesis, the scientists wrote. A separate study also found that numbers of cloud condensation nuclei, around which cloud droplets form, rise and fall in step with the same trends.

EVALUATION OF PLANTING MATERIALS UNDER COMMERCIAL PLANTING - THIRD REPORT

TOMS JOSEPH, Dr. V. HARIDASAN
RUBBER RESEARCH INSTITUTE OF INDIA

ABSTRACT

This is the third report of a continuous study undertaken by RRII to generate useful information on the yield of different planting materials under commercial planting. Along with the yield rates the consistency figures are also presented. The report covers a region wise analysis of yield of selected planting materials and a comparison with the commercial yield reported by Malaysia.

INTRODUCTION

Selection of the material to be planted is a crucial farm management decision. The decision assumes greater significance in the case of a perennial crop like rubber. Information on the relative performance of various planting materials helps the planters as well as policy makers in arriving at the correct decision. It is with the intention of providing reliable information on the comparative yield of different planting materials,that the Rubber Research Institute of India is undertaking a continuous evaluation. The evaluation was initiated in 1974 and the first and second reports were published in 1982[1] and 1985[2]

SAMPLE SIZE AND METHODOLOGY

Around 40 large estates are participating in this programme. They regularly furnish monthly yield statements. The present report contains data on 21 planting materials including 4 RRII varieties. It is well known that the number of trees tapped per ha differs from field to field in the initial years owing to variations in girthing. Hence only fields, with at least 250 trees tapped/ha in the first year, 275 trees in the second year, and 300 trees in the subsequent years were considered for tabulation. The final yield figures analyzed came from 364 fields covering a total area of 5202 ha. These fields more or less represent the different agro-climatic regions.

LIMITATIONS

Difference in the techniques employed in crop harvesting generally pose limitations in measuring the full yield potential of the clones. Rubber trees respond differently to the different systems of tapping. The type of knife used, the slope and direction of the tapping cut, depth in tapping, consumption of bark, time of tapping, frequency between tappings etc. influence the yield. Application of stimulants and the consequent effect on yield are also factors to be reckoned with. Even small variations in crop harvesting practices influence the yield, though not markedly in all the cases. Most of the fields taken into the study were prone to such variations. The figures reported here may be considered provisional since they may change over time, in tune with the change in the number of fields under evaluation.

DISCUSSION

In Table I yearly weighed average yield figures are given. For 8 planting materials data were available for 15 years of tapping. Excepting for PB 235, RRII 208 and RRII 116 data were available for 10 or more years of tapping. In Table II the summary results are given. Along with the first 5 year, 10 year and 15 year averages, the co-efficients of variation (CV) are also presented. The co-efficients of variation indicate the consistency of yield of the planting material.

a) **First Five Year Period:-** In the first five year period RRII 105 tops the list with 1412 kg/ha. This is followed by PB 28/59 with 1227 kg./ha. Other high yielding clones during this period were RRIM 600, PB 235 and RRIM 605. During this period PB 235

TABLE - 1

Yield performance of various planting materials in commercial practice in India (kg/ha)

Sl. No.	Planting Material	Total area under observation	No.of fields under observation	Year														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	PB 86	569	50	520	749	913	1057	1180	1231	1294	1347	1334	1285	1223	1227	1147	1178	1221
				(26)	(28)	(31)	(35)	(38)	(36)	(37)	(38)	(38)	(43)	(45)	(45)	(42)	(41)	(40)
2.	PB 6/9	68	8	734	995	1153	1164	1170	1249	1294	1187	1244	1124	1001	990	1135	1457	1364
				(7)	(7)	(7)	(7)	(8)	(8)	(8)	(8)	(8)	(8)	(6)	(5)	(5)	(5)	(5)
3.	PB 5/139	227	16	494	886	967	1244	1350	1398	1619	1398	1523	1371	1231	1218	1319	1195	1233
				(12)	(12)	(13)	(13)	(16)	(16)	(16)	(16)	(16)	(16)	(16)	(15	(14)	(13)	(13)
4.	RRIM 605	231	19	762	1034	1138	1185	1187	1204	1319	1162	1168	1301	1325	1431	1576	1237	1360
				(16)	(18)	(18)	(18)	(19)	(19)	(18)	(18)	(16)	(15)	(9)	(9)	(8)	(6)	(5)
5.	RRIM 623	363	28	694	846	927	967	1007	1213	1318	1169	1191	1223	1347	1301	1347	1421	1701
				(23)	(27)	(27)	(27)	(28)	(28)	(28)	(27)	(26)	(26)	(21)	(16)	(13)	(10)	(6)
6.	GI 1	487	22	532	786	1049	1138	1353	1276	1427	1378	1219	1281	1179	1222	1222	1116	1279
				(16)	(16)	(16)	(16)	(17)	(18)	(22)	(22)	(22)	(22)	(22)	(22)	(22)	(20)	(19)
7.	LCB 1320	117	15	405	635	821	842	910	910	946	1013	1067	1037	1014	802	855	885	877
				(10)	(10)	(11)	(11)	(12)	(13)	(14)	(14)	(14)	(14)	(14)	(14)	(13)	(13)	(13)
8.	PR 107	68	8	519	760	914	956	996	1088	1305	1317	1433	1350	1179	1014	1093	855	861
				(6)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(6)	(4)	(2)	(2)	(2)	(2)
9.	PB 5/51	232	13	708	905	1075	1136	1209	1369	1729	1526	1853	1627	1528	1489	1456	1301	
				(12)	(13)	(13)	(13)	(13)	(12)	(12)	(11)	(8)	(7)	(5)	(5)	(2)	(1)	
10.	RRIM 600	888	57	681	1164	1137	1277	1387	1430	1588	1663	1532	1508	1382	1389	1855	1527	
				(56)	(57)	(57)	(55)	(52)	(49)	(43)	(36)	(29)	(23)	(15)	(10)	(4)	(2)	

TABLE - 1 (Cont'd)

Sl. No.	Planting Material	Total area under observation	No.of fields under observation	Year														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11.	GT 1	992	48	672	924	1079	1173	1246	1259	1780	1665	1739	1756	1704	1551	1650	1330	
				(45)	(46)	(47)	(45)	(43)	(38)	(30)	(27)	(22)	(17)	(6)	(3)	(2)	(1)	
12.	PB 28/59	556	34	715	1138	1359	1493	1432	1438	1501	2060	1756	1624	1589	1396	999		
				(31)	(34)	(31)	(29)	(23)	(19)	(17)	(15)	(10)	(8)	(6)	(2)	(1)		
13.	RRIM 628	100	6	643	851	1005	987	783	1083	1185	1427	1488	1512	1162	1298			
				(5)	(6)	(6)	(6)	(6)	(6)	(6)	(6)	(5)	(4)	(4)	(1)			
14.	RRIM 701	32	3	509	841	686	1208	1159	1145	1490	1313	1627	1416					
				(3)	(3)	(3)	(3)	(30)	(3)	(3)	(3)	(2)	(2)					
15.	PB 217	125	7	691	918	1097	1090	1207	1290	1647	1530	1191	1917					
				(7)	7)	(7)	(7)	(7)	(7)	(6)	(5)	(3)	(2)					
16.	PB 252	18	2	604	973	1092	1289	1205	1172	1794	2048	1741	1735					
				(2)	(2)	(2)	(2)	(2)	(2)	(1)	(1)	(1)	(1)					
17.	PB 235	41	3	996	1001	1271	1219	986	1059	2089								
				(3)	(3)	(3)	(2)	(2)	(2)	(1)								
18.	RRII 105	44	11	888	1376	1473	1651	1675	1798	1608	2038	1365	1687					
				(10)	(7)	(8)	(7)	(4)	(4)	(3)	(2)	(1)	(1)					
19.	RRII 116	7	2	485	685	1009	1129	1016	1254	1133								
				(2)	(2)	(2)	(2)	(2)	(2)	(2)								
20.	RRII 208	12	4	498	941	1001	1108	1154	1132	943								
				(2)	(2)	(4)	(4)	(4)	(4)	(4)								
21.	RRII 118	25	8	433	699	1092	1240	1232	1171	1195	1576	1286	1719					
				(5)	(5)	(7)	(6)	(7)	(7)	(7)	(4)	(2)	(1)					
	Grand Mean Yield	5202	364	658	971	1095	1193	1237	1309	1488	1468	1446	1384	1299	1247	1257	1180	1178

TABLE - II

The first five, ten and fifteen year averages-(field in kg/ha)

Sl. No.	Planting materials	First 5 year average yield	Coefficient of variation	First 10 Year average yield	Coefficient of variation	First 15 year average yield	Coefficient of variation
1.	PB 86	884	29	1091	26	1127	21
2.	PB 6/9	1043	18	1131	14	1151	15
3.	PB 5/139	988	34	1225	28	1230	22
4.	RRIM 605	1061	17	1146	14	1226	15
5.	RRIM 623	888	14	1056	19	1178	22
6.	GI 1	929	28	1130	25	1145	20
7.	LCB 1320	723	28	859	24	868	19
8.	PR 107	829	24	1064	27	1043	24
9.	PB 5/51	1007	20	1314	28	—	—
10.	RRIM 600	1129	24	1327	21	—	—
11.	GT 1	1019	22	1329	29	—	—
12.	PB 28/59	1227	26	1452	25	—	—
13.	RRIM 628	854	18	1098	28	—	—
14.	RRIM 701	881	34	1139	32	—	—
15.	PB 217	1001	20	1258	29	—	—
16.	PB 252	1033	26	1363	33	—	—
17.	RRII 105	1412	20	1556	19	—	—
18.	RRII 118	939	34	1164	31	—	—
19.	RRII 208	940	25	—	—	—	—
20.	RRII 116	865	28	—	—	—	—
21.	PB 235	1095	13	—	—	—	—

recorded better consistency compared to other planting materials. The lowest yield figures are recorded by LCB 1320, RRIM 628 and PR 107. Among the top five materials PB 235 and RRIM 605 showed relatively less variation in yield. Among the top three, RRII 105 is relatively more consistent. Clones such as PB 5/139, RRIM 701 and RRII 118 were found to be comparatively unstable. The RRII Varieties other than RRII 105 were also highly unstable.

b) **First Ten Year Period :-** During the 10 year period also the first and second positions were claimed by RRII 105 with 1556 kg/ha and PB 28/59 with 1452 kg/ha. Other promising materials were PB 252, GT 1, RRIM 600, PB 5/51 and PB 217. During the 10 year period, LCB 1320, PR 107 and RRIM 623 had the lowest yield. The highest consistency in yield was recorded by PB 6/9 and RRIM 605. Among the 18 planting materials for which data are available for 10 years, RRII 105 shares the second position with regard to consistency along with RRIM 623. Among the highest ranking materials RRII 105 and RRIM 600 showed better consistency. The most unstable ones are RRII 118, RRim 701, PB 252, PB 217 and GT 1.

The average yield of PB 217, PB 252, PB 5/51 and GT 1, had increased during the ten year period compared to the first five years, while consistency was on the decline. Clones RRIM 605 and PB 6/9 did not show high yield figures but their consistency had improved. The RRII 105, PB 28/59 and RRIM 600 have retained their premier position on yield during the ten year period. Compared to the first five years consistency in yield improved during the ten year period.

Taking yield and consistency as criteria, (10 year data) a classification of 18 planting materials was attempted. The result is presented in Table III. The table illustrates the unique position of RRII 105 over other high yielding varieties. Among the planting materials with medium yield PB 6/9 and RRIM 605 mark high consistency while the rest, have shown low consistency with the exception of RRIM 623.

c) **First Fifteen Year Period:-** Data are available only for ten planting materials for the fifteen year period. Among them PB 5/139 claims the first position with regard to yield followed by

TABLE - III

Classification of Planting Materials according to yield and consistency.

	Group	Planting Material
1.	HY with HC	Nil
2.	HY with MC	RRII 105
3.	HY with LC	PB 28/59, PB 252
4.	MY with HC	PB 6/9, RRIM 605
5.	MY with MC	RRIM 600
6.	MY with LC	PB 5/139, GI 1, PB 5/51, GT 1, RRIM
7.	LY with HC	Nil
8.	LY with MC	RRIM 623
9.	LY with LC	PB 86, LCB 1320, PR 107, RRIM 628

Hy = High Yield
MY = Medium Yield
LY = Low Yield

HC = High Consistency
MC = Medium Consistency
LC = Low Consistency

HY = Yield 10% higher than grand Mean Yield.
MY = Yield falling within the range of 10% higher and 10% lower values of Grand Mean Yield.
LY = Yield 10% lower than Grand Mean Yield.
MC = CV falling within the range 10% higher and 10% lower values of Grand CV.
LC = CV 10% higher than Grand CV.
HC = CV 10% lower than Grand CV.

TABLE - IV

**Yield rates - A region - wise analysis (Kg/ha)

Planting Material		Year 1	2	3	4	5	Five year average	All India	Year 6	7	8	9	10	Ten year average	All India
RRIM 600	A	675	949	1416	1209	1426	1135	1129	1576	1717	1661	1860	1705	1403	1327
	B	732	1022	1193	1381	1481	1162		1537	1682	1520	1466	1586	1360	
	C	636	940	1107	1203	1326	1042		1313	1427	1576	1463	1441	1223	
	D	582	943	1041	1183	1405	1031		1323	1475	1567	1535	1541	1252	
	E	731	985	1042	1262	1244	1053		1277	1681	1442	1472	1350	1249	
PB 28/59	A	811	1385	1643	1677	1726	1448	1227	2005	1824	1307	1693		1563	1452
	B	826	1233	1559	1515	1548	1336		1568	1733	2353	1796	1677	1581	
	C	663	1036	1177	1337	1219	1086		1143	1143	1704	1431	1544	1240	
	E	589	1039	1187	1679	1594	1217		1795	2007	2565	2384	1646	1648	
PB 86	A	473	760	977	1096	1214	904	884	1422	1441	1380	1509	1364	1164	1091
	B	522	649	828	1038	1156	839		1160	1250	1337	1219	1230	1039	
	C	582	948	999	1123	1190	968		1276	1302	1357	1405	1442	1162	
	D	535	759	990	1121	1169	915		1397	1265	1369	1304	1032	1094	
	E	545	696	882	1062	1136	868		1231	1754	1342	1492	1407	1155	
RRIM 623	B	806	1027	1001	1111	1099	1009	888	1294	1389	1232	1263	1224	1145	1056
	C	672	797	1067	1094	1185	963		1407	1585	1333	1239	1532	1191	
	D	554	714	705	693	713	676		960	1043	947	832	886	805	
	E	654	817	770	991	1033	863		1091	1056	1388	1243		1005*	
GT 1	A	645	1149	1213	1142	985	1027	1019	1853	1480	1302	1852		1291*	1329
	B	793	1079	1203	1340	1455	1174		1327	1865	1724	1802	1387	1398	
	C	657	877	1068	1183	1153	988		1218	1739	1511	1433	1615	1245	
	D	556	844	930	940	1083	871		1176	1525	1683	1692	1669	1210	
	E	643	843	1055	1115	1209	973		1271	1814	1672	1927	1953	1250	

*Averages for the respective periods only. ** Weighted average

TABLE - V

Comparison between Yield Rates of Malaysia and India.

	Five Year		Ten Year	
	India	Malaysia	India	Malaysia
RRIM 600*	1129	1386	1307	2029
GT 1	1019	1206	1329	1860
PB 5/51	1007	1227	1314	1787
PB 28/59	1227	1532	1432	1708
RRIM 605	1061	1287	1146	1459
RRIM 623	886	1220	1056	1497
PB 86	884	886	1091	1225
GI 1	929	958	1130	1126
PR 107	829	970	1064	1329
LCB 1320	723	1017	859	1261

*9 Year averages.

Source for Malaysian Yield Figures: Planters' Bulletin No. 144, May 1976.

RRIM 605. RRIM 605 along with PB 6/9 has shown the highest consistency.

REGION-WISE ANALYSIS

There are agro-climatic rubber growing regions in India. Due to paucity of data we have limited the analysis to five regions.

A = Kanyakumari District of Tamil Nadu.
B = Quilon, Trivandrum and Pathanamthitta districts.
C = Kottayam, Alleppey, Idukki and Ernakulam districts.
D = Palghat, and Trichur districts.
E = Malappuram, Calicut and Cannanore districts.

A meaningful analysis demands sufficient number of fields and we have limited our analysis to five planting materials. The results are presented in Table IV. In all cases except one (GT 1, 10 year) the yield figures of Region A were above the respective all India averages. The yield figures in Region B were lower than all India figures only two cases (PB 86, 5 year and 10 year). It is found that in Region C and D three planting materials showed lower yield average compared to national average for both periods (C = RRIM 600, PB 28/59 and GT 1; D =RRIM 600, RRIM 623 and GT 1). Finally in Region E, the five materials recorded lower yield during the five year period compared to all India figures. During the ten year period only two materials (RRIM 600 and RRIM 623) showed yield lower than the all India averages.

COMPARISON WITH MALAYSIAN YIELD

An attempt has been made to compare the commercial average yields of India and Malaysia in Table V. We have comparable data only in the case of 10 planting materials.

In the first five year period the Indian averages were lower than those of Malaysia in all the ten cases. In the 10 year period all the materials in India except GI 1 showed lower yield compared to Malaysia. In the ten year period differences in yield also widened considerably.

CONCLUSIONS

In the first five year period RRII 105, PB 28/59 and RRIM 600 respectively claim the first, second and third position with regard to yield. The highest consistency is accounted for by PB 235 followed by RRIM 623. In the ten year period RRII 105, PB 28/59, PB 252, GT 1 and RRIM 600 were the first five better yielding clones. The highest consistency is claimed by PB 6/9 and RRIM 605. In the fifteen year period PB 5/139 tops the list with regard to yield. It is followed by RRIM 605.

A comparison of the regional averages with all India yield figures has shown that regions A and B perform better than other regions. The foreign clones do not yield in India as much as in Malaysia. In some cases the yield are strikingly different.

REFERENCES

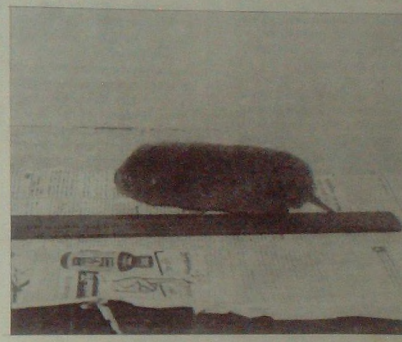
1. Rubber Board Bulletin, Vol. 17, 1982.
2. Rubber Board Bulletin, Vol. 20, 1985.
3. Handbook of Natural Rubber Production, RRII-Page 100.
4. Planter's Bulletin, No. 144-1976.

ACKNOWLEDGEMENT

We are grateful to Dr. M.R.Sethuraj for critically examining the paper. The comments on an earlier draft of this paper by Dr.Tharian George.K. are also acknowledged.

Bamboo Rat menace in Rubber Plantations in Tripura

The Tripura Rehabilitation Plantation Corporation Ltd. (T.R.P.C.) is engaged in raising rubber plantations over undulating hillocks, which abound in Tripura, for the resettlement of landless shifting cultivators (Jhumias). Usually the hillocks are covered with degraded bamboo forests. Some bamboo clumps present in the area have to be cut and burnt before planting rubber. These clumps take 2/3 years to die. From the third year onwards it has been noticed that occasionally rubber plants are being cut by the rats below the ground. The damaged plants vary between 15 cm. to 30 cm. in circumference at collar and from 3 to 4 meter in height. The damage is caused below the ground level at about 15 cm. resulting in the falling down or uprooting of the plants. A group of 10-15 plants in an area may be damaged before it is realised as to what is happening. The rats do not leave any external evidence of scooped earth or entrance or exist holes, hence remain undetected. The rat as seen in the picture, could be provisionally identified as Hoary Bamboo rat (Prater's Book of Indian Animals). The rat measures 24 cm. - 26 cm. in length with a tail of 3 - 4 cm. The insisors of the rat are large and they produce a hissing sound; the eyes are red and



there is practically no neck. Legs are small with powerful claws.

The body is hairy and the colour is greyish brown. The rats move in under ground tunnels of different lengths. The control measures adopted using zinc phosphide bait and rat traps have not been successful. Moosh - Moosh cake, a rodenticide marketed by M/S, Ralli's India is being tried for control, but so far it has not been effective. The only method which has achieved some success so far is manual capture. For every rat captured Rs. 15/- is paid to the trapper. The tribal beneficiaries are encouraged to capture the rats. The rats killed are delicious meat for the tribals.

These rats are found in the area which originally supported bamboo clumps and which take about 2 - 3 years to die completely after being cut and burnt in the first year. When their (rats) natural food the bamboo rhizomes are not available these rats look out for other available food.

H.N. Mathur, Managing Director, T.R.P.C. Ltd., Tripura.

CROP WEATHER CALENDAR FOR RUBBER IN THE N.E. INDIA

SASEENDRAN S.A., POTTY S.N., KRISHNAKUMAR A.K. & SETHURAJ M.R.
NORTH EASTERN RESEARCH COMPLEX RUBBER RESEARCH INSTITUTE OF INDIA.

ABSTRACT

Based on the meteorological data collected from 6 stations in the N.E. India and three in North Bengal, the climatic characteristics of the region were brought out and water availability periods were delineated. The results were utilised in scheduling cllimate dependent agromix and cultural operations for rubber cultivation in the region, and are presented as "Crop-weather calendar for rubber".

INTRODUCTION

The para rubber three (Hevea hrasiliensis) the principal source of natural rubber in the world is a native of Amazon tropical rain forests. The crop was introduced to the far east during the last part of the 19th century and the cultivation was confined to the tropical belt. In India, Kerala state accounts for about ninety per cent of the area. The demand of natural rubber far exceeds its production and the gap between the production and consumption is on the increase. This warranting imports resulting in drain of foreign exchange. To tide over this it became necessary to increase the production of natural rubber in the country. The production can be increased by increasing the productivity and also by bringing more area under rubber. There is no scope of further expansion of the area under rubber in its traditional belt and hence the exploratory surveys of Rubber revealed that North Eastern states could be considered for the cultivation of rubber thought it does not fall under the tropics. However, the crop requires specific agro-management practices to mitigate various stress factors prevailing due to agroclimatic constraints. As a first approximation, a refinement of existing agromanagement practices is attempted by modifying the calendar of operations based on the climatic characteristics of the region.

AGROCLIMATIC REQUIREMENTS OF RUBBER

A detailed account of the agroclimatic requirement of rubber is provided by Pushpadas and Karthikakutty (1980). The crop requires a warm, humid and equable climate. It is adaptable to a wide range of soils ranging from the flooded lands to humid and semirigid regions (Dijkman, 1950). It has also been reported thrive well in marginal soils which do not permit successful growth of other crops. Nevertheless, it responds well to better soils and can stand a wide range of pH(from 3-8). However, a pH of around 4.5 to 6 is considered as the optimum for the growth of the crop.

IMPORTANT CLIMATIC FACTORS

In the north Eastern region the major constraints limiting the growth and yield of rubber is a low temperature coupled with a dry spell encountered during the winter season.

RAINFALL

The crop has been considered to perform well in areas having annual rainfull of the order of 200 to 400 cm with about 100-150 rainy days and having a dry spell of not more than one month duration. However, the crop is seen to be successfully grown in areas which widely deviate from the above range. The traditional rubber growing Kerala have continuous dry spells ranging from 4 to 5 months (Rao et al, 1985). In the North Eastern region of India also, dry spells range from 4 to 5 months (Saseendran etal, 1990).

TEMPERATURE

Most tropical crops have a base temperature of 10°C, an optimum around 33°C and maximum around 45°C. The mean temperature encountered in the rubber growing tracts of India was

around 28°C with a maximum and minimum around 38°C and 15°C respectively. Low temperature below 10°C causes cold damage to the rubber plants.

MATERIALS AND METHODS

Data - The daily and monthly data for periods ranging from 30 to 45 years, for 9 stations (Fig.1) located in and around the N.E. region were collected from the Tocklai Experiment Station, Tea Research Association, Jorhat.

Climatic Characteristics - Climograms were prepared for the Nine stations under study making use of the monthly data on rainfall, number of rainy days, maximum temperature, minimum temperature, relative humidity, bright sunshine hours and wind speed for bringing out the agroclimatic characteristics of the region. As the general agroclimatic features are not found to vary significantly from station to station the climogram for a single station Silcoorie only was presented for discussion (Fig.2) (crop weather calender has also been discussed only for this station).

Agro-climate in the region - Monthly distribution of agroclimatic parameters viz., rainfall, no. of rainy days, air temperature (maximum and minimum), relative humidity, hours of bright sunshine, wind speed and pan evaporation at the different stations were studied. The agro-climate at Silcoorie is presented (see fig.2) for reference.

Winter season (Dec. to Feb.) - About 2% of the annual rainfall is received during this season. Low temperatures associated with cold waves often dip the mercury to as low as 3°C in the rubber growing plain and mid lands of the region. January was observed to be the coldest month with minimum temperature of the order to 10°C. Mean seasonal temperature in the region are in the range 15°C to 22°C. Comparatively mild winds of the order of 20 to 100km/day were observed in this area during this season. Mean relative humidity observed were in the order of 60 to 70%.

Pre-monsoon (March to May) - About 20% (57 cm) of the annual rainfall is received during this season in about 30 to 40 rainy days. May is the hottest month with maximum temperature of the order of 35 to 40°C. Comparatively high winds were observed in this season with wind speeds of the order of 235 km/day. Relative humidity observed was of the order of 70 to 80%.

South West monsoon season (June to Sept.) - This is the rainiest season of the year, with a mean rainfall receipt of about 203 cm (72%) in about 60 rainy days. Mean maximum temperature recorded during this season were of the order of 20 to 28°C. Relative humidity observed range from m65 to 100%. Strong winds of the order of 240 km/day were observed during this season.

Post monsoon season (Oct. and Nov.)- The south west monsoon retreat from this region by the 1st week of October. Rainfall received in this season contribute to only about 8% of the annual rainfall in about 10 rainy days. Relatively low winds were observed. Mean temperature of the season was of the order of 25°C. Mean relative Humidity ranges from 65 to 80%.

DISCUSSIONS

The data on the climatic characteristics of the region collected from the various agromet stations points out that it differs from that of traditional region and hence a rescheduling of the existing calender of operations for rubber for traditional region is warranted. Based on the information available and also taking in to consideration the growth phase, the various agronomic operations are to be scheduled as indicated below:

Clearing, Burning and Fitting- Clearing operations for planting have to be commenced after the rain withdraws and dry spell commences. The ideal time for starting this operation can be January when the soil moisture is adequate to facilitate removal of roots etc. and the burning can commence from February. Pitting can be started when rains are received in early April to enable easy digging.

Planting- The schedule of planting should be fixed taking in to consideration the planting materials as well as the soil moisture status. Planting dates should be fixed in such a way as to make available the maximum period of soil moisture available.

The effective growth period of Hevea in the North Eastern region has been found to be from April to November. Taking in to consideration the onset of monsoon and distribution of rainfall the planting can commence from last part of April/first part of May. When the planting material used is budded stumps the planting should be completed by June. However, planting can be extended up to August/early September when polybag plants are used.

Manuring- Like planting this operation also requires good soil

Fig. 1 - Map of NE India showing stations used for the study.

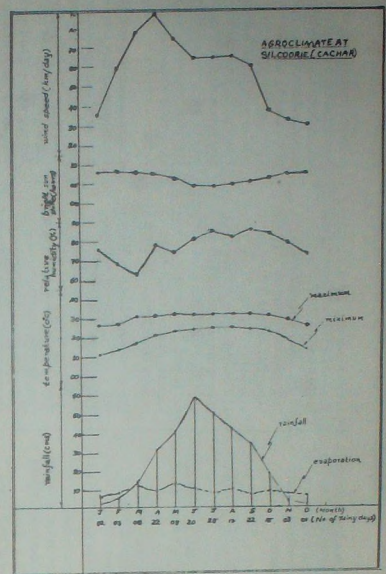


Fig. 2 - Agroclimate at silcoorie (Cachar)

CROP WEATHER CALENDAR

STATION: Silcoorie CROP: Rubber Plantations

Lat: 24°50'N Long: 92°43'E elevation : 39.6 m a msl.

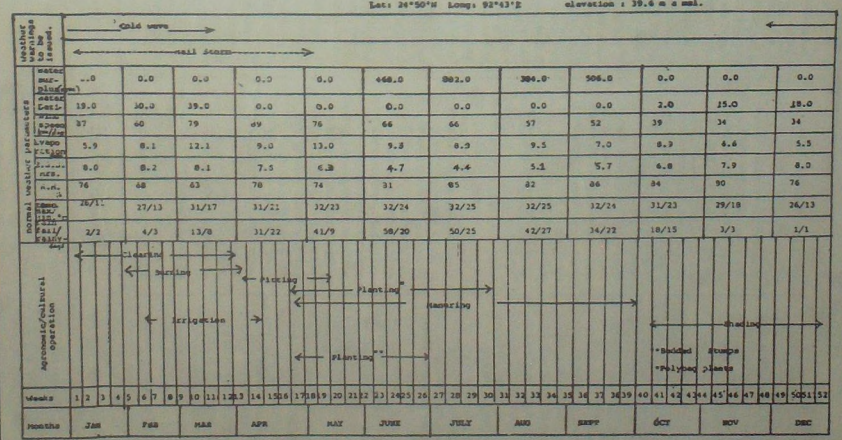


Fig. 3

moisture content in the soil and rainfall. The rainfall should not be very heavy to wash off the applied fertilizer. The optimum time for this operation would be April to September when enough soil moisture is available in the soil and when rainfall is received regularly (see fig.2). The fertilizer application can be started in the month of April after sufficient rains have been received. The last dose of fertilizer should be given the end of September.

When the planting is done with conventional budded stumps and if the planting is completed by April, fertilizers can be applied in September. If the planting material is polybag plant and when the planting is done in April/May first round of application of fertilizer can be done two to three weeks after planting and a second dose during September. However, if the planting of polybags is completed only during August, one round of fertilizer application only need be undertaken in September (Krishna Kumar and Potty, 1989).

Shade- Providing shade (approximately 40 percent light cut) has been observed to favour growth in nurseries. about 30% increase in the number of buddable plants have been noticed in the seedling nurseries at the same time helping to reduce frequency of irrigation. (Irrigation can be limited to once on 10 - 12 days). Shading has to be provided during the last part of October / first part of November.

Crop weather calendar- Based on the discussions presented above (on clearing, burning and pitting, planting, manuring and shade) a crop weather calendar was prepared and presented in Fig.3. The different agronomic operation to be carried out are represented as time intervals, indicated by horizontal arrows, in the bottom of the calendar. In the middle of the calender the normal weather conditions experienced in the region are presented. The top portion of the calendar gives the nature of weather warnings to be issued.

CONCLUSIONS

The climatological data collected at five locations in the North Eastern region were processed and climograms were prepared. The study reveals that there is variation in agro-climate in this region when compared to traditional rubber growing region and thus warraning for specific crop weather calender. The crop weather calender prepared from the data on agro-climate is expected to cater the need of rubber growers, and plantation managers and also will help on the development and extension activities pertaining to rubber.

REFERENCES:

1. Dijkman, H.J. (1950) Hevea- thirty years of Research in the far, University of Miami Press, Florida.

2. Krishna Kumar A.K. and Potty S.N. (1989), a new fertiliser recommendation for rubber in North Eastern Region. Rubber Board Bulletin 24(4) P.5-8.

3. Penman, H.D. 1948. Natural evaporation from open water, bare soil and grass. Proc. Roy, Soc. London, 193, 120-145.

4. Pushpadas, M.V. and Kartika Kutty Amma M.(1980) Agro ecological requirements. In Hand Book of Natural Rubber Production in India. Ed. P.N. Radhakrishna Pillai, Rubber Research Institute of India, Kottayam. P. 154-184.

5. Rao. A.S., Varadhan, K.M. and Vamadevan, V.K. 1985. Evaporative index for Scheduling irrigation in plantation crops. Mausam, 36: 205-208.

6. Saseendran S.A. and Potty S.N. 1990. On the suitability of NE India for rubber cultivation a climatic analogue evaluation (Under Communication).

7. Thronthwaite, C.W. Mather, J.R. 1955. The water balance. Pbl. in Cli. lab. of climatology, Drexel Inst. or Tech. Vol - VIII, No.1.

8. Weiss A, et al. 1988. Comparison of within canopy microclimate and white mould disease development in dry edible beans ac influenced by canopy structure and irrigation. Agri. & Forest Meteorol., Vol. 43, No. 3-4.

Rubber Wood

The Bureau of Indian Standards has included the rubber wood in the standard "Indian Timbers for Door and Window Shutters and Frames" (IS 12896 : 1990). The rubber wood shall be pressure / vaccum treated with suitable preservative conforming to IS : 401 of 1982. The details can be had from the above standards, sold by the Bureau of Indian Standards, Manak Bhavan, 9, Bahadur Shah Safar Marg, New Delhi - 110 002.

A NOTE ON THE RESEARCH COMPLEX FOR NORTH EASTERN REGION OF THE R. R. I. I. IN TRIPURA

A.K. KRISHNA KUMAR
REGIONAL RESEARCH STATION, KUNJABAN

Tripura, one of the seven states in the North Eastern region, was known as 'hill tipperas' in British political parlance. The origin of the name Tripura is still disputed. The traditional belief is that the name has originated from King Tripur, the successor of King Daitya a desendent of the mythical ruler Yayati. However, the most popular version is that it has come from two tripuri words Tui (water) and Pra, means land adjoining water. (In the days of yore the boundaries of Tripura extended upto Bay of Bengal).

Tripura was a princely state and it enjoyed a special status among the princely states even during the British regime since there was no treaty obligations with British government. The state formally acceded to the Indian union and the instrument of accession was signed by the regent Maharani on 14th August, 1947. However, the actual administration of the state was taken over by the government of India on 15th October, 1949. Following the reorganisation of the sates, Tripura was a part C state without legislation and became a union territory with effect from 1st November, 1956. It was accorded the status of a full fledged state in January, 1972.

THE LAND AND THE PEOPLE

As the name hill tipperas suggests the terrain is highly undulating with about six large hill ranges comprising of hills and valleys. The mountains are the extension from the eastern Himalayas between Brahmaputra and the chindwain - Iravati river systems. The mountain ranges from north west to south east separated by beautiful valleys. The state is surrounded by Bangladesh with an international boundary of 839 kms. The geographical area of the state is 10,491 sq.km. Tripura has no mountain proper but some of the peaks in the eastern ranges of hills reach a height of more than 2000 ft. The highest peak in Tripura is the Betalangshiv which is 3200 ft. high. The valleys consists of flat lands mostly to the west and south which constitute 40% of the area of the territory.

Administratively Tripura is divided into the three districts with 10 sub-divisions. The total population of the state as per latest figures is 25 lakhs and density of population being more than 200/sq.km. About 90% of the total population lives in villages. As a result of the partition and the wars the state had to absorb an exodus of refugees from the erstwhile east Pakistan creating an imbalance in the demographic situation. The present figures say that the original inhabitants, i.e. tribals is 30% of the total population only. The influx of migrants from east Pakistan begun almost in 1942 following a communal riot resulting in an alarming increase in population during the partition of the country. There were 19 scheduled tribes in Tripura, the predominant of which are Tripuris, Reang, Jamathia, and Chakma.

Forest form a predominant part of Tripura. The bulk of forest in the hills is dense bamboos, thatch grass, sal and gurgen forests and mixed evergreen forests and the evergreen Savana. The principal rivers in the state are Gomathy, Howra, Kowai, Manu Deo, Dolai and Feni., all draining in to Bay of Bengal through Bangladesh.

The state lies within latitude of 20° 60' and 24° 32' north and longitude of 90° 10' and 92° 20' east. The geographic area is 10,491 sq.km. which has a area under cultivation of 2,46,000 ha.

Tripura enjoys sub-tropical weather. The mean daily maximum temperature is 25°C and the mean daily minimum is 10.4°C during the coldest month. The cold spell starts from November and January is the coldest month. From the beginning of March, temperature

rises. The highest maximum temperature recorded at Agartala is 52.2°C (on 1-5-1960) and the lowest 3.8°C (on 14-1-'89). The average rainfall of the territory is about 2100 mm. Occurrence of cyclonic storms as a result of depression in Bay of Bengal and hail-storms are also a special weather phenomenon of Tripura.

The state has mainly an agrarian economy and main crops are rice, jute, mustard, sugar cane, tea etc. Most of the cultivation in the state is rainfed. The landscape is interspersed with hills called as 'tillas' and valleys called as 'lungas'. Majority of the area is coming under tilla land thus providing enough scope for horticultural and plantation crops.

Sixty percent of the area is classified as forest and this forests contribute significantly to the income of the state. The area under forest suffered a lot due to the indiscriminate felling of trees to meet the increasing demand of a sudden spurge in the population due to various socio-political reasons. Apart from this, the traditional way of cultivation, shifting cultivation, locally known as jhumming also paved way for the large scale destruction of thee forests particularly trees. As a result of this, the trees gave way for bamboos and thatch grass and later denuding the land to a great extent.

As already pointed out, vast expanses of land have been subjected to jhumming and these lands if not properly rehabilitated with crops would become infertile and ultimately turn to be waste lands. Afforestation off these land is only the answer to tide over this environmental catestrophy. It is in this context, the potential rubber plantation could be made use of to the fullest extent.

RESEARCH ACTIVITIES

The cultivation of rubber in the state was started during 1963 on a trial basis by the forest department. The Rubber Board started its activities by opening a Junior Field Officer's office in the year 1967. The activities were further strengthened by opening a Regional Office at Agartala in 1979. Simultaneously research activities also were initiated by opening a Regional Research Centre at Agartala with a farm attached to it at Taranager, Mohanpur located 20 km. from Agartala town (23° 53' N latitude and 91° 5' E longitude, 166 mtr. above MSL). The research centre was established to provide R & D support to the Board's developmental activities. Rubber being a tropical tree crop, may face problems while being extended to non-traditional region like North East where a sub-tropical climate prevails. A low winter temperature coupled with dry spell have been observed to influence the growth pattern as well as the yield of rubber.

The thrust areas of research at the station are:

1. To evolve suitable clones for this region.

2. To evolve suitable agromanagement practices.

3. To evolve suitable rubber based cropping systems embracing the principles of agro-forestry, mixed farming, intercropping etc.

4. To monitor thee ecological impact of Hevea in the

View of a mature plantation (1980 planting) in the Taranagar farm with a watercatchment and some other crops like banana, coconut, mango etc. planted on the frinches of catchment area.

ecologically fragile north eastern region.

5. To offer technical guidance to growers in the state on all aspects off scientific plantation management.

RESEARCH FARM AT TARANAGAR

The Taranagar farm almost represents the state since it has got tilla lands interspersed with valleys. The farm extending over an area of 66 ha. has almost been planted with rubber, the total planting area is around 46 ha. About 10 ha. of lunga land (low lying paddy land) available could be successfully converted as water catchment (Fig. 1) providing perennial supply of water for irrigation etc. The state has too much similarity with Kerala and a range of crops which grows well in Kerala has been observed to thrive up in Tripura also. Some of the plantation / horticulture crops raised in thee fringes of the water catchment area in thee Taranagar farm adds weight to this.

TRIALS IN PROGRESS

The first trial started in the station was in 1979 which was aimed at evaluation of 15 clones for their performance under Tripuraa conditions. The analysis of data from the trial has provided interesting information on the growth pattern, yield, stability pattern etc. Two distinct growth phases could be observed, a retarded growth during winter (October - April) and luxuriant growth during summer (May - September). Through there is a retardation in growth, this is made up during the growth in summer thus almost maintaining same growth rate as that off traditional region. The trend of yield during the first two years indicate that the high yielding clones are RRIM 600, RRII 105, PB 235 and RRIM 703. The average yield during the first year for RRIM 600 was around 900 kg./ha. and in the second year it touched around 1.2 MT.

In 1980 the station initiated a rial on the nutritional aspects of *Hevea* and the factorial experiment with three combinations of N.P.K. indicate that higher doses of nutrients have significant influence on growth and on the nutrient levels in soil as well as leaf of trees. Similar results were obtained in an 'on-farm' trial started in 1986 where it was established that planting material while used as polybag plants require much higher doses of N.P.K. The studies also were initiated on the planting techniques, mixed cropping, nursery practices, physio chemical characteristics of the soil etc. The preliminary results obtained from the above trial and also the information gathered while offering discriminatory fertilizer recommendation were used for evolving a new fertilizer recommendation for North Eastern region.

Detailed studies on physiological aspects of *Hevea* and analysis of yield component are also being undertaken. Data to establish relation between girth and biomass in *Hevea* also have been generated. The exploitation studies needed emphasis due to various problems encountered while tapping during winter time and this has been accorded highest priority.

Trials were initiated for progeny analysis selection from polyclonal seedlings, mother tree selection and screening of clones for performance etc. aimed at breeding the crop improvement apart from studies on flowering and wintering. Studies were also taken up to evolve specific

Two years old immature plantation - cover crop established. (photographed during summer).

agromanagement practices for nursery and other growth phases of *Hevea* including evolving a new cropping pattern embracing the principles of multiple cropping/mixed farming. The station also has undertaken location specific trials in farmers fields in Tripura as well as in the Karimganj district of Assam where in various clones are under evaluation.

Studies on ecological impact of *Hevea* plantations in the north eastern states were initiated and influence of plantation on soil properties had already been published. The impact of *Hevea* on the micro climate also is being monitored besides comparing the rubber trees with other trees being popularised under social forestry. It is hoped that useful information on this will be generated.

A germplasm collection is maintained and various trials for evaluation for stress tolerance etc. are also initiated.

Research complex under construction at Agartala. Office and laboratory of the Research Dept., Regional office of R.P. Dept. and residential buildings are under construction.

A Mobile Soil and Tissue Testing Laboratory has been commissioned aimed at offering discriminatory fertilizer recommendation to growers in the North Eastern region.

Intercropping of rubber with coffee in progress

INFRASTRUCTURAL FACILITIES

The station has a well-equipped laboratory with equipments such as: Portable Photosynthesis system, Dew Point microvoltmeter, Steady state pyorometer, UV Visible Spectrophotometer, Sophisticated balances, and microscope, Trace system, Pressure plate apparatus etc. An automatic Weather Station is also being procured. The laboratory has been approved for Ph.D. work, by IIT, Kharagpur, Calcutta University etc. A reasonably good library with about 800 volumes off scientific books and a regular subscription of 31 journals (18 international journals) have been set up during the last three years at a cost of around Rs. 5 lakhs.

The total strength of this station at present is 24 which include 8 scientists. A new research and residential complex is being constructed at Bhalukia tilla, about 5 km. from Agartala town at a cost of around Rs. 2 crores and the construction is expected to be over by June, 1991. Apart from the Regional Research Station, the Regional Office also proposed to be accommodated here.

The state offers excellent future for rubber though there are constraints such as hailstorm. Though the normal hailstorm which occur almost every year do not damage the plants heavily, the odd ones as the one that had bit the Taranagar farm during 1986 might lead to problems. Nevertheless it has been observed that even plants severely damaged could recover in a period of two years.

The Taranagar farm is also a centre of attraction visited by dignitaries within and outside the state. Recent visitors include Hon'ble Governor of Tripura and senior secretaries and army/police officers etc. The farm is having all basic infrastructural facilities built up such as processing factory, farm office and also a solar based smoke house is under construction.

Rubber Meet to Focus on Prices

Ministers of the world's leading rubber producing nations will meet for the first time in four years in june in Papua New Guinea to map out a future for the flagging industry, a senior rubber industry official said.

"The meeting will seek ways to overcome the current depressed prices and falling demand," Abdul Madjid, secretary-general of the Association of Natural Rubber Producing Countries (ANRPC) announced in a weekend interview.

"We will examine new mechanisms to improve prices to help sustain production," Madjid said.

ANRPC officials met in Kuala Lumpur to finalise the ministerial meeting on june 5-6 in the north-eastern PNG coastal town of Madang. Those discussions will be preceded by a series of committee meetings from May 29.

The Kuala Lumpur-based ANRPC, set up in 1970, accounts for 84 percent of the world's total natural rubber production. The group comprises India, Indonesia, Malaysia, Papua New Guinea, Singapore, Sri Lanka and Thailand.

Slow consumer offtake, falling tyre demand and lack of new industrial uses are keeping a lid on rubber prices, analysts say. Rising competition from synthetic rubber has also hurt.

Meanwhile, the Gulf War failed to boost rubber prices significantly, confounding expectations in the trade.

Price of International RSS Ones rubber, the Malaysian benchmark, are hovering at 227 Malaysian cents a kg against 243 cents six months ago and 230 cents a year ago.

World natural rubber output fell 4.7 pct to 4.8 mln tonnes in calendar 1990 from 5.04 mln in 1989, ANRPC figures show.

But world natural rubber consumption fell to 2.62 mln tonnes in the first half of 1990, down three percent from the same 1989 period, according to the London-based International Rubber Study Group (IRSG).

Stocks of natural rubber in producing countries fell to 350,000 tonnes at the end of june 1990 from 485,000 a year earlier, the IRSG says.

The tyre manufacturing industry is the biggest user of natural rubber. But the slowdown in the U.S. economy and its falling car production have affected demand for tyres.

Madjid said the june meeting must address ways to curb rising production costs, raise yields and productivity, boost marketing and step up local consumption.

"We must keep production costs low to compete with producers of synthetic rubber," Madjid said.

The ANRPC must also find ways to boost prices to encourage tapping and replanting of rubber trees, Madjid said. Low prices had discouraged tapping, as "tappers normally switch to other jobs when prices are weak," he said.

The ministserial meeting may recommend efforts to boost research and development in rubber technology and planting.

Natural rubber output in Malaysia, the world's top producer, slumped to a 20 year low of 1.29 mln tonnes in 1990 from 1.41 mln in 1989, according to Statistics Department figures.

The fall was largely due to a decline in cultivated area, as estate owners switched to palm oil and other crops.

NEWS & Notes

INDONESIA TO IMPROVE QUALITY

Indonesian rubber producers, under pressure from low prices, need to improve quality if they want to be competitive on the world market, delegates at a seminar on rubber quality were told.

"Consumers are demanding (a high) quality of natural rubber. Manufacturers would happily buy the higher quality rubber at prices the market dictates from time to time", said Tan Sri. Sekhar, Secretary-general of the London-based International Rubber Study Group, who addressed the seminar.

He said consumers, over 80 percent of whom are tyre manufacturers, required a consistently clean supply of rubber.

But traders say that processing by the country's smallholders, which produce 80 percent of Indonesia's total rubber output, often means inferior quality.

Indonesia, the world's second largest rubber manufacturer, produced 1.3 mln tons of rubber in 1990. The total is expected to fall five percent to 1.24 mln in 1991 because of heavy rains and declining prices.

Standard Indonesian Rubber (SIR) 20, its main export grade, trades at about 77 cents a kg. against an average of 85 cents a year ago.

But Sekhar said that despite current prices, prospects for natural rubber demand looked good in the long-term. He cited the changes in Eastern Europe as one reason for optimism.

"About 10 years from now they (east Europeans) should have shifted into a free market economy", he said. By then the region will need a further 1.5 mln tonnes of rubber a year, he added.

Current world consumption is about 5.34 mln tonnes.

Chairman of the Indonesian Rubber Association (Gapkindo), Hasan Zakaria, said in a bid to boost output, Indonesia has begun to rejuvenate old rubber trees. These account for about 3,50,000 hectares of the country's 2.6 mln hectare of rubber plantations.

GOODYEAR ANNOUNCES 25% DIVIDEND

Directors of Goodyear India have recommended a dividend @ Rs. 2.50 per equity share on the increased share capital.

The company reported increased turnover of Rs. 237 crores against Rs. 217 crores in the previous year. After providing for depreciation Rs. 445 lakhs and taxation Rs. 593 lakhs the net profit from the company's operations is Rs. 667 lakhs.

Exports during the year recorded a phenomenal increase of 212% in terms of value, with turnover of Rs. 452 lakhs. During the year 1990, about 50% of total export of rear tractor tyres from the country was from Goodyear India.

As per Chairman & Managing Director, Dr. Roop S Bhakuni, a Polymer Scientist, the Company is poised for growth and breakthrough in areas like product innovations, technology transformation, productivity and a new approach to manpower management.

Smt. J. Lalithambika I.A.S., Chairman, Rubber Board, delivering the presidential speech at the 116th meeting of the Rubber Board. M.M. Jacob, P.C. Thomas and Joseph Monipally are also seen.

NEW USES FOR NATURAL RUBBER

The public sector Hindustan Latex Ltd. is awaiting the evaluation by expert foreign agencies of the female condom samples made of natural rubber latex developed by it for possible commercial manufacture.

This was reported in a paper on "latex products for medical application" presented by J. Sahayadasan, Lissy Thomas and Rajalakshmi at a seminar on "latex products" here on Sunday under the auspices of the Kerala branch of the Indian Rubber Institute.

The paper pointed out that female condom available in developed countries is made out of synthetic latex. The result of inhouse studies on the sample developed by HLL in natural rubber latex has been encouraging.

The female condom is a safe and effective alternative contraceptive and prophylactic to male condom. It is protective measure against sexually transmitted diseases, including AIDS. The foreign industrialist analysts have predicted that the female condom might capture 10 per cent of the condom market in the near future.

Among the other natural rubber latex products for medical application under various stages of research and development by the HLL are uriserves for urine collection of bed-ridden patients, dental dam used in orthodontial treatment and thigh guard for protecting the bare skin of the women workers employed in the silk yarn industry in Madhya Pradesh.

The seminar was inaugurated by Dr P.V.S. Namboodiripad of the Appollo Tyres. Dr. D. Joseph Francis of Cochin University, Mr. M.R. Kurup, honorary adviser, HLL, Mr. Baby John of the VSSC, Thiruvananthapuram, and Dr. P.K. Mohammed, honourary secretary, IRI, Kerala branch, spoke.

JOSEPH MONIPPALLY : Vice-Chairman

116th meeting of the Rubber Board unanimously elected Shri. Joseph Monippally as its new Vice-Chairman. Shri. Monippally who represents rubber growers on the Board is General Secretary of the Indian Rubber Growers' Association. He is also member of the Board of Directors of NAFED.

Dr. B.K. MODI : Chairman, A T M A

The 15th meeting of Automotive Tyre Manufacturers Association (ATMA) held at Bombay elected Dr. Bhupendra Kumar Modi as its new Chairman.

S.N. SRIVASTAVA : Vice-Chairman of A T M A

The meeting of ATMA held at New Delhi elected Shri. S.N. Srivastava (Managing Director, Dunlop India Ltd.) as its Vice-Chairman.

DR. ROOP S. BHAKUNI : Chairman, Goodyear, India.

Dr. Roop S. Bhakuni, a distinguished Polymer Scientist and former Director of Research of The Goodyear Tire & Rubber Company, U.S.A., has been appointed Chairman & Managing Director of Goodyear India.

Born in India, Dr. Bhakuni, obtained his Master's degree from IIT, Kharagpur, and completed his PHD studies at the University of Akron, the world's premier university in polymer sciences. A distinguished author of several research papers, Dr. Bhakuni has made notable contributions in the development of reinforcing and compounding materials for radial tyres.

RUBBER BOARD BULLETIN
Vol. 26 Number - 2 October - December, 1990

CONTENTS

Published by
THE RUBBER BOARD

Editor
P.K. Narayanan
Jt. Director
(Rubber Promotion)

Asst. Editor
K.A. Aravindakshan Nair
Asst. Director (Publicity)

Cover: **SOMU**

THE QUARTER

Most of the nations in the world which had established themselves as top rankers in respect of production and productivity of natural rubber are now lagging behind and comparatively smaller nations have conquered their coveted positions. Thailand has now reached an enviable position and even defeated Malaysia in the race for improving production.

The world production of NR for the last 10 year period had recorded a total increase of 11.45 lakh tons. Now Natural rubber is produced in over 20 countries in the world. Of these, Malaysia, Indonesia and Thailand have a total share of 37.05 lakh tons in 1981 while 17 nations put together contributed only 8.17 lakh tons. The ratio works out to 82 : 18. Again, after a lapse of a decade, the three produced 36.70 lakh tons and others 13.8 lakh tons at a ratio of 74:26.

Malaysia, the foremost producer of natural rubber in the world had its share of 15.70 lakh tons in 1980. In 1990 it was only 12.91 lakh tons registering a sharp decline. During the past 10 years their production declined by 18%. Production for 1990 was the lowest ever recorded during a period of 20 years.

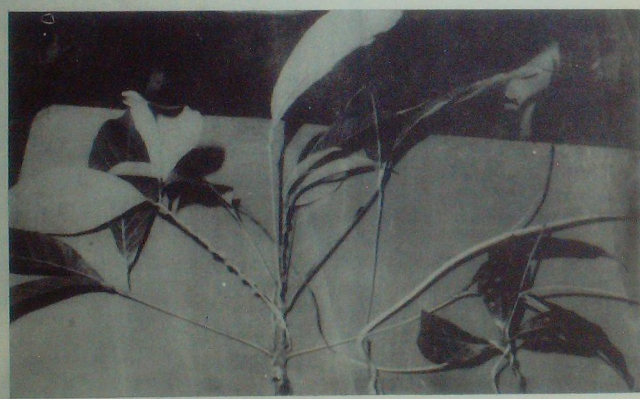
Though Malaysia is the foremost among the natural rubber producing countries, Indonesia has the highest acreage. Their total area under rubber comes to 31.10 lakh hectares. Though production has increased in Indonesia during the last 10 year period, annual production fluctuated according to prices ruling the world market.

Thailand, the third highest producer of natural rubber had recorded consistent increase in production in all these years. Their production in 1990 was 11.92 lakh tons. Declining Malaysian production and an ambitious replanting programme in Thailand will make that country, perhaps, the world's largest rubber producer for the first time this year. In 1991, Thailand expects to produce 1.34 million tons of natural rubber.

DODDER MENACE : A THREAT TO RUBBER PLANTATIONS

L. THANKAMMA, MYCOLOGIST
RUBBER RESEARCH INSTITUTE OF INDIA
KOTTAYAM - 686 009.

A large number of plant species belonging to different genera and families are plagued by the parasitic infestation of the noxious weed Dodder (Cuscuta sp. belonging to Convolvulaceae). Of late it has been observed that the flowering plant parasite has encroached into the rubber plantations also infesting the cover crop *Pueraria Phaseoloides* and rubber tree *Hevea brasiliensis*.



Close observation of plantations with young rubber may reveal thick meshes of entangled leafless vines with golden yellow colour, growing over the thick bed of Pueraria growth. This apparently in nocuous growth is nothing but the noxious parasitic weed 'Dodder' or 'Cuscuta'. This plant is devoid of leaves and roots and is a total stem parasite having a wide host range including many cultivated species and few plantation crops. The Pueraria vines and petioles are held firmly together in a langled mass. The parasitic colony circular in outline at first will grow outwards increasing in circumference. As the colony advances towards the periphery, the central portion dies out along with the host. The growing tip of the parasitic vine entwines the Pueraria vines and petioles as if for support and once it comes into contact with the host it coils repeatedly around it so that the host tissue is not visible outside. Once the vine comes into contact with the host, on the surface facing the host large number of tooth like projections or prohaustoria are produced which later pierce the host tissue, reach the vascular elements and absorb assimilates, water and minerals from it. The

(Continued on Page - 27)

Smt. J. Lalithambika, Chairman, Rubber Board, expressed the view that the people all over the world are becoming more and more conscious over environmental issues and they are quite concerned about the residues of the toxic agricultural chemicals accumulated in soil and water. She also announced that the environmentalists are keen on natural control which can restore the biological balance of nature. She was inaugurating the National Seminar on Biological control in plantation crops at the Rubber Research Institute of India, Kottayam , Kerala. About 200 scientists from different parts of

NATIONAL SEMINAR ON BIOLOGICAL CONTROL IN PLANTATION CROPS

the country attended the two day seminar jointly organised by the Rubber Board, Spices Board, North Eastern Hill University (Shillong) and Kerala Agricultural University.

Dr. R. Jayarajan of Tamil Nadu Agricultural University delivered the keynote address at the inaugural function which was presided over by Dr. G. B. Pillai, Principal Scientist, Central Plantation Crops Research Institute, Kasaragod. Felicitation speech was delivered by shri P.Mukundan Menon. Dr. M. R Sethuraj, Director of Research, RRII, welcomed the delegates. Dr. K. Jayarathnam Dy. Director (Pathology Divn. RRII) proposed a vote of thanks. About forty research papers relating to various aspects of biological control were presented in the different sessions of the seminar which concluded on 28th June, 1991.

Following is the text of the inaugural speech made by Smt. J. Lalithambika:

"We consider it our privilege in having got an opportunity to host this National seminar on Biological control in plantation crops. We had planned to hold this seminar a few months ago but had to postpone it because of the restrictions imposed on holding such seminars and conferences. Anyway better late than never. Even though the formal welcome address has already been delivered, as Chairman of the Rubber Board, I would like to personally extend a very hearty and warm welcome to the distinguished delegates who have come here from different parts of the country, representing various Universities and prestigious Organisations. I must be the only generalist in this august assembly of specialists. I am sure that all of you know the definitions of a specialist and a generalist. A specialist is one who knows more and more about less and less whereas a Generalist is one who knows less and less about more and more. So I can be justified in knowing only very little about biological control. So I would like to say only a few words from the point of view of a generalist administrator.

CONTROL MEASURES

It is believed that pests and diseases account for a loss of nearly 20% of the crops produced and hence the control of pests and diseases of crop plants assumes special significance. Though the use of agricultural chemicals in the past two centuries has given

rich dividends by way of increased crop production, it has damaged our environment seriously. People all over the world are becoming more and more conscious about environmental issues and they are quite concerned about the residues of toxic agricultural chemicals accumulated in the soil and water. Environmentalists are keen on 'natural control' which can restore the biological balance of nature.

But one of the reservations expressed in the use of biological control is that it is slow acting. The Integrated Pest Management (IPM) programme appears to be a sound compromise. It is high time that Scientists working in Crop protection of Plantation crops made sincere attempts to evolve biological alternatives for the chemical control measures now being practiced. The biological agents must be safe, long-lasting, quick-acting and economic.

Our Rubber Research Institute has already initiated various research programmes in this direction. Initially a survey was made on the occurence of bacteria and actinomycetes, the major antibiotic producing organism in the rubber growing soils and the root zones of Hevea. Over 50% of the organisms were found to exhibit major pathogens attacking rubber plants.

During the survey an actinomycete was observed to have very high inhibitory activity against the pink disease pathogen. Both lab and field studies have indicated the possibility of using this organism for the control of pink disease of rubber. Moreover it has faster bark healing property also.

Some isolates of the actinomycetes also prevented the growth of phytophthora, the causative organisms of abnormal leaf fall disease. It is only in the preliminary study stage. Whether it is cost effective is also to be examined.

PROGRESS

Some work has been done in Brown root diseases also. Intensive studies on the isolation and identification of antagonistic fungi like Trichoderma species which are effective for the control of root disease of plants have been initiated. Success has been achieved in identifying a species of Trichoderma which is capable of inhibiting brown root disease pathogen in the rhizospere. The use of this antagonist resulted in the control of disease in polybag plants and also in the increase of plant growth. This study has been extended to the field.

White grub attack is a serious menace in rubber nurseries which necessitates the application of very high dose of insecticides in soil. To overcome this, two species of entomopathogenic fungi were tested. Both the species are found to be as effective as highly toxic insecticides in reducing the incidence of white grub attack. Studies on the attack of this fungus on eggs, grub, pupa and adult beetles were also carried out. We were able to standardise the optimum innoculam dose required, mode of field application and methods of inoculum preparations.

Investigations on the bio-control of weeds started only on the recent past. Larvae of the insect pareuchaetus was introduced on Eupatorium, weed commonly found in Rubber plantation and it was found to be much effective in controlling the weeds without damaging rubber plants and cover crops. But some difficulties are experienced for large scale establishment of the insect. Attempts were made for multiplying and maintaining this pest under laboratory conditions.

However it has been found difficult to mass produce biological control agents and stabilise them in nature. Hence the work so far done in RRII is of preliminary nature in identifying the potential biocontrol agents. Field establishment of these organisms is being undertaken.

Our future programmes include testing of more bioagents for the control of diseases, isolation of leaf surface, root surface and stem surface micro organisms and testing them for the control of leaf and stem dideases, testing of various pathogens and stem diseases, testing of various pathogens and predators for the control of insects attacking aereal parts of rubber, stabilising the population of pareochaetus for the control of Eupatorium and introduction of weed control agents for controlling other major weeds."

INSECT PESTS OF RUBBER WOOD IN KERALA

GEORGE MATHEW
KERALA FOREST RESEARCH INSTITUTE, PEECHI

INTRODUCTION

Rubber wood is an important source of raw material for many wood based industries in Kerala following the acute short supply of several conventional timber species. According to an estimate by RRII (1980) an area of 225,000 ha. has been planted with rubber by 1979. It is also estimated that an area of 5000 ha. is being replanted each year following the clear felling of older plantations upon completion of the rotation period. At the time of clearfelling, 5000 ha. could yield about 570,000m3 of round wood and 360,000m3 of branchwood which is expected to add substantially to the timber produced from the Kerala Forests.

In Kerala rubber wood is mostly used for packing cases, match veneers and splints, toolhandles, etc. It's susceptibility to fungal and insect attack limits its wider utilisation although studies elsewhere have established that rubber wood is highly suited for various purpose like furniture making, manufacture of panel products etc. In Kerala attempts are underway to make use of this timber for the above purposes as well. A knowledge of the insects damaging this wood as well as their damage potential is very much needed for developing appropriate techniques to avoid the insect caused deterioration. Information in this regard is given in this paper.

INSECT PESTS OF RUBBER WOOD

Literature records on the insect pests of rubber wood in various countries indicate that beetles belonging to the families Cerambycidae, Bostrychidae, Platypodidae and Scolytidae are the major threat for the successful storage and utilisation of this timber species. In a study on the insect pests of this timber in Malaysia, Norhara (1981), listed about 25 species of beetles belonging to the families Cerambycidae, Scolytidae, Platypodidae, Bostrychidae and Lyctidae as pests. Of these, 8 species (6 spp. belonging to Bostrychide and one each to Lyctidae and Scolytidae) were recorded as specifically associated with seasoned timber. Similarly, in Sri Lanka, Tisseverasinghe (1970) reported two species of botrychids, viz, Heterobostrychus sp., and Sinoxylon conigerum as the most destructive pests warrenting prophylactic treatment of the timber.

In India, large scale storage and utilisation of rubber wood has started only recently and as such much information is not available on the relative pest potential of the various insects recorded. Mathur and Singh (1960) and Duffy (1968) reported about 30 species of beetles mostly belonging to the families Cerambycidae, Platypodidae and Scolytidae as pests of freshly felled timber.

Recently Mathew (1987) recorded 11 species of beetles belonging to the families Platypodiade, Curculianidae, Bostrychidae and Lyctidae from Kerala. Among these the bostrychids and Lyctids were mostly associated with converted timber or finished products while the remaining species were collected from stored logs. The status and damage potential of these insects are discussed below:

BEETLES ATTACKING ROUND LOGS

1. Batocera rufomaculata De Geer. (Cerambycidae)

In Kerala, B. rufomaculata is well known as a major pest of live mango and cashew trees. It is highly polyphagous and is known to attack over 30 species of timbers in india (Beeson 1941). Generally it attacks unhealthy standing trees or freshly felled logs. The grubs make extensive excavations between the bark and the wood in the early stages. Later, they tunnel into the wood resulting in large longitudinal cavities.

The incidence by this pest could be reduced by enforcing sanitary conditions in the storage yards and by debarking the logs before storing. Not considered as a serious pest for the time being.

2. Xyleborus similes Ferr. (Scolytidae)

This is a widely distributed species of scolytid borer in India attacking over 50 timber species

(beeson, 1941). It is primarily a pest of stored logs particularly of newly felled timber. The larval tunnels extend deep into the wood. Occurrence of shot holes in the logs affect the quality of veneers that are peeled out of such timbers.

3. Platypus solidus Wlk. (Platypodidae)

It is a common but occasionally serious pinhole borer in several timber species in Kerala. It generally attacks round logs with intact bark. It is highly polyphanous and attacks over 30 species of timbers in India (Beeson,1941). The larval galleries penetrate deep into the wood. Damage caused by this insect is a problem in logs meant for peeling veeners.

4. P. latifinis Wlk. (Platypodidae)

The distribution, nature of attack and pest potential are the same as that of P. solidus.

5. Phaenomerus sundevalli Boh. (Cucrulionidae)

Generally attacks stored logs with bark. The attack is usually confined to the sapwood, resulting in the formation of minute holes. This is a polyphagous species and in Kerala, its distribution is not as extensive as that of the Scolutidae and Platypodidae discussed earlier.

Beetles attacking converted timber or finished products.

6. Sinoxylonn anale Les. (Bostrychidae)

It is one of the commonest timber pests in India as well as in several countries in the Oriental region having an unusually wide host range. Beeson (1941) has listed about 68 species of hosts. The gallery system is ramifying and runs radially through the bark into the sapwood. In low density wood where there is not much demarcation of sapwood and heartwood, the wood is completely riddled causing serious economic loss. Usually it attacks converted timber although various finished products made out of such timbers also suffer damage. During the course of this study this insect was found to be a major problem in several industrial units which use rubber wood as the raw material.

7. Sinoxylon conigerum Gerst. (Bostrychidae)

In appearance and nature of damage this species closely resembles S. anale although it is not as widely distributed as S. anale. Tisseverasinghe (1969) considers this species as a serious pest of rubber wood in Sri Lanka. Being a close relative of S. anale, S. conigerum has potentialities in attaining major pest status in Kerala.

8. Heterobostrychus aequalis Wat. (Bostrychidae)

This is a common borer in packing cases, tea chests, veneers, etc. It is highly polyphagous and attacks about 36 timber species in India. Its nature of damage is typical of the powderpost beetles. It generally attacks the sapwood riddling it with several shot holes. It may also develop in stacked veneers eating out galleries between different layers. The infestation usually goes unnoticed as the frass formed usually remain stuffed within the larval tunnels. This species has been considered as a major pest of rubber wood in Sri Lanka (Tisseverasinghe 1969). In Kerala, this insect may be considered as a potential pest of various rubberwood products especially match veneers.

9. Dinoderus spp. (Botrychidae)

Species belonging to the genus Dinoderus are well known as pests of stored reeds and bamboos. A few are known from various timbers as well but none has attained major pest status. As such, the species collected on rubber wood is unlikely to cause any damage to stored rubber wood.

10. Minthea rugicollis Wlk. (Lyctidae)

The nature of attack of this beetle is similar to that of bostrychids. Generally it attacks finished products like bobbins, tool handles, veneers, match splints etc. The damage does not become apparent in the initial phases due to the small size and fewer number of the shot holes but after a month or two the damage becomes pronounced due to the formation of numerous shot holes. This insect may be considered as a potential pest of finished products like furniture, carvings, match veneers etc.

11. Lyctus brunneus (Steph.) (Lyctidae)

The nature of damage and pest status are the same as that of M. rugicollis.

DISCUSSION

Altogether 38 species of beetles are recorded as pests of rubber wood in India (Table 1). Based on the information available for the species collected from Kerala, two types of pest problems have been recognized (1) damage caused to stored logs and (2) damage caused to converted timber or finished products. Insects belonging to the families viz., Cerambycidae, Scolytidae, Platypodidae and Curculionidae were found to be associated with fleshly felled timber. Damage caused by these insects affect the quality of products made out of such logs. Debarking the logs immediately after felling and application of

prophylactic insecticide treatments as suggested for protection of other softwoods (Gnanaharan et al.1982) may be followed for rubber wood as well for keeping it free from insect attack.

Damage caused to converted timber or finished products is still more important. Borers belongings to the other two families viz. Bostrychidae and Lyctidae belong to this category. Besides sawn timber a variety of finished products like tool handles, bobbins, veneers, furniture, packing case boards etc. were found to be heavily damaged. Although, at present only one (Sinoxylon angle) out of the 6 beetles recorded under this category was found to be more prevalent all the other species (except perhaps Dinoderus sp.) have the potentiality to attain major pest status under favourable conditions as evidenced by their sporadic outbreak at different localities. Conversion and treatment of timber by boron diffusion techniques immediately after feeling have been suggested for protection from this insect (Gnanaharan and Mathew, 1982). Since the biology and behaviour of the other beetles belonging to Bostrychiudae and Lyctidae are closely similar, this treatment is likely to give sufficient protection from the other pests as well.

REFERENCES

Beeson, C.F.C. (1941). The Ecology and Control of the Forest Insects of India and the neighbouring countries. Vasant Press, Dehra Dun, pp.1007

Duffy, E.A.J. (1968). A monograph of the immature stages of Oriental timber beetles (Cerambycidae). British Museum (N.H.) London 434 pp.

Gnanaharan, R. and Mathew, G.(1982). Preservative treatment of rubber wood(Hevea Brasiliensis). KFRI Research Report 15, 16 pp.

Gnanaharan, R., Nair, K.S.S. and Sudheendrakumar, V.V. (1982). Protection of fibrous raw material in storage against deterioration by biological organisms. KFRI Research Report, 12, 24 pp.

Mathew, G. (1987). Insect borers of commercially important stored timber in the State of Kerala, India. J.Stored Prod. Res.23 (4): 185-190.

Mathur, R.N. and Singh, B. (1960). A list of insect pests of Forest Plants in India and the adjacent countries. Part.5, Indian Forest Bulletin, 172(5): 91 pp.

Norhara, Bt. Hussein (1981). A preliminary assessment of the relative susceptibility of rubberwood to beetle infection. Malaysian Forester, 44(4): 482-487.

Rubber Research Institute of India (RRII) (1980). Handbook of natural rubber production in India. Rubber Board, Kottayam, 668pp.

Tisseverasinghe, A.E.K. (1970). Utilisation of rubber (Hevea brasiliensis) Wood. Ceylon For. 9 (3 & 4): 87-94.

1. Insect pests of rubber wood in India

Species		Family	Associated with			Source		
			1	2	3	4	5	6
1.	Batocera rufomaculata De Geer	Cerambycide	x			x		x
2.	Hoplocerambyx spinicornis Newman	"	x			x		
3.	Agelasta cristata Breun.	"		x		x		
4.	A. nigromaculta Gah.		x			x		
5.	Coptops aedificator Fb.	"		x		x		
6.	C.lichenea	"		x		x		
7.	Dihamus rusticator Fb.	"		x		x		
8.	Mechotuypa verru-cicollis Gah.			x		x		

Species	Family	Associated with			Source		
		1	2	3	4	5	6
9. Pterolophia annulata Chevr.	"		x		x		
10. Anancylus Griseatus	"		x			x	
11. Neocerambyx paris	"		x			x	
12. Crossotarsus venustus Chap.	Platypodidae		x				
13. C. minax Wlk.	"	x			x		
14. Platypus cupulatus Chaup.	"	x			x		
15. P. lepidus Chap.	"	x			x	x	
16. P. solidus Wlk.	"	x			x	x	
17. P. latifinis Wlk.	"	x			x	x	
18. Xyleborus perforans Wollaston	Scolytidae				x		
19. X. similes Ferr.	"	x			x	x	
20. X. comptus Sampson	"	x			x		
21. X. dilatatus Eichh.	"	x			x		
22. X. discolor Blandford	"	x			x		
23. X. exiguus Wlk.	"	x			x		
24. X. fornicatus Eichh.	"	x			x		
25. X. interjectus Blandfeld	"	x			x		
26. X. morigerus Blandford	"	x			x		
27. X. noxius Blandford	"	x			x		
28. X. obliquecauda Blandford	"	x			x		
29. X. semigranosus Blandford	"	x			x		
30. X. semiopacus Eichh.	"	x			x		
31. X. testaceus Wlk.	"	x			x		
32. Phaenomerus sundevalli Boh.	Curculionidae				x		
33. Sinoxylon anale Lesne	Bostrychidae		x	x		x	x
34. S. cibugeryn Gerst,	"		x	x		x	x
35. Dinoderus minutus Fb.	"		x	x			x
36. Heterobostrychus aequalis Wat.	"		x	x		x	
37. Minthea rugicollis Wlk. Lyctidae	"		x	x		x	x
38. Lyctus brunneus (Steph.)	"		x	x		x	x

1. Freshly felled timber
2. Unprocessed stored logs
3. Converted timber and finished products
4. Mathur & Singh (1960)
5. Duffy (1968)
6. Mathew (1987)

REPORT OF A STUDY ON THE EXTENT AND PATTERN OF UNREGISTERED HOLDINGS

TOMS JOSEPH
RUBBER RESEARCH INSTITUTE OF INDIA

The Rubber act (1947) prescribes that every rubber holding in the country must be registered with the Rubber Board. Only registered holdings are eligible to receive the benefits under the various development schemes of the Rubber Board. A survey conducted in 1984 in Vakathanam Village in Kottayam District reported 50 per cent unregistered rubber area (1). Again another survey conducted in Madapally, a nearby village of Vakathanam in 1988 showed that 46 percent of the total rubber area was unregistered (2).

To study the extent of unregistered area in the small holding sector in the traditional rubber growing regions, a ward in the Mutholy Panchayat of Palai Region (Neyyoor Desom) was selected and relevant data were gathered from 231 households covering 176 ha. In this ward a large number of tiny small holdings in clusters were found. In the previous studies, tiny small holdings were found to be generally unregistered. The survey was carried out during 1989.

From the survey the average size of a holding is found to be 0.76 ha. Table I illustrates the extent of unregistered area among various groups. From the table it is seen that 35 per cent of the total area under rubber is unregistered in the ward. This is considerably low compared to the reported figures in the 1984 and 1988 studies mentioned above. This may be due to the fact that Vakathanam and Madapally villages are relatively newcomers in rubber cultivation. In these two villages rubber area occupied only around 40 percent of the total area, while in Neyyoor it was 68 percent.

The extent of unregistered area is higher in the new planted rubber area and it is the highest (74 percent) in the immature area in this category. Table 2 shows the volume of unregistered area across the different size classes of holdings.

As the average size of the land in possession increases the extent of unregistered area under rubber diminishes, except in the size class 3.5 ha and above. Such an inverse relationship is also found when the extent of rubber cultivated in the total land is on the increase.

A comparison of the adoption of planting materials in the registered fields vis-a-vis the unregistered fields, is presented in Table.3.

TABLE - 1

Extent of unregistered area (as percentage of the total rubber area)

Category	In mature area.	In immature area.	In total area.
New planted area	45.1	74.0	54.7
Replanted area	24.1	22.1	23.3
Total	33.3	36.1	34.5

TABLE - 2

Extent of unregistered area-size class wise (area in ha).

Total area	0-0.2	.2-.5	.5-1.0	1-1.5	1.5-2.5	2.5-3.5	3.5 & above	Total
Average size of land in possession	.03	0.32	.71	1.22	1.93	2.77	4.22	0.76
Percentage of rubber area	49	67	71	66	67	77	64	68
Percentage of unregistered rubber area	100	95	62	47	23	6	23	35
No. of units	105	29	31	21	28	7	10	231

TABLE - 3

Trends in the adoption of planting materials*(%)

Period	Registered Area					Unregistered Area				
	RRII 105	PB 311	RRIM 600	Other planting materials	Total	RRII 105	PB 311	RRIM 600	Other planting materials	Total
Before 1970	--	--	45	55	100	--	--	--	100	100
			(4.65)	(5.80)					(1.83)	
1970 - 1974	--	--	64	36	100	27	--	16	57	100
			(3.45)	(1.98)		(1.10)		(0.66)	(2.36)	
1975 - 1979	53	--	40	7	100	83	--	10	7	100
	(6.37)		(4.89)	(0.80)		(8.92)	--	(1.08)	(0.72)	
1980 - 1984	89	2	7	2	100	83	--	--	17	100
	(22.90)	(0.68)	(1,73)	(0.45)		(8.54)			(1.71)	
1985 onwards	59	33	4	4	100	93	7	--	--	100
	(14.32)	(8.08)	(0.85)	(1.00)		(13.12)	(1.00)			
Total	56	11	20	13	100	77	3	4	16	100
	(43.59)	(8.76)	(15.57)	(10.03)		(31.68)	(1.0)	(1.74)	(6.62)	

*Area in ha. is given in brackets.

Before 1970, all unregistered fields were planted with unselected varieties. But in the course of time, high yielding varieties were progressively planted in both registered and unregistered plots. It is interesting to note that the growers selected their unregistered plots for the initial planting of RRII 105. It is possible that the growers experimented with the new variety in their unregistered plots which are small to avoid the risk of possible low yield. But the situation after 1985 exhibits a drastically different picture. Though not officially recommended for widespread adoption nor backed by reliable yield data, the growers are increasingly planting PB 311 (a new-comer in the small holding sector) in their registered fields.

A comparison of the intensity of planting in registered and unregistered fields is attempted in Table 4.

It seems that the initial stand/ha of registered and unregistered fields is more or less the same and nearer to the officially recommended 420 to 445 plants per ha. But in 1970's and in early 1980's the picture was different. In those periods, the planting intensity was higher in the unregistered fields.

The Rubber Board has recommended that by selective

TABLE - 4

Planting intensity (Stand/ha.)

Period	Immature phase	Mature phase				
Year	1-3	4-7	8-10	11-13	14-16	17 & above
Registered area	448	437	395	362	373	326
Unregistered area	441	464	455	382	347	342

thinning out during immaturity period and the initial years of tapping, the stand/ha may be brought down to 310 by the 10th year of planting (generally third year of tapping) (3). But it is seen from the study that even in the registered fields the stand per ha at the 10th year of planting is around 400 per ha. In the unregistered fields it is still higher.

The study also focused on the extent of interplanting in the unregistered area. The fields are classified according to the extent of interplanting which is defined as the ratio of interplanted trees to the total rubber stand.

It is seen that generally the intensity of interplanting increases as the size of the field declines. The maximum intensity of interplanting is found in the lowest size class.

An attempt is also made to understand the reasons for the reluctance of the growers to register their plots with the Rubber Board. In the two studies mentioned above, the reasons for non-registration have not been mentioned. The information gathered from the growers during the present study is summarised in Table 6.

It appears that more than half of the unregistered fields either belong to the category of marginal land or the total area is below 0.2 ha which is the minimum limit required for availing subsidy. The fields in the size class 0.2-0.50 ha are not registered mainly due to the lack of awareness on the part of the growers and high level of interplanting. The growers with unregistered fields above 0.49 ha stated that it is due to official delay that they did not register the holding with the Rubber Board.

It has been observed that rubber cultivation was extended to tiny plots previously used for raising other crops like tapioca and vegetables. Certain households with less than 0.10 ha were forced to cultivate rubber due to the development of rubber cultivation in the surrounding plots which prevented successful growth of

TABLE - 5

Extent of interplanting. (percentage of fields under different intensity levels).

Size of fields (in ha)	Intensity ratio				
	Below 0.10	0.10-0.20	0.20-0.40	0.40 & above	Total
Below 0.20	38	32	19	11	100
0.2-0.5	57	31	10	2	100
0.5-1.0	63	25	12	-	100
1.0 & above	50	25	25	-	100
total	47	31	16	6	100

TABLE - 6

Reasons for non registration. (Percentage of fields unregistered due to different reasons).

Reasons	Size class of fields (in ha)				
	Below 0.20	.20-0.50	0.50-1.00	1.00 & above	Total
1. Official delay	NA	9	43	50	7
2. Area below the minimum limit to avail the Rubber Board's financial assistance	100	NA	NA	NA	53
3. No.of other trees are above the maximum limit prescribed by the Rubber Board.	NA	33	--	25	14
4. Lack of awareness of the schemes of the Rubber Board.	NA	39	14	--	16
5. Other reasons	NA	19	43	25	10
Total	100	100	100	100	100

NA: Not applicable.

other crops due to shade. The plots in which the number of other trees were very high are also planted with rubber. Since, subsidy cannot be availed by such plots, they remain unregistered. Lack of awareness of the benefits and the formalities of registration also appear to be a reason for a portion of the plots to remain unregistered.

ACKNOWLEDGEMENT

The author is grateful to Dr. MR. Sethuraj, Director and Dr. V. Haridasan, Deputy Director for critically examining the paper and offering valuable comments. The comments given by Dr. Tharian George on an earlier draft of this paper are also acknowledged with thanks.

REFERENCES

1. V.K.B. Nair, "Report of Survey Made in Vakathanam Village" (1984) Rubber Board Bulletin, 20, No.1.
2. V.K.B. Nair, "Rubber Cultivation in Madapally Village" (1988) Rubber Board Bulletin. 23, No.4.
3. Hand Book of Natural Rubber Production in India, page 154, RRII(1980).

Jatropha oil, a diesel substitute

A non-edible oil extracted from a desert plant Jatropha can be an efficient and environmentally clean substitute for diesel, says a recent analysis by petroleum engineers in Thailand.

Test with a four-stroke watercooled engine and an aircooled engine running on Jatropha oil gave favourable results, according to reports presented at a seminar on "Substitutes for diesel oil" in Pune.

Inspection of the engine parts after running them on Jatropha oil for, 1,000 hours showed them to be in a satisfactory condition, less than the accepted specification fixed by the Thai Environmental Board.

Another major finding of the study was that no sulphur dioxide was emitted in the engines, compared to 125 parts per million (PPM) of the gas found in the exhaust of engines running on diesel oil.

The findings assume importance in the light of the expected shortfall in diesel supply due to the gulf war. Scientists the world over are striving to tap every available renewable energy sources including the sun, wind, tides, waves and non-edible plant oils.

Villagers in India use Jatropha oil as a lubricant for bullock carts axles and other agriculatural implements. In recent times, this neglected sources of non-edible oil is receiving attention from scientists and industrialists because of its very high oil content (35 to 45 per cent.)

Also known as wild castor, parsee castor or moghul castor, the plant grows well in soils receiving moderate to heavy rains, but needs temperate and humid conditions for germination. It thrives well in a variety of soil and increasing numbers of fruits from the first year onwards both in arid as well as rain fed areas.

A single hectare of Jatropha plantation can produce one quintal of seeds in the second year which increases to 75 quintals after 10 years in rainfed areas, and 125 quintals in irrigated areas. The plant can bear fruits that are as large as petel nuts or gooseberries for 25 years in regions with heavy rainfall.

It is naturally resistant to pests and diseases and needs no pesticides and insectices, but only urea as a fertiliser.

Scientists recommend that Jatropha plants should be used in forestation programmes of arid areas as they grow very fast and very well on barren, rocky slopes.

The support price for seeds is Rs. 350/- per quintal today. One hectare of land requires five kilograms of seeds, but it is also possible to prepare plantlets from trees through vegetative propagation.

Cash returns are to the tune of Rs. 17,000/- to Rs. 31,000/- per hectare, depending on the quality of soil and irrigation facilities available.

As of today, the price of Jatropha is more than that of diesel oil, but it could come down once cultivation is undertaken on a large scale, experts say.

However, it may be necessary to design special engines to use this oil. Talks are underway with some German manufacturers but collaborators are insisting on an assurance of regular supply of Jatropha oil to make the engines viable.

India imports Rs. 4000/- million worth Jatropha oil every year for industrial use.

CONCEPT OF CLONE BLENDS : MONOCULTURE Vs. MULTICLONE PLANTING

Y. ANNAMMA VARGHESE, V. C. MERCYKUTTY, A.O.N. PANIKKAR, P.J. GEORGE AND M. R.. SETHURAJ.
RUBBER RESEARCH INSTITUTE OF INDIA

In recent years development and wide spread cultivation of a few improved varieties have, within a short period, reduced the number of commercial cultivars in the case of many major crops. *Hevea brasiliensis*, the para rubber tree, is no exception to this.

Fig. 1 RRII 105 *

Monoculture of high yielding varieties of any agricultural crop in a geographical area has the potential danger of narrowing down the genetic variability. The practice of continuous planting of any single cultivar promotes genetic changes in major pests and pathogen. Pests and diseases of minor nature are likely to assume major significance. Such changes in disease and pest epidemics make control operation difficult and less effective. Bitter experience did occur in the past and some of the specific examples include :

1) Irish famine of the 1940's due to damage to potato crop by *Phytophthora infestans*,

2) Bengal famine of 1943 associated with brown spot disease of rice,

3) Break down of rust resistance in Kalyan Sona wheat in SE Asia during 1973-'74,

4) Coffee rust in Sri Lanka which caused a shift to tea production,

5) the disastrous southern corn leaf blight epidemy of the USA in the early 1970's and

6) the rapid shift from the rice brown plant hopper biotype 1 to biotype 2 during 1974-'76 when large areas in Philippines and Indonesia were planted with a few semi-dwarf rice varieties.

GENETIC ADVANCE

In *Hevea*, genetic improvement has resulted in substantial increase in productivity from around 250 Kg^{-ha-yr} for the original material to over 2500 Kg^{-ha-yr} for recent clones. Though the early phases of selection could achieve substantial improvement in yield over the original Wickham material, a slow down of genetic advance is evident in the recent breeding phases. One of the reasons that can be attributed to

Fig. 2 RRIM 600

this is a narrowing down of the genetic variability in the breeding pool exploited from time to time. The original genetic base of *Hevea* in the East is very narrow, limited to 20-22 seedlings collected from a minuscule of the gene- tic range at Amazonian river basin in Brazil. Budgrafting, an established commercial practice of clonal propagation in *Hevea* results in uniform plantations. This practice however, has resulted in the non-conservation of natural genetic variability available in seedling populations. The cyclical generation wise assortative mating adopted in *Hevea*, where, the best clones in one gene-ration are used as parents for the next cycle of breeding, has also restricted the number of high

* Clones (Fig. 1 to Fig. 11) two years after planting.

yielding clones, most of which have originated from a few dominant parents. Thus, at present, extensive areas are cultivated with a very few high yielding clones which are more or less closely related.

In *Hevea*, recent reports indicate instances of less serious diseases becoming more severe. The most serious problem reported is severe incidence of *Corynospora* leaf disease observed from 1985

Fig. 3 PB 235

onwards affecting clones RRIC 103, KRS 21 and RRIM 725 in Sri Lanka. As a result RRIC 103, one of the most popular high yielders planted extensively had to be withdrawn from the planting recommendation and extensive areas under this clone were replanted in Sri Lanka. A new anthracnose caused by *Fusicoccum* reported during 1987 in Malaysia, a minor disease of *Guignardia* observed intermittently in Malaysian estates since 1982 affecting clones like PB 217, PB 235 and PB 260 and incidence of target leaf spot in Malaysia are some examples which deserve attention. In the case of the emergence of a virulent strain of a particular pathogen in a favourable environmental condition, the disease will spread, and cause serious damage, if monoculture is adopted.

MAJOR CONTRIBUTION

In India, the high yielding clone RRII 105 was released for commercial planting in 1980. This clone, very popular in the traditional rubber growing tract, performs very well and has recorded the highest commercial yield in comparison with other high yielders. A good share of the yield increase during the recent years can be attributed to this clone. An analysis of the use of planting materials reveals that RRII 105 has been increasingly used since its release, especially by the small holders, who account for more than 80% of the area under rubber. During recent years, around 90% of the planted area is under this clone. If this trend is continued, it can lead to serious consequences resultant of monoculture. Although there is no alarming situation yet, the need for preventing such a possible danger assumes much significance.

Considering the gravity of the situation, RRII has proposed a strategy for encouraging multiclone planting. With a view to reducing the proportion of RRII 105 in future planting programmes the Rubber Board now recommends a multiclone planting of different selected clones.

These clones, selected based on available data from India and/ or abroad, are included in three different categories depending on the stage of evaluation. Materials included under Category I will continue to be those approved for large scale planting but should not exceed 50% of the total area of planting in any estate/holding. According to 1991 recommendation only RRII 105 is included in category I for traditional area. Category II includes six clones, which in combination of three or more can be planted upto 50% of the area. Category III materials are recommended for planting only upto 15% in aggregate of the total area of any estate/holding. The different materials are recommended as follows :

Steps have already been taken to popularise these clones with a view to making the planting materials available to planters. Experiments have been initiated for identification of suitable clonal blends and for evaluation of the performance of different clone combinations in comparison to monoclone population of RRII 105. Based on the availability of more data from time to time, both from experiments and from

Fig. 4 PB 217

Category	Materials recommended	Remarks
I	RRII 105 (also RRII 600 & GT 1 for non-traditional area)	Should not exceed 50% of the total area.
II	RRIM 600 GT 1 PB 28/59 PB 217 PB 235 RRIM 703	Combination of three or more clones for planting upto 50% of the area
III	a) RRII 5, PCK 1, PCK 2, PB 260, PB 280 and PB 311 b) Tjir 1, PB 86, G1 1 , PR 107, RRIM 605, 623, 628, 701, PB 6/9, PB 5/51, RRII 118, 203 and 208 and polyclonal seeds from approved sources. c) Other old or new promising clones specially approved by the Chairman, Rubber Board.	Planting not to exceed 15% in aggregate

commercial trials the recommendations will have to be modified/updated.

Diversity within the crop will counter balance the epidemic prone situation associated with continuous monoculture. This will also provide potential for further genetic improvement. There is no doubt that clone blends of diverse genetic material will offer better protection to the plantation industry from possible disasters in future.

Fig. 5 RRIM 703

SHORT NOTES ON CLONES

1. RRII 105 (Parentage : Tjir 1 x G1 1)

A promising clone developed by the Rubber Research Institute of India. Mean yield in large scale trial over first five and ten years is 65.57 and 66.71 $g^{-tree-tap}$ respectively. Commercial yield over five and ten years is 1450 and 1555 kg^{-ha-yr}. Trunk tall and straight; branching good; canopy dense; crown restricted to the top; foliage dark green with glossy leaves. Vigour before and after tapping average; virgin and renewed bark thickness above average.

Fig. 6 PCK 1

This clone has fair degree of tolerance to abnormal leaf fall disease under normal prophylactic measures; susceptible to pink; fairly tolerant to yield depression during drought; S/2 d/3 system of tapping is preferable as susceptibility to brown bast is reported from many holdings. Latex colour white and d.r.c. high.

2. RRIM 600 (Tjir 1 x PB 86)

A popular high yielding clone developed by the Rubber Research Institute of Malaysia. Average commercial yield over first five, ten and fourteen years in India is 1129, 1327 and 1387 kg^{-ha-yr}. Experimental yield in large scale trial over first five, ten and 15 years is 48.0, 52.3 and 52.6 $g^{-tree-tap}$ respectively. Experimental yield in large scale trial in Malaysia over first five, ten and fifteen years is 1540, 1990 and 2199 kg^{-ha-yr}. Summer yield is high. Young plants show spindly growth and late branching. Trunk is tall and

Fig. 7 PCK 2

straight, canopy broom shaped and narrow with moderate heavy branches, foliage sparse and small yellowish green leaves. Though girth at opening is low, girth increment on tapping is high. Similarly virgin bark thickness is low and thickness of renewed bark over five years is high.

The clone is highly susceptible to *Phytophthora* leaf fall; incidence of pink medium; *Oidium* mild; incidence of wind damage and brown bast mild. Latex colour white and d.r.c. medium, latex unsuitable for concentration.

3. GT 1 (Primary Clone)

A high yielding clone developed in Indonesia by way of mother tree or ortet selection. Commercial yield in India over the first five, ten and 13 years is 1019, 1329 and 1400 kg-ha-yr. Experimental yield in large scale trial in Malaysia over five, ten and 15 years is 1300, 1727 and 1723 kg-ha-yr respectively. Summer yield is very high.

Trunk upright and slightly kinked, branching habit variable; canopy narrow, open and globular; dense, dark green leaves. Girth at opening and girth increment on tapping medium; virgin bark thickness medium and thickness of renewed bark over five years is low.

This clone shows good tolerance of pink disease, and brown bast. Incidence of *Phytophthora* mild to medium; wind damage low and *Oidium* medium to severe. Withstands higher intensities of tapping, latex colour white, d.r.c. medium.

4. PB 28/59 (Primary clone)

A high yielding Prang Basar clone. Commercial yield in India over first five, ten and 13 years is 1227, 1451 and 1423 kg-ha-yr respectively. In Malaysia, large scale trial yield over first five, ten and 12 years is 1780, 1986 and 2023 kg-ha-yr respectively. Summer yield medium.

Trunk is fluted and crooked, sometimes showing a leaning tendancy, low branching, moderate to heavy branches, Girth at opening medium and girth increment on tapping low; thickness of virgin bark low and that of five years renewed bark high. The incidence of *Phytophthora*, *Oidium* pink and brown bast high; wind damage medium.

5. PB 217 (PB 5/51 X PB 6/9)

A Prang Basar hybrid clone, showing rising yield trend. Commercial yield in India over first five and ten years is 1001 and 1257 kg-ha-yr respectively. Experimental yield in large scale trial over first five, ten and fifteen years is 38.0, 56.8 and 62.4 g-tree-tap respectively. Estimated yield in large scale trial in Malaysia over five, ten and fifteen years is 1220, 1675 and 1778 kg-ha-yr respectively. Summer yield is very high.

Trunk is tall and straight. Canopy high with dense foliage and usually light branches. Medium girth at opening with high girth increment on tapping. Thickness of virgin bark low and that of renewed bark over five years medium.

Incidence of *Phytophthora* leaf fall is mild in India, but it is reported to be very severe in Malaysia. *Oidium* and pink severe; wind damage very low and brown bast mild. Latex colour light yellow and d.r.c medium.

Fig. 8 RRII 5

6. PB 235 (PB 5/51 X PB S.78)
A high yielding hybrid clone developed by Prang Basar Institute in Malaysia. Average commercial yield for first five and ten years in India is 1095 and 1232 kg-ha-yr respectively. In Malaysia, experimental yield in large scale trial over first five, ten and fifteen years is reported to be 1964, 2273 and 2485 kg-ha-yr respectively. Summer yield medium.

Vigorous clone, trunk very tall and straight with long, light branches. Spreading canopy and dense foliage, Girth at opening very high, Girth increment on tapping medium; thickness of virgin bark medium and that of renewed bark over five years low.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wild damage high. This clone is susceptible to brown bast. Latex colour is pale yellow and d.r.c. very high.

7. RRIM 703 (RRIM 600 X RRIM 500)

A high yielding hybrid clone developed by the Rubber Research Institute of Malaysia. In India, block trial yield in one location over first five years of tapping is 1424 kg^{-ha-yr} and yield in large scale trial over five years is 45 g-tree-tap. In Malaysia, large scale trial yield over first five, ten and thirteen years of tapping is 1828, 1847 and 1736 kg^{-ha-yr} respectively. Summer yield low.

Trunk is upright and slightly kinked, canopy open and narrow, branches few and heavy. Girth at opening medium while girth increment on tapping is low. Thickness of virgin bark high and that of renewed bark over five years medium.

This clone has recorded severe incidence of *Phytophthora* in India but medium in Malaysia ; Pink severe, *Oidium* mild; incidence of wind damage and brown bast high. Latex light yellow in colour with medium d.r.c.

8. RRII 5 (Primary clone)

A primary clone developed in India. Experimental yield in one large scale trial in India over first five, ten and sixteen years is 56.2, 70.3 and 76.4 $g^{-tree-tap}$ respectively. Summer yield high.

Trunk is straight and terete; heavy oval canopy; low branching with several branches arising at acute angles; foliage dense. Girth at opening very high with medium girth increment on tapping. Thickness of virgin bark and that of five year renewed bark high.

Incidence of *Phytophthora* and *Oidium* medium to severe; pink mild, wind damage low and brown best severe. Latex colour pale yellow and d.r.c. high.

9. PCK 1 (Tjir 1 x PR 107)

This clone is only in the early years of tapping. Promising yield trend. Trunk is tall and straight; branches spreading with light side branches and dense foliage. Girth

Fig. 9 PB 260

at opening high; medium girth increment on tapping. Thickness of virgin bark high and that of five year renewed bark medium.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wind damage low and brown bast medium. Colour of latex pale yellow and d.r.c. high.

10. PCK 2 (Tjir 1 x PR 107)

This clone also is only in the early years of tapping; promising yield trend.

Canopy spreading and 'V' shaped with dense foliage, many light and low branches. Girth at opening, and girth increment on tapping medium; thickness of virgin bark and that of five year renewed bark medium.

Incidence of *Phytophthora* pink and *Oidium* medium; wind damage very low and brown bast medium. Latex colour is pale yellow, high Dr. C.

11. PB 260 (PB 5/51xPB49)

A vigorous and high yielding hybrid clone developed by the Prang Basar Institute. In India, this clone is only in the early years of tapping; promising yield trend. In Malaysia, yield in large scale trial over first five, ten and twelve years of tapping is 1880, 2168 and kg-ha-yr. Summer yield high.

Trunk is slightly kinked and fluted, dense canopy, foliage thick; balanced branching with light spreading branches. Girth at opening high and girth increment on tapping medium. Thickness of virgin bark and that of five year renewed bark low.

Incidence of *Phytophthora* medium; pink mild; *Oidium* mild-medium; wind damage medium; brown bast severe. Latex light yellow in colour with high d.r.c.

12. PB 280 (Primary clone)

A Prang Basar primary clone. In India, this clone is only being evaluated. In Malaysia, yield in

Fig. 10 PB 280

large scale trial over first five, ten and 13 years is 1740, 2003 and 2006 kg^{-ha-yr} respectively. Summer yield high. Girth at opening and girth increment on tapping medium; thickness of virgin and renewed (five years renewal) bark very high.

Incidence of *Phytophthora* and pink medium; *Oidium* severe; wind damage severe and brown bast mild. Latex light yellow in colour, d.r.c. very high.

13. PB 311 (RRIM 600 x PB 235)

An advanced generation hybrid clone bred by prang Basar Institute. This clone is only in the early years of tapping in India. Promising yield tread. In Malaysia yield in large scale trial over first three years is 1580 kg^{-ha-yr}. Summer yield high.

The trunk is sometimes leaning. Canopy heavy and foliage dense. Girth at opening medium and girth increment on tapping high; thickness of virgin bark low and that of five years renewed bark medium. According to report from Malaysia, wind damage very high; incidence of pink and *Oidium* medium; brown bast mild; latex colour light yellow.

14. Tjir 1 (Primary clone)

A primary clone developed in Indonesia, heavy crown liable to wind damage. Average commercial yield in India over 15 years is 978 kg^{-ha-yr}. Highly susceptible to *Phytophthora*, *Oidium* and pink diseases; latex yellow.

15. PB 86 (Primary clone)

A Malaysian primary clone. Commercial yield in India over 15 years is 1127 kg^{-ha-yr} Resistant to wind damage, suitable for exposed areas; prolific seeder; highly susceptible to *Phytophthora* leaf fall and shoot rot. Good performance in kanyakumari district.

16. GI 1 (Primary clone)

A Malaysian primary clone; vigour below average, canopy healthy with characteristic glossy leaves. Average commercial yield over 15 years is 1145 kg^{-ha-yr}; resistant to wind damage; good performance in areas of high water table; susceptible to brown bast.

17. PR 107 (Primary clone)

An Indonesian primary clone; sturdy, vigour average, good girth increment on tapping. Though a slow starter, shows rising yield trend. Average commercial yield over 15 years is 1043 kg^{-ha-yr}; withstands higher intensities of tapping; resistant to wind damage, susceptible to *Phytophthora*.

18. RRIM 605 (PB 86 x Pil B 84)

Growth average. Average commercial yield over 15 years is 1226 kg^{-ha-yr}.

19. RRIM 623 (PB 49xPil B 84)

A vigorous clone with rising yield trend. Average commercial yield over 15 years is 1178 kg -ha-yr. Susceptible to wind damage, abnormal leaf fall and pink diseases.

20. RRIM 628 (Tjir 1xRRIM 527)

Vigour medium before tapping and low after tapping. Average commercial yield over 10 years is 1096 kg^{-ha-yr}. Summer yield poor; incidence of *Phytophthora* leaf fall and wind damage poor, brown bast severe.

Fig. PB 311

21. RRIM 701 (44/553xRRIM 501)

Vigour high in the early years,girth increment on tapping medium. Average commercial yield over 10 years is 1139 kg^{-ha-yr}. Susceptibe to pink , powdery mildew and wind damage.

22. PB 6/9 (PB 24xPB 28)

Trunk some what crooked, canopy light. The average commercial yield over 15 yeas is 1151kg^{-ha-yr}.

23. PB 5/51 (PB 56xPB 24)

Stem straight and upright, balanced canopy; virgin bark thickness medium and renewed bark thickness low. Commercial yield over 10 years is 1314 kg-ha-yr. Summer yield good. Incidence of *Phytophthora* leaf fall medium; pink, *Oidium* and brown bast high; resistance to wind damage high.

24. RRII 118 (Mil 3/2xHil 28)

A very vigorous clone, trunk tall and stout, canopy dense, crown balanced. Mean commercial yield over six years is 1117 kg-ha-yr. Incidence of diseases and brown bast average.

25 RRII 203 (PB 86x Mil 3/2)

A very vigorous clone, trunk straight and tall, rather robust, balanced crown. Thickness of virgin and renewed bark medium. Average commercial yield over five years is 1142 kg-ha-yr. Latex coagulum show black discolouration, which ,however, does not affect the quality of rubber. Average tolerance to diseases.

26. RRII 208 (Mil 3/2 x AVROS 255)

Average commercial yield over six years is 122 kg-ha-yr. Highly susceptible to shoot rot; medium tolerance to other diseases.

Rubber Seed Oil

Studies undertaken in the RRII show that an average of 150 Kgs of useful seeds are available from 1ha. of mature plantation. At present we have 3,00,000 ha. of mature area and an estimated production of 45,000 tonnes of rubber seeds per annum. About 10% of the production is used for raising stock materials in the plantations. Under commercial conditions, the oil recovery is around 12 to 16% of the total weight of the seed. Normally, about 4,000 tonnes of rubber seed oil is processed per annum. During 1990 - 91 the rubber seeds are being procured at the rate of around Re. 1/- per Kg. The production of rubber seed oil is concentrated in Virudhunagar due to favourable weather conditions and unutilised capacity in the oil mills sector. The present market price of rubber seed oil is Rs. 15/- per Kg.

Usually the rotary(Chakku) machine is used for extraction. The extraction process involves the installation of a pair of rotary machines. The oil recovery under commercial conditions is around 35% of the weight of the kernal.

Rubber seed is mainly used for manufacturing imferior quality washing soaps. A small quantity is also used in the paint, varnish and leather industries. It is widely suspected that rubber seed oil is being used for adultering coconut oil as reporated by smt. Surekha Sule in the 'Economic Times' (30-9-1983)-: "Informed sources feel that there is a strong possibility of rubbef seed oil being used for adulteration purposes. The Government should lay down the specifications of the oil for use in various industries as is done for vanaspati industries".

Rubber seed oil is a non-edible oil. The presence of "hydrocyanic acid" and other elements makes it harmful to health. It is possible to find out whether coconut oil is adultered through simple lab tests . But the presence of rubber seed oil cannot be identified easilly. It requires more reference and lab tests to investigate and find out a methodology for the same. Rubber seed oil is easily mixable with other oils . Hence it is felt that the dealers of coconut oil are the main adelterators.

Properties of rubber seed oil

Rubber seed oil is light yellow in colour and free from deposits on standing. It is a semi-drying oil with the following chemical properties.

Acid Value	4 — 40
Saponification Value	190 — 195
Iodine value	132 — 141
Hydroxyl value	12 — 32
Unsaponification (%)	0.5 — 1.0
Refractive index 40°C	1.466 — 1.469
Sp gravity 15 / 15°C	0.924 — 0.930
Titra (°C)	28 — 32

Fatty acid composition (%)	
Palmitic acid	11
Stearic acid	12
Arachidic acid	1
Oleic acid	17
Linoletic acid	35
Linolenic acid	24
	100

MAJOR LEAF DISEASES OF RUBBER AND THEIR MANAGEMENT

A dense and healthy foliage is a reflection of good agronomic and management practices and with it comes expectation of good yields. Thus, rubber planters, be they smallholders or estate managers, are understandably apprehensive if their trees bear poor canopies. Poor canopies are the result of several causes, leaf diseases being one of them.

In Malaysia, rubber plants suffer from several leaf diseases. In the nurseries, birds eye spot, caused by *Bipolaris heveae*, and Colletotrichum leaf spot, caused by *C. gloeosporioides* are the two most common leaf diseases. On mature rubber, secondary leaf fall (SLF), caused by *Oidium heveae* and *C. gloeosporioides*, are the most important leaf diseases, followed by abnormal leaf fall (PLF), caused by *Phytophthora botryosa*, in certain years during the monsoon months in the northern states of Peninsular Malaysia. Lately, *Corynespora cassiicola* has gained some prominence, especially in Johor Darul Takzim. The severity of these diseases as well as changes in their distribution, are being monitored through leaf-disease surveys which are carried out at least once in two years.

The economic impact of leaf diseases depends on the growth stage of the plants. Severe leaf diseases, which leave the trees bare of leaves, retard growth of young plants, thus prolonging the immaturity period. On yielding plants, severe and repeated attacks of leaf diseases reduce yield. This can be clearly seen in disease-control trials where increases in yields were obtained following disease treatments. The magnitude of yield increase depends on the type of leaf diseases, their severity as well as the effectiveness and duration of disease control. Yield increase is usually small hovering around 10% in the case of SLF and PLF. Higher increases are expected following extended disease-control programmes, as experimental evidence indicates that better canopy can be achieved following several years of treatment. As an example, after three years of artificial defoliation to control SLF, a yield increase exceeding 30% was achieved. Of course, greater losses and better yield improvements following chemical treatments have been reported in other countries where leaf diseases are more severe than here.

Corynespora leaf fall had been devastating in Sri Lanka and its potential destructiveness has been demonstrated in Malaysia too where the highly susceptible clone, RRIC 103, failed to reach maturity. Of late, there are reports that Corynespora is the cause of poor tree canopy in several plantations in Johor.

DISEASE SYMPTOMS

OIDIUM LEAF DISEASE

Hevea leaflets are susceptible to infection from budburst till they are past the limp-green stage. Fully hardened leaves are however resistant to infection. Disease symptoms vary with the

Fig. 1. Rubber leaves severely infected with *Oidium heveae*.

Fig. 2. Rubber leaflets defoliated by *Oidium heveae*.

age of the affected leaflets. A distinctive diagnostic feature is the presence of few white powdery colonies of the fungus on the infected leaf surfaces. On very susceptible clones, the entire leaf surfaces may be covered with these lesions and the young flushes appear yellowish (Figure 1). Severely affected young leaflets shrivel, turn black to varying extent and drop. Older infected leaves also undergo premature defoliation. The scene depicted in Figure 2 is very common in susceptible fields during a severe Oidium SLF season. Affected leaflets that escape defoliation are likely to be those with hardened cuticles. They remain on the trees, bearing heavily sporing colonies which eventually dry up, producing translucent yellow patches which later turn brown when the leaf tissues die.

COLLETOTRICHUM SLF

C. gloeosporioides infects only immature leaves. It also infects inflorescenses, young fruit pods and shoots which may lead to shoot dieback. On the very young leaflets, similar to *Oidium* infection, the infected leaflets pucker, shrivel, turn black and finally fall (Figure 3). On close observation, slimy orange masses of spores could be seen. Infected older immature leaflets may be partially damaged, whereby the leaf tips and margins may turn black and abscise. On intact leaves, numerous lesions occur which are brownish in colour surrounded by yellowish halo regions. As the leaves mature, the typical symptom is the raised lesions with holes in the centre which can be easily felt with the fingers.

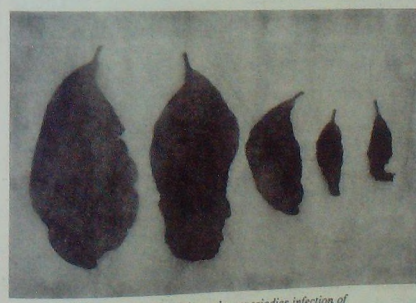


Fig. 3. *Colletotrichum gloeosporiodies infection of Hevea leaflets of different ages.*

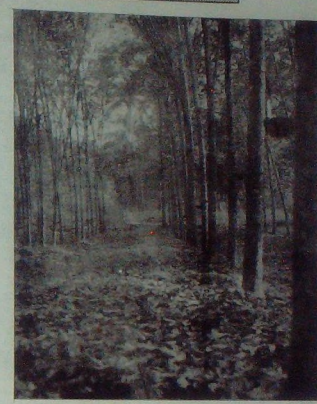


Fig. 4. ***Leaves defoliated by Phytophthora leaf fall.***

PHYTOPHORA ABNORMAL LEAF FALL

The first evidence of an attack by PLF is the presence of a carpet of green mature leaves on the ground (Figure 4). These leaves are shed with the leaflets still attached to the leaf petioles or stalks. The leaf stalks detach cleanly from the branches. The leaf blades are usually green and healthy-looking; however, one or

more dark brown or blackish lesions may be seen on the leaf stalks. Normally drops of coagulated latex can be seen at the centre of these lesions (Figure 5).

Infection of shoots, which is common on young plants during the monsoon seasons in Phytophthora-endemic areas, lead to shoot dieback.

Fig. 5. *Drops of coagulated latex in lesions caused by Phytophthora.*

Phytopthora may also infect young pods hindering their further development. The infected pods

Fig. 6. *Rubber pods infected by Phytophthora.*

remain hanging on the trees and, under wet conditions, spores are produced from the pods which are later spread to the leaves.

CORYNESPORA LEAF FALL

Corynespora infects leaves of all ages. However, leaves at the limp-green stage are most susceptible. The symptoms that develop differ between clones and locality. Circular lesions which may be small or large are common in Thaliland and Brazil. In Malaysia, the 'railway track' or 'fish bone' symptom is most common. Normally, infection occurs along the veins, either the main veins or the small veinlets. Initially, small circular brownish lesions develop. These lesions may remain small or large forming irregular lesions and the tissues in the centre of the lesions die, giving a papery appearance. The surrounding tissues subsequently turn brown reddish, thus developing a ripened appearance. The veins and veinlets in the vicinity of the lesions are discoloured and these dark veins give rise to the 'fish bone' appearance.

Infected leaflets abscise prematurely and defoliation may occur throughout the year (Figure 7). Repeated and continuous defoliation may lead to shoot dieback, eventually causing branches to fall off. A single or numerous lesions can occur on a leaflet. However,

Fig. 7. *Defoliation of rubber plants caused by Corynespora cassiicola.*

one lesion on the main vein especially at the leaf base is enough to cause leaf fall.

BIRDS EYE SPOT

This disease basically affects young plants especially in badly managed intertile ground nurseries. Normally the disease is not severe on budded plants. Similar to *Colletotrichum* infection, severely infected young leaflets shrivel, turn black and

drop. The typical 'birds eye' symptom develops on the intact green leaves being formed when the tissues in the centre of the lesions die, turn whitish and are bordered with brownish margins (Figure 8). Severely affected

Fig. 8. *Leaves infected by birds eye spot.*

plants are usually stunted with swollen growing shoots giving the 'cigar-top' appearance.

FACTORS AFFECTING DISEASE DEVELOPMENT

Three major factors that influence or determine the severity of any disease are the susceptibility of the clones, the environmental of the pathogens. Changes in any of these factors will influence conditions and the virulence disease severity. The susceptibility of rubber clones to leaf diseases has been documented in the RRIM Planting Recommendations published in the earlier issue of *Planters Bulletin*. Weather factors such as humidity, rainfall and to a lesser extent, temperature determine disease severity. Oidium leaf disease favours cooler misty conditions with light showers. PLF also prefers cooler temperatures; however, prolonged rainfall is necessary. Colletotrichum SLF is normally serious under prolonged heavier rainfall. Moisture is necessary for the fungal spores to germinate and initiate infection. A susceptible clone may escape infection by leaf diseases if the annual refoliation coincides with dry period. Normally, SLF is also less severe if the refoliation period is short and abrupt, for staggered refoliation allows repeated disease infection.

DISEASE MANAGEMENT

It has been a general belief that application of fungicide is the only method of controlling diseases. Few realise that diseases should be managed and various alternative strategies are available. Application of fungicide is only a short-term remedy. However, an integrated approach combining the biological, cultural and chemical control methods is most beneficial. These strategies should be adopted to control rubber leaf diseases.

PLANTING OF DISEASE - RESISTANT CLONES

The enviromax planting recommendation has been long advocated. By and large, this strategy of planting only disease-resistant clones in environs conducive to disease has helped in reducing the impact of leaf diseases. The strategy fails only during years when there are drastic changes in weather patterns.

DISEASE AVOIDANCE

SLF can be avoided if the tress are made to refoliate during the drier periods which are non-conducive to disease development. Tress, artificially defoliated about one month before the onset of natural wintering, refoliate shortly after and these periods often remain dry. When the wetter periods arrive later, a large portion of the tree canopy is already green, passing the susceptible stage and thus escaping severe disease infection. Several chemical defoliants mixed with water (normally about 10% concentration) are aerially sprayed at the rate of 35 litres/ha. Helicopters are suitable for spraying in terms of effectiveness and easy access to the areas to be sprayed. Ground mistblowers can also be used for small areas of immature rubber.

Oidium SLF can also be avoided through increased nitrogen manuring which should be applied judiciously at the time of wintering. The extra nitrogen, normally double the normal rate, boosts the speed of refoliation and increases the density of the canopy. The mechanism of disease escape is similar to artificial defoliation, though this strategy is only suitable for clones which are wind-resistant, since the extra nitrogen increases the density of the canopy.

CHEMICAL CONTROL

Chemical treatment is the most appropriate method of controlling diseases of high-value crops where the financial profits can be immediately calculated. For other crops including rubber, where the quality of the harvest is not affected and the financial gain may not be instantaneously felt, chemical control is normally scrutinised. The effect of *Hevea* leaf diseases on yield is cumulative, as trees suffering lingering leaf diseases are less

vigorous and often with low canopy density. Such areas benefit most from chemical treatment. Table 1 shows the various treatments recommended to control *Hevea* leaf diseases.

Tractor-mounted dusters are suitable for large areas of tall trees. For shorter immature plantings, nurseries or areas not accessible to tractors, back-pack power dusters may be employed.

TABLE 1.

FUNGICIDE TREATMENT FOR CONTROLLING HEAVEA LEAF DISEASES

Diesease	Fingucide	Rate	Method and rate of application
Oidium	Sulphur	9 kg/ha	Disting at 5-7 days interval until leaves mature
	Calixin 75 EC	0.5 kg/ha a.i.	Fogging at weekly interval until leave mature
	Folex	10% a.i.	Aerial spraying at 35 litres/ha a month before wintering
	MSMA	2 kg/ha	
Collectotrichum (in nurseries immature planting).	Daconil	0.2%	Mistblowing at weekly intervals until leaves mature
	Antracol	0.2%	
	Folex	10% a.i.	Aerial spraying at 35 litres/ha a month before wintering
	MSMA	2 kg/ha	
Phytophthora leaf fall	Copper Oxychloride	20% in oil	Aerial spraying at 35 litres/ha before onset of monsoon
	Copper Oxychloride	1.2 kg/ha a.i.	Mistblowing before onset of monsoon
Birds eye spot	Antracol or Dithane M 45	0.2%	Weekly spraying with knapsack sprayer until leaves mature

Fungicide control of Oidium SLF. A cheap but effective method of protecting the young leaves against *Oidium* attack is to dust them with sulphur (Figure 9). Dusting at the rate of 9 kg/ha should commence as soon as the leaves begin to unfold. Thus, about four to six rounds of dusting, spaced at five to seven days intervals, are required throughout the refoliation period. As sulphur is not systemic, it has to be constantly present on the leaves to give protection. If rains fall after dusting, it is recommended that dusting be repeated.

Mechanised fogging of tridemorph-in-oil (0.5 kg/ha/ round) also gives good control of the disease (Figure 10). Three to four rounds of fogging applied at intervals of seven to ten days are recommended for the duration of refoliation. The initial cost of fogging is high because the machine, fungicide and oil used as the carrier is expensive. However, its advantage is that the oil formulation ensures better retention of the fungicide on the leaves. Moreover, the technique itself enables larger areas to be treated in a much shorter time than sulphur dusting. It is a control method worth considering in view of the increasing shortage of labour in some rubber-growing areas of the country.

Fig. 9. *Sulphur dusting to control Oidium secondary leaf fall.*

Suitable foggers would be machines such as the Tifa Tart and Leco 120B and 120D, which can be mounted on trailers or directly onto tractors for easier maneuverability. Tractor paths 3 m wide need to be constructed every four to five rows to enable

Fig. 10. *Fogging of fungicides to control Oidium secondary leaf fall.*

use of these equipment on hilly terrains,

Chemical control of *Colletotrichum*. There are numerous fungicides such as Daconil, Antracol, Tilt and Topas which are effective against *Colletotrichum* leaf fall of rubber. However, the main hindrance to their usage is the lack of suitable sprayers which are powerful enough to deliver these chemicals to the top of the canopy. The problems is more acute for rubber planted on hilly terrain.

Fogging of chemicals has been tried as a method to control *Colletotrichum* SLF, however the success was not to the extent achieved for Oidium. During fogging most of the chemical are deposited on the upper leaf surfaces but minimum deposition occurs on the lower surfaces where most of Colletotrichum infection occurs. In addition, better success is achieved with fungicides soluble in the oil carriers. Fogging of Difolatan (600 g/ha a.i./round), Tilt (125 g/ha a.i) and Topas (75 g/ha a.i..) has some effect in reducing Colletotrichum SLF on mature plants. In the nurseries or immature plantings, Daconil or Antracol at 0.2% can be sprayed using knapsack or motorised back-pack mistblowers. Repeated spraying at five to seven days intervals is necessary, and spraying should be terminated when the leaves are already green. Normally, for trees refoliating after annual wintering, four to six rounds are recommended.

Chemical control of PLF. Successful control of PLF is highly dependent on the correct timing of fungicide applications. It must be applied before the onset of the monsoon to prevent the production and distribution of the infective zoospores. Copper oxychloride-in-oil (1.2 kg a.i./ha) can be sprayed about one month before the onset of the infection period. Aerial application of this fungicide is more effective.

CONCLUSION

Yield loss can be minimised if severe leaf diseases are controlled. However, this process will incur some cost. Nevertheless, under proper disease-management practices these expenditure will be worthwhile in terms of benefits obtained through increased yield, reduced weeding costs and even better bark renewal. It is acknowledged that at present the draw- back to control leaf diseases of mature rubber is the lack of suitable spraying machines. However, of late, several new imported sprayers are being tested which could overcome this urgent need. Research on the control of Corynespora which may become a major problem is being intensified. Chemical control in this case may not be the solution because of the ability of the fungus to infect leaves of all ages, which will require continuous application of fungicides. ●

Article credit : Radziah, N.Z and Ismail Hashim
Source : RRIM Planters' Bulletin.

MODERN RUBBER SHEET DRIER : A NOVEL EXPERIMENT

ARAVINDAN, ASST. DIRECTOR (PUBLICITY)
RUBBER BOARD, KOTTAYAM - 686 001.

What is this modern rubber sheet drier? How dos it function. What is its advantage?

The modern sheet driers are developed to produce high quality rubber sheets with minimum expenditure on firewood and labour. It has been designed in such a way that anybody could operate it. The operator is not exposed to smoke and the flue gases. On a comparison with the conventional smoke houses its dual advantages are the minimum labour coupled with low expense and the simple method of changing the sheets from the reapers. The savings on fuel and labour and the higher sales realization due to the quality improvement of sheets for about 2 to 3 years is sufficient to recover the entire expenses on purchase of a drier.

All modern driers are made of steel. The interior of the rubber sheet drier which resembles an almirah is divided into different rows. The sheet holders made of wood can be pushed into each row of compartments and they serve as hangers for the sheets. There is a steel step to remove the sheet holders from the top rows. Exchanging of sheets is greatly facilitated by the use of sheet transfer rack. There is also a scrap rubber drying tray to dry the scrap. The steel step, sheet transfer rack and the scrap rubber try are supplied as part of the smoke house. Since the drier has a well built roof., it functions easily under any weather conditions. A double walled furnace with an air regulator on the furnace door controls the temperature inside the drier. To reduce the possibility of fire hazard when the furnace door is carelessly kept opened there is an exclusive safety device which cuts off flames from entering the drier.

TEMPERATURE WELL DISTRIBUTED

The hot gas which emanates from the furnace traverses diagonally from one corner to the other in each row thereby transferring

enough heat to the sheets for drying. Every daydried sheets are removed from the lowest rack allowing systematic shifting of sheets from the top to bottom. During this process, vacant rows at the top are filled with wet sheets. Firewoods of rubber, small wooden pieces, coconut husk and about 8 to 10 coconut shells etc are the fuels normally used. These compact driers can be easily accommodated either in the open courtyard or even on terrace. It can even be put on the floor specially made for it in the rubber plantation. Sufficient precaution is essential to avoid water logged areas. Usually sheets are satisfactorily dried in three or four days.

The modern driers are the results of five years' continuous research by its manufactures m/s. Low Heat Driers (p) Ltd., Kizhakkambalam, Ernakulam, Kerala. Rubber Board has completed its evaluation and approved the marketing on a commercial scale. The Board has also sanctioned subsidy at the rate of Rs. 3,000/- each for the two models viz., RRSD160 and RRSD 240.

NEW MODELS

If any manufacturing defect is detected, it will be rectified free of cost. The manufacturers have a very effective network of after sales service. Formalities have been completed for the approval of two new models viz., RRSD 96 and RRSD 320. The new model RRSD 96 developed recently by them will be of much help to the small rubber growers.

Though new to the rubber plantation sector, this novel experiment will pave the way to large scale production of good quality sheets. The modern drier can well be defined as 'mobile' as it has the added advantage of shifting it to anywhere in the plantation. Only very little space is required for its accommodation.

Through we speak very high of fuel saving now-a-days, it is a fact that a project like this which developed a fuel saving technique is denied of any financial assistance by any nationalised bank. Imposing tax on a fuel efficient smoke house does not augur well. Conventional smoke houses are exempted from taxes and at the same time these modern driers which are designed and developed for the same purpose are subjected to taxation.

The manufacturers have sofar marketed more than 50 driers. They claim that all their customers are highly satisfied with the turn-out. It is even claimed that not a single smoke house is kept idle due to malfunctioning or manufacturing defect. ●

(Continued from Page No. 2)

host gradually dies out. During April-May the parasitic vines flowers profusely. The seeds germinate and help in the spread of the plant.

The rubber tree infestation was noticed mostly on the green stem and petioles on the lower branch on the border of rubber estate. The vine coiled round green stem, petioles and the small stalks of the three leaflets. The vines adhere firmly on the host tissue sending haustoria or sucking roots into it. The affected leaves do not fall, but remain on the plant providing nourishment to the parasite for long.

CONTROL MEASURES TO BE ADOPTED

1. Against Dodder on Pueraria

The colonies of the parasitic plant are to be traced as early as possible, anyway before commencement of flowering. The growth along with Pueraria from top to ground level has to be cut including healthey Pueraria upto 0.75 m width alround, the whole has to be heaped in the centre and burnt after sprinkling a little kerosene. Bits of Parasitic vines may not be allowed to fall in other parts, so as to check spread to healthey areas.

2. Aganist Dodder on rubber

The lower branches of trees on the border of estates with other hosts of Dodder like Mallotes sp. (in Malayalam - Vatta) sp. coffee plants etc. growing nearby and young trees in plantations with Pueraria as cover crop are to be examined throughly well for the persence of any infestation by Dodder. If the vines yellow or greenish yellow in colour are traced then the whole of the green shoots with the parasite are to be cut and removed and burnt in a safe place taking care not to contaminate other healthy plants or Pueraria. No trace of the parasite should be left on the host lest it may grow again from it. ●

NEWS & Notes

EMPLOYEES' CONTRIBUTION TO CANCER WARD

Smt. J. Lalithambika presented a cheque for Rs. 57,165.00 to Shri Alphons Kannanthanam, Collector, Kottayam towards the first instalment of contribution from the Board's employees to the Cancer ward to be constructed at the Medical College Hospital, Kottayam. Dr. P. G. Ramakrishna Pillai, Superintendent, Medical College, Kottayam, P. Mukundan Menon, Rubber Production Commissioner, M. O. Joseph, Secretary, P. K. Narayanan, Joint Director, P. U. George, Financial Adviser were present besides representatives of all the Employees' Organisations.

THAILAND BECOMES TOP RUBBER PRODUCER

Declining Malaysian production and an ambitious replanting programme in Thailand will make Thailand the world's largest rubber producer for the first time this year.

But shifts in tyre production technology could give rival producer Indonesia the edge in the longer term, rubber industry sources said.

Thailand will produce 1.34 million tonnes of rubber in 1991, figures from the country's rubber research institute showed. A July 10 estimate by the London based International Rubber Study Group puts 1991 Indonesian production at 1.26 million tonnes and Malaysian production at 1.23 million.

The key to future markets for the three rubber producers is the way they process the raw latex for tyre

manufacturers, which consume more than 70 per cent of all natural rubber. Malaysia and Indonesia both mainly produce block rubber, or technically specified rubber. Thailand produces sheet rubber or ribbed smoked sheets.

Japan, which produces most of the World's tyres and consumes majority of Thai rubber, has shown a strong preference for RSS. But the fact that RSS sells at about a 7 per cent premium to TSR for similar quality rubber means tyre producers may shift towards TSR.

The longer term depends on tyre consumers. The trend seems to be towards cheaper tyres, and manufactures are responding accordingly. France's michelin tyre has shifted from Malaysian RSS-1 to cheaper Thai RSS-3 in recent years. The company is now using some TSR, traders said.

Even some Japanese tyre manufactures are experimenting with TSR/RSS blends. The shift is expected to gain pace because lower Indonesian labour costs are bound to widen Thai RSS premium to Indonesian TSR.

"The Japanese have the most flexible technology in switching between block and sheet rubber", one trader said. "Given the premium, it's only a matter of time before they shift to the block". Less than 15 per cent of overall Thai rubber production is now in the form of TSR. Traders said it would take 5 to 10 years for significant quantities of Thai TSR to find their way onto the world market. The small holders who own the vast majority of Thai rubber trees prefer sheet rubber because it doesn't have to be delivered to a smokehouse as quickly as latex for block rubber production.

Thai rubber production has grown at an average annual rate of 9 per cent since 1987. With domestic consumption at a mere 110,000 tonnes, Thailand has 1.2 million for export this year. In 1987, a World Bank-funded project to replace old rubber trees with high- yielding hybrids started in Thailand.

Thailand will spend more than 12 billion baht in the next 5 years to replant an additional 250,000 hectares, the official said.

THE HEADQUARTERS OF THE RUBBER BOARD

Smt. J. Lalithambika IAS, Chairman, Rubber Board formally inaugurated the works of the Head Quarters of the Rubber Board proposed to be constructed at a cost of Rs. 2 Crores. The building is to be constructed on a 90 cents plot purchased years back near Civil Station, Kottayam. The invitees on the occasion included Dr. M. R. Sethuraj, Director, RRII, Shri M. O. Joseph, Secretary, Rubber Board, Dr. E. V. Thomas, Director (P&PD), Abraham Joseph, Superintending Engineer, V. Mukundan, Executive Engineer and V. N. R. Nair, K. T. Pious, Asst. Engineers. The construction of the multi storeyed building is expected to be completed in a couple of years. All the Rubber Board Offices now functioning in different locations in the town could be accomodated in the new building on its completion. In 1984 Shri V. P. Singh laid the foundation stone of this building. Shri K. Karunakaran, the present and the then Chief Minister of Kerala presided over the meeting.

REVIEW OF DEMAND AND SUPPLY POSITION OF NATURAL RUBBER

Production of natural rubber during April to November '90 was 218,950 tonnes. Provisional estimate for December '90 is 40,000 tonnes, which will put the total production during April to December '90 to 258,950 tonnes. This figure is 11.3% higher than the production during the corresponding period in the previous year. Climate during January 1991 was comparatively good and assuming normal conditions during February and March 1991, production during the year 1990-91 is estimated to reach 3,30,000 tonnes. At the beginning of 1990-'91 production had been provisionally projected as 335,000 tonnes. But during May 1990 there was significant drop in yield to the extent of 10,000 tonnes from the envisaged level due to the early onset of monsoon which was partially made up in the subsequent months.

Consumption of natural rubber during April to November 1990 totalled to 238,945 tonnes. Provisional estimate made for December 1990 based on the returns so far received and including estimate to cover pending returns is 31,500 tonnes. The total consumption of 270,445 tonnes during April to December 1990 shows an increase of 6.5% over the corresponding period in the previous year. At the beginning of the year 1990-'91 the consumption had been projected as 370,000 tonnes assuming a growth rate of 8.2%. The hike in oil prices and curb in its use have affected the rubber demand significantly. According to ATMA, during current year upto August, the growth in production of truck and bus tyres, which account for about 70% of the tyres in terms of tonnage, is only about 1%. The current developments indicate that there is very little chance for improving the demand for rubber. The average monthly consumption during April to December 1990 was 30,000 tonnes and if the same rate is projected for the period January to March 1991, the estimated consumption during 1990-'91 can be put at 361,000 tonnes. If, however, the growth of 6.5% realised for April to December 1990 is projected for the whole year, the consumption would touch 364,000 tonnes during 1990-'91.

The deficit to be met by import had been estimated at the beginning of the year as 30,000 tonnes. It was intended that 10,000 tonnes would be distributed during February-March 1990 and 20,000 tonnes during April-August 1990. An additional quantity of 10,000 tonnes was allowed by the Government during June 1990 to make up the temporary loss in production in May 1990. The entire quantity had been imported and out of this around 31,700 tonnes had landed during April to September 1990. The quantity released during April to July 1990 was 32,000 tonnes. The unsold stock with STC at present is 16,892 tonnes. The import under export incentive scheme during April to November 1990 was 11,936 tonnes as against 10,849 tonnes during the corresponding period in the previous year and 17,896 tonnes during the whole year 1989-90. During the year 1989-90 the tyre industry had exported products worth Rs. 153 crores. Truck and bus tyres accounted for the bulk of exports. The performances during this year so far indicates that the total import under export incentive scheme during 1990- 91 may exceed 19,000 tonnes.

RUBBER WOOD

In most Asian rubber plantations, old trees chopped down to make room for new have minimal value. Because their logs are small and their soft wood vulnerable to insects and fungi, the trees are routinely burned to provide heating or charcoal or simply as waste.

Now, thanks to advances in processing developed in Sri Lanka, rubberwood can be trans- formed into an attractive raw material for constructing furniture or joinery lumber. As such, it provides a substitute for increa- singly rare hardwoods from tropical forests.

Using techniques developed by the internationally funded Sri Lankan programme, rubberwood is dried and then chemically treated to resist insect infestation. The result is a uniform cream-coloured lumber that can be easily sawn, planed, or moulded, and then painted, laquered or waxed. Engineers at Sri Lanka's Peradeniya University have produced laminated and finger jointed beams that, they claim, are just as strong as standard types of lumber.

The programme began in 1968 as a UNESCO project to produce low- cost school furniture. Since then, the U.S.A. Agency for International Development, the United Nations Development Programme and other agencies have contributed to forming a solid R&D base. Experiments have shown that solar heated kilns can dry rubberwood to a moisture content as low as 12%. That prevents the wood from cracking as it ages.

Continued research has shown that a second treatment - impregnation with compounds of the element boron - makes rubberwood highly resistant to fungi and insects, yet non-toxic to humans. - Asia Pacific Tech Monitor.

SEI SILVER JUBILEE CELEBRATIONS - NACOSTAN '92

Institute of Standards Engineers (SEI), a professional body of practising standards engineers, was established on 8 March 1967. During the last 25 years, SEI has been spearheading the cause of standardization and quality movement and providing a useful forum for exchange of experience. As part of the Silver Jubilee Celebrations, SEI has scheduled a National Conference on Standardization (NACOSTAN 92) on 6-7 March 1992 at New Delhi to discuss the challenge faced by standardization on account of globalization of trade.

This Silver Jubilee Conference is expected to provide a forum for executives and policy makers to deliberate upon the new challenges posed to standardization and quality systems and to chalk out strategies to effectively employ these techniques to achieve international competitiveness by the Indian Industry.

The technical sessions shall cover the vital areas like, Standards, Quality System and International Trade; Quality System-Assessment and Accreditation; Success in export through standardization-Case Studies; Role of Consultants in Export Promotion and; Role of Government and Industry Associations in Export Promotion.

A participation fee of Rs. 1500/- (Rs. 1250/- for SEI members) per delegate will be charged to cover the Conference material, mid-session coffee/tea, lunch, etc.

Sponsoring organizations are required to contribute Rs. 10,000/- and will have the option to nominate up to three delegates to participate in the Conference. In addition, they are also entitled to a full page advertisement space in the Souvenir.

Nomination in the requisite proforma along with a draft/local cheque drawn in favour of 'Institute of Standards Engineers' towards sponsorship/participation fees should be forwarded to the following address on or before 31 December 1991.

Honorary Secretary,
Institute of Standards Engineers,
(Delhi Section),
C/o Metallurgical Deptt.
Bureau of Indian Standards,
9 B. S. Zafar Marg,
New Delhi-110 002.

NATURAL RUBBER OUTPUT TO FALL

Natural rubber output of the world's main producing countries is likely to fall as prices weaken in the international market, an Association of Natural Rubber Producing Countries (ANRPC) official said.

"Prices have been very bad in the past few years. It made farmers reluctant to tap their trees," ANRPC secretary-general Abdul Madjid told Reuters in an interview.

"If prices continue to stay low, farmers will shift to other jobs and production will be affected even more," he said on the second day of the three-day meeting of rubber producing nations.

Madjid said that output had already declined slightly in the past years in Malaysia, Indonesia and Thailand, where small holders were the dominant producers, but he gave no figures.

The executive committee of the seven-member ANRPC will formulate production and marketing strategies at the Solo meeting to tackle the problems of the industry.

The strategies will be discussed in detail at a meeting of ANRPC's standing committee in Thailand next month, ahead of a conference of the council of the International Natural Rubber Organisation (INRO).

Indonesia, the world's second largest natural rubber producer, plans to slow its growth in output by around three percent annually. Indonesian trade officials said.

"We may have to ease production growth in order to help lift up prices," one official said.

Indonesia's rubber output grew by two to six per cent a year for 10 years until 1990. But it forecasts a drop in production to 1.24 million

tonnes in calendar 1991 from last year's 1.26 million.

The London-based International Rubber Study Group projected output in Malaysia, the world's leading producer, to drop to 1.55 million tonnes in 1995 from 1.66 million three years ago.

Thailand is expected to raise production in the next few years because its plantations have many young trees.

"But almost all Thai producers are smallholders, just like the others. If prices are not attractive they may give up tapping gradually," Madjid said.

Producers said natural rubber demand had increased but the number of buyers had declined after the merger of some big tyre manufacturers, which are the main consumers of natural rubber.

"With a few buyers and so many producers, they (buyers) can play around with prices. Rubber is a commodity in which the buyer is the king", a Singapore trader said.

But producers have called on consumers to consider rubber as an industrial raw materials, not just a cheap commodity.

"We don't want something unreasonable, just fair prices to let farmers live properly. It's too bad if they have to be out of business or cut down trees in desperation," Madjid said.

ANRPC consisting of Indonesia, Malaysia, Thailand,India, Sri Lanka, Papua New Gunea and Singapore, will also press for early renegotiation of INRA, a pact administered by INRO which maintains a buffer stock to stabilise prices.

RUBBER PRODUCERS MAY PRESS FOR NEW PACT

The world's leading natural rubber producers are expected to press for early renegotiation of the International Natural Rubber Agreement (INRA) to bolster the flagging industry.

"We will try to push for a new pact," said Abdul Madjid, secretary-general of the Association of the Natural Rubber Producing Countries (ANRPC). "The current agreement has failed to provide fair and remunerative prices to producers."

The executive committee of the seven member ANRPC held a special meeting in Solo, Indonesia, from September 5 to 7.

The meeting precedes next month's crucial International Natural Rubber Organisation (INRO) council meeting to consider renegotiating INRA, a pact administered by INRO to maintain a buffer stock to stabilise prices.

The current five-year pact, known as INRA 2, came into force in late 1988. The INRO council also groups major consumer members, led by the United States.

The ANRPC, led by Malaysia, has said failure to have a new agreement ready by the end of INRA 2 in December 1993 would mean prolonging the producers' misery.

Under INRO rules, the agreement can be extended for another two years.

The ANRPC special meeting follows the group's first ministerial meeting in 15 years in Papua New Guinea last June to propose ways to improve the INRA and the industry.

The Malaysia-based ANRPC, set up in 1970, represents 84 per cent of the world's total output. The group comprises India, Indonesia, Malaysia, Papua New Guinea, Singapore, Sri Lanka and Thailand. Singapore, although not a rubber producer, is a major market for Southeast Asian producers.

Indonesia, Malaysia, Sri Lanka, Thailand and non-member Nigeria are also signatories to INRA.

The producers have said the current INRO buffer stock mechanism tends to stabilise prices at low levels.

"We are conscious of the fact that what we want is not unreasonable price increases, but an appropriate upward adjustment of not only INRO's reference price range, but also the floor and ceiling prices," Ahmad Farouk said recently.

NEWS PROCESS YIELDS OZONE-RESISTANT LATEX

A newly patented process that creates an ozone resistant, highly saturated nitrile rubber in latex form has been announced by Goodyear's Chemical Division.

Called Chemisat saturated latex, the process was developed jointly by Goodyear and the Olin Corporation.

"Chemisat saturated latex combines excellent performance benefits with potential applications in gasketing, latex dipping, cord dip for HNBR belts and many other products," said Joe Campo, marketing manager for the division's specialty polymers. "Some of the other benefits are resistance to heat, wear, fluids, ultraviolet rays and oxygen."

RUBBER BOARD BULLETIN
Vol. 26 Number - 3 Jan - March, 1991

Chairman
(Smt.) J. Lalithambika I.A.S.

CONTENTS

Published by
THE RUBBER BOARD

Editor
P.K. Narayanan
R. P. C.

Asst. Editor
K.A. Aravindakshan Nair
Dy. Director
(Publicity and Public Relations)

Cover : **SOMU**

THE QUARTER

Fall in rubber prices has become a global phenomenon due to several reasons. The sharp decline in the offtake of automobiles, the aftermath of the Gulf war and the developments in the earstwhile Soviet Union are some of the reasons attributed to the declining trend noticed in the International market.

Global rubber output stood at 5.22 million tonnes in 1991 which was 2.1 percent higher than the previous year. But the consumption during the corresponding period was only to the tune of 5.15 million tonnes which is less than 1.8 percent from a year earlier.

Thailand has become No.1 producer of natural rubber in the World. The total production of that country in 1991 was 1.335 million tonnes. It was 5.9 percent more than what they got during the previous year. Indonesian output stood at 1.262 million tonnes which was 3.9 percent higher than what they could produce a year ago. Malaysian production was 1.276 million, down by 2.8 percent. Indian production was 3,60,000 tonnes and it was 11% higher than the previous year. Excepting Malaysia, all the other countries produced more.

What was really happening with regard to consumption? In 1991 consumption fell 5.6 percent to 7,63,000 tonnes in USA, 33.8 percent to 1,80,000 tonnes in Eastern Europe, 0.3 percent to 2 08,000 in Western Germany and 4.8 percent to 1,29,000 in the UK.

The reasons for the declining trend that rules the international market are evident. The sharp fall in the consumption pattern even in the advanced countries is the result of low offtake of rubber made materials. The repercussions of this development affect the economy of all natural rubber producing countries. The alternative is to identify new areas of uses for natural rubber. The untapped areas have to be exploited and the consumption pattern is to be improved. It is possible if joint efforts are to be made by the Natural Rubber Producing Countries.

THE NR INDUSTRY OF THE 21ST CENTURY – WHAT IS NEW?

THE KEY-NOTE ADDRESS DELIVERED
BY TAN SRI Dr. B.C. SEKHAR
SECRETARY - GENERAL, IRSG
AT THE INTERNATIONAL NATURAL
RUBBER CONFERENCE INDIA - 1992
HELD AT BANGALORE

I must at the very outset thank the Chairperson of the Rubber Board, Mrs Lalithambika and the Convenor of the Conference and Director of the RRI (India), Dr. Sethuraj for their invitation to me to be a keynote speaker at this conference. It was some two years ago that they broached this issue, giving me little chance for anything but a positive answer. Soon enough, the pressure to provide a title arose and in a hurry I offered the title you have in the programme hoping that this will give me maximum flexibility. I must admit however that when it came to thinking and writing the script, the complexity of the task of providing a cohesive, cogent picture became a challenge. Basically I am a rebel against convention and I will be treading an unconventional path in the analysis I present to you.

In substance, it has to be accepted that Hevea has existed from time immemorial in the jungles of the Amazon. Natural rubber as a polymer became a raw material for industry over 100 years ago. It is the oldest known elastomer which has inspired scientists to attempt duplication chemically. In fact it can legitimately be claimed that the enormous strides made by the SR industry stem largely from the physiochemical study of the natural rubber polymer molecule. With the transfer of the Hevea germplasm from the Amazon to plantations in Asia, Africa and elsewhere, every facet of Hevea culture from planting materials through to extraction, processing and manufacturing technology has undergone detailed scientific, technological and economic research, study and analysis.

PLANTING MATERIALS AND YIELD

The plant breeders have done a yeoman job through the years. The germplasm imported from Brazil some 116 years ago with a yield capacity of 200 to 300 kg/ha have been transformed through their efforts to modern clones providing a tenfold increase in commercial yields. Under favourable agroclimatic conditions, yields in excess of 3 metric tonnes per ha have also been realised. However national yields actually realised in producing countries even today are considerably lower, ranging from 550 kg to 1200 kg/ha.

Past achievements of the plant breeders were handicapped by the very narrow genetic base available from the early collections. This has now been rectified by the establishment of new germplasm centres in Malaysia and Cote d' Ivoire after the more imaginative 1981 collection organised by the IRRDB. It will however take some 30 years to achieve any quantum leap in yield capacity. It is nevertheless clear that substantial yield increases can be achieved. Hevea deposits some 35 tonnes of dry matter per ha annually. What the plant breeder has managed so far is to partition off less than 10% of this to rubber yield. It is not unreasonable to target 20%

(Contd on page no. 4)

Hon'ble Dy. Minister of Commerce Mr. Salman Khursheed inaugurating the conference. Mr. Eti Shambunath, Hon'ble Minister of Forests, Govt. of Karnataka and Smt. J. Lalithambika IAS, Chairman, Rubber Board are also seen.

THE INTERNATIONAL NATURAL RUBBER CONFERENCE INDIA 1992

The four day long International Natural Rubber Conference India, 1992 held at Bangalore from 5th to 8th February, 1992 concluded with the optimistic note that the prospects of the natural rubber the world over would be brighter and the superiority of natural rubber would remain unchanged. Over 500 delegates from 20 countries including India participated in the conference which mainly discussed the biological and technological aspects of natural rubber production. In his key note address, the internationally acclaimed scientist Dr. B. C. Sekhar made a quick scan of the different sectors of Hevea and NR developments and this highlighted the challenges and requirements confronting the elastomer industry in the 21st century. Hopefully he analysed the reasons regarding what the Natural Rubber Industry could do to retain and strengthen its position in the changing world of elastomer production and utilisation. He said while the SR sector was applying its efforts on a multiplicity of elastomers, the NR sector was contending with the study and improvement of CIS 1, 4 Polyisoprene emanating from *Hevea Brasiliensis*. Organised R&D in support of Hevea and NR can perhaps be dated from the early 1920s. Some 70 years of concentrating R & D effort the world over has underpinned the NR industry. Substantial achievements could be highlighted, he said. Numerous inventions, innovations and developments could be catalogued, he added.

STRENGTH AND STABILITY

Dr. B. C. Sekhar declared in his key note address that the resultant inventory of achievements certainly proved beyond doubt that strength and stability of the NR industry derived from the strong foundation laid by the scientific and technological efforts mounted in the past seven decades.

Inaugurating the International Natural Rubber Conference, 1992,

Honourable Union Deputy Minister for Commerce Mr. Salman Khursheed said that the research in the use of rubber was of primary importance as the country's percapita consumption was very low. He said there was an enormous gap between the developing countries and the developed in the use of rubber.

There was tremendous potential for rubber use especially in the context of increasing awareness with regard to the use of bio-degradable products. He said there was extensive scope for using rubber in the family planning programme as well as in items like garments. "The future of rubber is assured, but we must assure rubber for the future", he said.

Smt. Lalithambika, Chairman, Rubber Board said that the Government should take steps to bring degraded forests under rubber.

Datuk Ahmed Farook Haji S. M. Ishak, Chairman and Controller of Research, Malaysian Rubber Research and Development Board said that natural rubber should be oriented into specialised markets such as high precision engineering industry to get attractive prices.

Dr. M. R. Sethuraj, Director, Rubber Research Institute of India said the cost of rubber production was the highest in India and scientists should come out with solutions to bring it down through high yielding varieties and better management practices. Mr. Jacob Thomas, Vice Chairman proposed a vote of thanks.

NR VISION '92

The Minister opened an exhibition "NR Vision '92". The Minister of State for Forests, Karnataka Mr. Eti Shambunath, who presided over the function appealed to the scientists to develop high yielding and early maturing rubber and stressed the need for bringing non-conventional regions under rubber cultivation.

Mr. L.H.A. Rego, former Inspector General of Forests Govt. of India who delivered the valedictory address at the conference said that the country had done exceedingly well in raising the per hectare yield of rubber plantations from a meager 330 kg a hectare to 1200 kg in the past four decades. He however stressed the need for further improving the productivity in our plantations.

Smt. J. Lalithambika I.A.S., Chairman, Rubber Board in her presidential address stressed the need for globalisation of scientific knowledge and expertise. She said the views expressed by the eminent scientists gathered at the conference served as the source of strength and inspiration to those who stood for the development of the rubber plantation industry in India. Dr. M. R. Sethuraj summed up the four day deliberations by the delegates gathered there from 20 countries including India.

Dr. L. Mullins, an expert on natural rubber from the United Kingdom touched upon the usefulness of the conference. Shri. P. K. Narayanan, Rubber Production Commissioner welcomed the gathering. Dr. N. M. Mathew, Deputy Director, RRII proposed a vote of thanks. ●

(cont'd from page no. 2)

partition into rubber, which would mean that the trees will not protest when latex yielding 7 metric tonnes/ha is extracted. Using existing commercially proven high yielding material, world NR production capacity can easily be raised at least two-fold through a consistent and vigorous replanting programme.

AGRONOMY

Soil and foliar analysis have become diagnostic tools to implement a discriminating fertiliser policy. Advances in this area could assure yield increases of 14% and more.

PLANT PROPAGATION

Green budding has become a universally established practice and various refinements are now available. Anther-culture is showing promise of increased yields. Tissue culture however is yet to make a commercial impact. Field immaturity is being drastically reduced. Mechanisation in the nursery and the field is now available.

PHYSIOLOGY

Biochemical and electron microscope studies are continuing to expand the understanding of the fundamentals of latex generation and flow, especially in the context of stimulation. However it is as yet not possible to say with any certainty the exact role latex plays in Hevea.

New practical techniques are now on offer for extended flow of latex for over 60 hours and mechanisation of tapping. There is certainly the distinct possibility of reducing labour drastically without any significant drop in yield.

PATHOLOGY

Most diseases of Hevea - root, trunk and leaves have been studied and diagnostic, preventive

(to be continued)

USE OF PLANTING MATERIALS IN INDIAN RUBBER ESTATES

TOMS JOSEPH, V. HARIDASAN
RUBBER RESEARCH INSTITUTE OF INDIA

The selection of planting material is an important farm management decision. When the crop concerned is perennial like rubber the selection assumes added significance.Studies conducted earlier have shown that the small growers are increasingly planting RRII 105, the high yielding variety indigeneously developed(1). Now it is the turn to find out the trends in the use of planting materials in the estate sector. The present study attempts to evaluate the response of estates to modern planting materials particularly RRII 105.

OBJECTIVES AND METHODOLOGY

The objectives of the study are the following:

a) to evaluate the type of planting material stock existing in the estate sector,

b) to analyse the planting policy and highlight the recent trends and

c) to explain the differences in the use of planting materials with regard to the variations in the location, size and ownership of estates.

For the purpose, a large scale survey was undertaken covering 105 estates located in Kerala, Tamil Nadu and Karnataka with a total planted area of 37193 ha. The area covered is around half of the total area in the estate sector. The survey was conducted during the period August 1990 to January 1991.

RESULTS AND DISCUSSION

The pattern of the stock of planting materials existing at present is given in Table 1. The varieties Tjir and RRIM 600 claim the major positions. It will take years for the large growers to replant the area planted during 1950's and 1960's with low yielding varieties. The estate sector has followed the principle that it is always wise to keep the "eggs in different baskets". Contrary to the small holding sector, the share of a single material does not exceed 1/5th of the total area. While materials of PB origin accounted 20.3 per cent,and RRIM varieties claimed 19.4 per cent, RRII varieties occupied only 10.6 per cent of the total planting materials stock.

HISTORICAL ANALYSIS

Table 2 displays the planting policy followed by the estates during the last four decades. The share of seedlings which had been around one fourth of the total upto 1960's got reduced to 6 per cent during 1970's and disappeared thereafter. During 1950's, PB 86, GL 1 and PBIG were the highly preferred materials. The next decade witnessed the declining significance of the materials while Tjir and GG series of seedlings came forward. The prominent materials of 1970's were RRIM 600 and GT 1. Though they are at the mainstream still, during the 1980's their prominence have been cut shortened by RRII 105 and the upcoming of materials such as PB 217 and PB 235. RRII 105 claimed 42 per cent of the planted area during the last decade.

RECENT TRENDS

Table No.3 shows the detailed account of the planting done during the 1980's. As years passed, the percentage share of PB 235 has gone down while PB 217 has regained its significant position in the recent years. Though PB 28/59 is the second best yielder as per commercial yield figures, its share has gone down(2). The planting material GT 1 introduced in India during the 1960's have almost retained its leading position all over the period. Though it has lost its prominent place occupied during the 1970's RRIM 600 is still among the preferred clones .The single major planting material planted is RRII 105. During the period 1982-85 more than half of the area was planted with RRII 105.The large growers who were reluctant to plant RRII 105 have been prompted to do the same,thanks to the success stories of small growers who planted RRII 105.

REGION-WISE PATTERN

The pattern of planting done in three different regions is looked into (See Table 4).While the share of GT 1 in region A is 5.9 per cent and that of region B is 10.9 per cent, around 1/4th of the area in region C is planted with this variety. RRIM 600 and RRII 105 are prominently planted in region B. Most of the old stocks of Tjir,PB 86 etc., remain in region A. Relatively higher share of PB 235, PB 217 and PB 28/59 planting is claimed by region C.

SIZE-WISE PATTERN

The main planting materials used by small estates are RRII 105 and RRIM 600 while medium estates have shown preference for GT 1, RRII 105 and RRIM 600. The large estates planted mainly GT 1 and RRIM 600. Thus while RRIM 600 is preferred by all groups, GT 1 is more preferred by medium and large estates. It seems that the large estates are relatively reluctant to adopt RRII 105. The first two planting materials claimed 55 per cent of the area of small estates while in others the first two planting materials accounted for only below 40 per cent of total area (See Table 5).

PUBLIC SECTOR VS. PRIVATE SECTOR

While planting in private sector is spread over a large number of materials, the public sector has relatively concentrated on a few varieties. As can be seen from Table 6, the share occupied by the first two planting materials in the private sector is 30.5 per cent while that of the public sector is as high as 49.9 per cent. A good portion of the planting material stock of public sector is claimed by Tjir, RRIM 600, RRII 105 and GT 1. The prominent ones in private sector are GG series seedlings, GT 1, RRIM 600 and Tjir. It is in the public sector that RRII 105 makes relatively greater presence. The modern high yielding planting materials of PB origin are mainly planted in the private sector.

TABLE I

Nature of the Stock of planting materials used

Sl. No.	Planting Material	Area (in ha.)	% share	Rank
1.	GG Series	4473	12.0	4
2.	Tjir	6142	16.5	2
3.	LCB 1320	523	1.4	14
4.	PBIG	417	1.1	16
5.	Polyclone	447	1.2	15
6.	GL 1	690	1.9	12
7.	PR 107	776	2.1	11
8.	PB 86	2712	7.3	6
9.	PB 5/139	218	0.6	21
10.	PB 6/9	243	0.7	19
11.	PB 28/59	1024	2.8	7
12.	PB 235	945	2.5	10
13.	PB 217	980	2.6	9
14.	PB 5/51	1000	2.7	8
15.	PB 260	136	0.4	23
16.	PB 311	242	0.7	20
17.	GT 1	4705	12.6	3
18.	RRIM 600	6211	16.7	1
19.	RRIM 605	316	0.9	17
20.	RRIM 623	574	1.5	13
21.	RRIM 628	122	0.3	24
22.	RRII 105	3811	10.0	5
23.	Other RRII varieties	206	0.6	22
24.	Others	280	0.8	18
	Total	37193	100.0	--

CONCLUDING REMARKS

The general tendency seen from the study is that leading planting materials reach prominence during a decade, give way to other upcoming materials during the next decade and get lost of their significance by the third decade. This was the fate of GG series seedlings, Tjir, GL 1, PB 86 etc. During 1970's, GT 1 and RRIM 600 had acquired highest prominence and during 1980's, while their significance gradually declined, the share of RRII 105, PB 217 has increased.

TABLE II

Use of planting materials during the last four decades

Sl. No.	Planting Material	1950-60		1960-70		1970-80		1980-90	
		A	B	A	B	A	B	A	B
1.	GG Series	9.4	4.8	24.7	85.8	--	--	--	--
2.	Tjir	11.0	4.2	36.0	95.2	3.7	9.4	--	--
3.	LCB 1320	2.1	8.8	1.5	44.8	0.3	0.6	--	--
4.	PBIG	15.5	82.9	0.5	17.1	2.1	46.4	--	--
5.	Polyclone	--	--	1.3	44.5	--	--	--	--
6.	GL 1	16.6	55.3	1.9	42.7	2.2	55.5	--	--
7.	PR 107	0.5	1.4	3.4	65.2	0.1	2.0	--	--
8.	PB 86	41.7	34.1	10.1	56.7	2.3	33.4	--	--
9.	PB 5/139	1.7	17.2	1.2	82.8	1.8	7.6	0.5	1.6
10.	PB 6/9	1.5	14.0	0.7	42.3	--	--	--	--
11.	PB 28/59	--	--	0.8	12.6	0.6	27.0	0.5	16.7
12.	PB 235	--	--	--	--	5.6	62.8	3.0	24.6
13.	PB 217	--	--	0.1	0.6	1.5	18.0	9.4	82.0
14.	PB 5/51	--	--	1.0	14.1	1.8	21.3	9.3	78.1
15.	PB 260	--	--	--	--	6.5	70.7	1.9	15.2
16.	PB 311	--	--	--	--	--	--	1.6	100
17.	GT 1	--	--	1.1	3.5	--	--	2.8	100
18.	RRIM 600	--	--	10.4	24.0	27.6	64.6	18.5	31.9
19.	RRIM 605	--	--	1.0	47.7	36.7	63.2	10.2	12.8
20.	RRIM 623	--	--	3.5	93.3	1.5	52.3	--	--
21.	RRIM 628	--	--	0.8	93.8	0.3	6.7	--	--
22.	RRII 105	--	--	--	--	0.1	6.2	--	--
23.	Other RRII varieties	--	--	--	--	4.0	11.9	41.6	88.1
						1.3	73.6	0.7	26.4

A = Percentage share of the item in the decade
B = Percentage share of the decade for an item.

TABLE III

Recent trend in the use of planting materials (% share)

Sl. No.	Planting Material	1980-81	1982-83	1984-85	1986-87	1988-90
1.	PB 86	--	0.7	--	--	--
2.	PB 6/9	--	0.5	0.5	--	--
3.	PB 28/59	6.8	--	2.4	7.8	2.9
4.	PB 235	15.4	12.6	9.8	8.4	2.3
5.	PB 217	21.6	5.0	3.0	7.1	16.8
6.	PB 5/51	13.4	--	--	0.2	1.7
7.	PB 260	0.5	--	1.1	4.1	3.6
8.	PB 311	--	--	2.3	7.8	4.8
9.	GT 1	21.6	17.3	16.5	15.0	21.7
10.	RRIM 600	6.9	8.4	8.5	20.7	10.9
11.	RRII 105	13.8	55.3	55.7	28.4	33.1
12.	Other RRII varieties	--	0.2	0.2	0.5	2.2

TABLE IV
Use of planting materials - region-wise (% share)

Sl. No.	Planting Material	Region A (Tamil Nadu & Karnataka)	Region B (Travancore & Cochin)	Region C (Malabar)
1.	G.G Series	0.5	12.4	18.4
2.	Tjir	34.4	13.6	14.7
3.	LCB 1320	0.2	0.1	0.1
4.	PBIG	0.8	1.3	0.3
5.	Polyclone	3.2	1.0	0.5
6.	GL 1	2.6	0.7	4.5
7.	PR 107	2.2	2.4	1.3
8.	PB 86	19.9	6.0	3.2
9.	PB 5/139	3.3	0.2	--
10.	PB 6/9	0.1	0.1	2.5
11.	PB 28/59	2.7	2.5	3.4
12.	PB 235	0.9	2.0	5.0
13.	PB 217	--	2.5	4.7
14.	PB 5/51	2.5	3.6	0.9
15.	PB 260	0.2	0.5	--
16.	PB 311	--	0.8	0.6
17.	GT 1	5.9	10.9	23.4
18.	RRIM 600	12.4	21.5	9.0
19.	RRIM 605	0.5	0.5	0.5
20.	RRIM 623	0.1	1.6	2.3
21.	RRIM 628	0.8	0.4	0.3
22.	RRII 105	6.4	14.8	4.1
23.	Other RRII varieties	0.4	0.6	0.3

TABLE V
Use of planting materials- Size-wise (area in ha.) (% share)

Sl. No.	Planting Material	Small (below 200 ha.)	Medium (200- 400 ha.)	Large (above 400 ha.)
1.	GG Series	3.2	7.6	12.4
2.	Tjir	7.4	12.8	11.0
3.	LCB 1320	1.6	0.3	1.5
4.	PBIG	0.4	0.8	1.1
5.	Polyclone	--	--	1.4
6.	GL 1	4.0	2.3	1.1
7.	PR 107	1.5	0.8	2.4
8.	PB 86	5.4	8.0	7.3
9.	PB 5/139	0.4	1.8	0.4
10.	PB 6/9	--	--	1.9
11.	PB 28/59	3.5	1.5	2.7
12.	PB 235	2.7	2.7	2.3
13.	PB 217	0.5	0.1	3.0
14.	PB 5/51	1.0	1.0	3.1
15.	PB 260	0.1	0.6	0.3
16.	PB 311	1.2	1.4	0.4
17.	GT 1	9.8	19.0	19.0

18.	RRIM 600	26.0	14.5	18.7
19.	RRIM 605	0.2	0.5	0.5
20.	RRIM 623	0.2	5.9	1.0
21.	RRIM 628	0.2	--	0.4
22.	RRII 105	29.7	16.9	7.7
23.	Other RRII varieties	1.0	1.5	0.4

Table VI

Use of planting materials- Ownership- wise (% share)

SI No.	Planting Material	Public Sector	Private Sector
1.	GG Series	5.8	15.5
2.	Tjir	25.7	10.7
3.	LCB 1320	1.8	1.2
4.	PBIG	--	1.8
5.	Polyclone	1.7	1.0
6.	GL 1	0.4	2.4
7.	PR 107	4.2	1.0
8.	PB 86	7.9	7.1
9.	PB 5/139	0.4	0.5
10.	PB 6/9	0.3	0.9
11.	PB 28/59	--	4.4
12.	PB 235	--	4.0
13.	PB 217	--	4.1
14.	PB 5/51	4.1	1.9
15.	PB 260	--	0.6
16.	PB 311	--	1.0
17.	GT 1	9.2	15.0
18.	RRIM 600	24.2	14.0
19.	RRIM 605	0.3	0.6
20.	RRIM 623	--	2.5
21.	RRIM 628	--	0.5
22.	RRII 105	13.8	8.5
23.	Other RRII varieties	0.2	0.8

The detailed analysis of the last decade has shown that during the recent years the popularity of PB 235 and RRIM 600 has gradually gone down. Again a new planting material PB 311 is introduced during mid 1980's. It can be expected that RRII 105, GT 1, PB 217 and PB 311 will be the leading planting materials during 1990's in the estate sector. From the experience it also seems that the share of RRII 105 (41.6 percent during 1980's) may decline as the popularity of PB 217 and PB 311 is likely to be on the rise. Yet RRII 105 may remain as the single major planting material during the current decade.

ACKNOWLEDGMENTS

The authors are grateful to Dr.M.R. Sethuraj for critically examining the paper. The comments given by Dr. Tharian George.K. on an earlier draft of this paper are also acknowledged. The co- operation extended by the large growers to this study is acknowledged with thanks.

REFERENCES

1. Viju Ipe C and V. Haridasan(1987) , Adoption of Improved Planting Materials in Rubber Small Holdings, Rubber Board Bulletin Vol. 23,No.3.

2. Toms Joseph and V. Haridasan (1990), Evaluation of Planting Materials under Commercial Planting : Third report, Rubber Board Bulletin Vol.26, No.1.

Transportation Products

— What's in a name?

A lot more than there used to be, says Goodyear's Engineered Products Division, which announced that Transportation Products is now the new name of its former Automotive Products groups.

"Transportation Products better reflect the division's market coverage, which has come to reach far beyond autos alone," said Paul Foley, director of sales and marketing for the operations.

Foley said the division continues to market a variety of automotive related products, including instrument panels, air springs, belts and hoses, engine mounts, trim and fascia parts. "For some time, however, we've also been heavily involved in the trucking, farm implement, military vehicle and railroad markets."

In addition to supplying original equipment manufacturers, the unit is a major supplier to the industry's more than $6 billion a year aftermarket.

GENETIC RESEARCH AND EDUCATION : CURRENT TRENDS AND THE NEXT FIFTY YEARS

C.K. SARASWATHY AMMA, Dy. DIRECTOR (BOTANY) AND
KAVITHA K. MYDIN, JUNIOR SCIENTIST
RUBBER RESEARCH INSTITUTE OF INDIA

The Indian Society of Genetics and Plant breeding, the premier society in the country in the discipline of Genetics and Plant Breeding, has completed 50 years of its existence. On the occasion of its Golden Jubilee Celebration, an International Symposium on'Genetic Research and Education: Current trends and the next fifty years' was organised at New Delhi from 12th to 15th February 1991. The venue of the symposium was Hotel Ashok, New Delhi. The Symposium was inaugurated by Hon'ble Prime Minister Shri Chandra Sekhar. The inaugural function was chaired by Shri Devi Lal, Hon'ble Deputy Prime Minister. In his inaugural address the Prime Minister emphasised the importance of genetic engineering and biotechnology for bringing in newer concepts and their conceptualisation in crops. He also stressed the relevance of conservation of natural biological resources for keeping environmental balance. In conclusion, he advocated that the benefit of science should reach the common man. Shri Devi Lal in his remarks emphasised that the scientists should pay maximum attention to programmes of lab-to-land.

Dr. M.S. Swaminathan, our most distinguished agricultural scientist, in his key note address touched upon the prominent land marks in the history of genetics, which is just ninety years old. Within such a short period, this discipline of science has made tremendous contributions with far reaching consequences in all walks of human life. He contemplated that the contribution of the present era of molecular genetics and biotechnology is going to provide unlimited power for manipulating the genetic architecture of plants and animals. He also emphasised the importance of genetic conservation for posterity. He suggested that out country should formulate a National Commission on Genetics for strengthening teaching and research in this area. He expressed his firm belief that genetics is a unifying science and its propagation will have far reaching effects on our cultural, social and ethnic issues.

SPECIAL STAMP AND COVER

During the inaugural session Dr. Sanjay Singh, Hon'ble Minister of State for Communication, released the First Day Cover to commemorate the Golden Jubilee function. The cover depicts some of the organisms which have been extenstively used in the researches on genetics and in harvesting the benefits of genetics for the improvement of plants and animals as well as in human health. A stamp was also released on the occasion.

INDIAN SOCIETY OF GENETICS AND PLANT BREEDING

The Society was founded by Dr. B.P. Pal at the time of the Indian Science Congress at Banaras Hindu University in January, 1941. Shri T.S. Venkatraman, the renowned sugarcane breeder was the first president of the Society and Dr. B.P. Pal, the Secretary, as well as Editor of the Journal of Genetics and Plant Breeding. The objectives of the society have been to advance the cause of genetics and plant breeding in India, to encourage and promote study and research to disseminate knowledge in these subjects, to provide facilities for associations and conferences among students of heredity and for encouragement of close relationship between workers in genetics and plant breeding and those in related disciplines.

The society has been active in organizing symposia on various subjects, periodically. Five international and fourteen national symposia on basic and applied genetics were held under the aegis of the society in the fifty years of its existence. It had the honour to host the XV International Genetic Congress (1983) held in India for the first time. The society is a member of the International Genetics Federation.

During the Golden Jubilee year, the Society organized six

Dr. M.S. Swaminathan, delivering his key-note address.

symposia in collaboration with the Indian Council of Agricultural Research. The symposia in genetics of various field crops included one each on Maize (April 1990 at Coimbatore) Pennisetums (May 1990 at Hyderabad), Cotton (April 1990 at New Delhi), Sorghum (May 1990 at Rahuri), Brassicas (August 1990 at Jaipur) and Pulses (February 1991 at New Delhi). Besides this, a symposium on "Biotechnoloy in Agriculture" was held at Coimbatore and "Genetics and Biotechnology for crop improvement" at Hyderabad. The society also organized Golden Jubilee lectures by its past presidents and eminent scientists. To commemorate the contributions of Dr. B.P. Pal, the society had instituted an annual B.P. Pal Memorial lecture. The first lecture was delivered by Dr. M.S. Swaminathan and the second by Dr. N.G. Rao. As part of its Golden Jubilee Celebrations the society honoured all its past Presidents and 15 eminent scientists associated with the society.

The symposium was felicitated by 16 eminent dignitaries which include his excellency R. Venkataraman, President of India; S.D. Sharma, Vice-President, Mohan Dharia, Deputy Chairman, Planning Commission, Dr. M.S. Swaminathan, President of the International Union for the conservation of Nature and Natural Resources and of the World Wide Fund for Nature India and the President of the National Academy of Sciences of India, and Dr. A.P. Mitra, Director General, CSIR. The President of the Society Dr. V.P. Gupta traced the history of Indian Society of Genetics and Plant Breeding and Dr. Balram Sharma, the Organizing Secretary of the Society proposed a vote of thanks.

The organizing committee of the Symposia received a number of goodwill messages from several organisations and eminent individuals from India and abroad including Dr. N. Borlaug, nobel laureate. About 1400 delegates from 16 countries participated.

SCIENTIFIC PROGRAMME

The scientific programme touched upon topics like biological diversity, stress resistance, biotechnology, non-convential approaches in plant and animal improvement, genetics and human health, genetics and society, and genetics education. Parallel scientific sessions were run in four venues on three days. There

GENETIC RESEARCH AND EDUCATION : CURRENT TRENDS AND THE NEXT FIFTY YEARS

C.K. SARASWATHY AMMA, Dy. DIRECTOR (BOTANY) AND
KAVITHA K. MYDIN, JUNIOR SCIENTIST
RUBBER RESEARCH INSTITUTE OF INDIA

The Indian Society of Genetics and Plant breeding, the premier society in the country in the discipline of Genetics and Plant Breeding, has completed 50 years of its existence. On the occasion of its Golden Jubilee Celebration, an International Symposium on'Genetic Research and Education: Current trends and the next fifty years' was organised at New Delhi from 12th to 15th February 1991. The venue of the symposium was Hotel Ashok, New Delhi. The Symposium was inaugurated by Hon'ble Prime Minister Shri Chandra Sekhar. The inaugural function was chaired by Shri Devi Lal, Hon'ble Deputy Prime Minister. In his inaugural address the Prime Minister emphasised the importance of genetic engineering and biotechnology for bringing in newer concepts and their conceptualisation in crops. He also stressed the relevance of conservation of natural biological resources for keeping environmental balance. In conclusion, he advocated that the benefit of science should reach the common man. Shri Devi Lal in his remarks emphasised that the scientists should pay maximum attention to programmes of lab-to-land.

Dr. M.S. Swaminathan, our most distinguished agricultural scientist, in his key note address touched upon the prominent land marks in the history of genetics, which is just ninety years old. Within such a short period, this discipline of science has made tremendous contributions with far reaching consequences in all walks of human life. He contemplated that the contribution of the present era of molecular genetics and biotechnology is going to provide unlimited power for manipulating the genetic architecture of plants and animals. He also emphasised the importance of genetic conservation for posterity. He suggested that out country should formulate a National Commission on Genetics for strengthening teaching and research in this area. He expressed his firm belief that genetics is a unifying science and its propagation will have far reaching effects on our cultural, social and ethnic issues.

SPECIAL STAMP AND COVER

During the inaugural session Dr. Sanjay Singh, Hon'ble Minister of State for Communication, released the First Day Cover to commemorate the Golden Jubilee function. The cover depicts some of the organisms which have been extensively used in the researches on genetics and in harvesting the benefits of genetics for the improvement of plants and animals as well as in human health. A stamp was also released on the occasion.

INDIAN SOCIETY OF GENETICS AND PLANT BREEDING

The Society was founded by Dr. B.P. Pal at the time of the Indian Science Congress at Banaras Hindu University in January, 1941. Shri T.S. Venkatraman, the renowned sugarcane breeder was the first president of the Society and Dr. B.P. Pal, the Secretary, as well as Editor of the Journal of Genetics and Plant Breeding. The objectives of the society have been to advance the cause of genetics and plant breeding in India, to encourage and promote study and research to disseminate knowledge in these subjects, to provide facilities for associations and conferences among students of heredity and for encouragement of close relationship between workers in genetics and plant breeding and those in related disciplines.

The society has been active in organizing symposia on various subjects, periodically. Five international and fourteen national symposia on basic and applied genetics were held under the aegis of the society in the fifty years of its existence. It had the honour to host the XV International Genetic Congress (1983) held in India for the first time. The society is a member of the International Genetics Federation.

During the Golden Jubilee year, the Society organized six

Dr. M.S. Swaminathan, delivering his key-note address.

symposia in collaboration with the Indian Council of Agricultural Research. The symposia in genetics of various field crops included one each on Maize (April 1990 at Coimbatore) Pennisetums (May 1990 at Hyderabad), Cotton (April 1990 at New Delhi), Sorghum (May 1990 at Rahuri), Brassicas (August 1990 at Jaipur) and Pulses (February 1991 at New Delhi). Besides this, a symposium on "Biotechnoloy in Agriculture" was held at Coimbatore and "Genetics and Biotechnology for crop improvement" at Hyderabad. The society also organized Golden Jubilee lectures by its past presidents and eminent scientists. To commemorate the contributions of Dr. B.P. Pal, the society had instituted an annual B.P. Pal Memorial lecture. The first lecture was delivered by Dr. M.S. Swaminathan and the second by Dr. N.G. Rao. As part of its Golden Jubilee Celebrations the society honoured all its past Presidents and 15 eminent scientists associated with the society.

The symposium was felicitated by 16 eminent dignitaries which include his excellency R. Venkataraman, President of India; S.D. Sharma, Vice-President, Mohan Dharia, Deputy Chairman, Planning Commission, Dr. M.S. Swaminathan, President of the International Union for the conservation of Nature and Natural Resources and of the World Wide Fund for Nature India and the President of the National Academy of Sciences of India, and Dr. A.P. Mitra, Director General, CSIR. The President of the Society Dr. V.P. Gupta traced the history of Indian Society of Genetics and Plant Breeding and Dr. Balram Sharma, the Organizing Secretary of the Society proposed a vote of thanks.

The organizing committee of the Symposia received a number of goodwill messages from several organisations and eminent individuals from India and abroad including Dr. N. Borlaug, nobel laureate. About 1400 delegates from 16 countries participated.

SCIENTIFIC PROGRAMME

The scientific programme touched upon topics like biological diversity, stress resistance, biotechnology, non-convential approaches in plant and animal improvement, genetics and human health, genetics and society, and genetics education. Parallel scientific sessions were run in four venues on three days. There

were a total of 110 invited papers and 920 contributed papers. All the contributed papers were poster presentations and from among them a few papers were selected for incorporation in the proceedings. Among the contributed papers the crops covered along with the number of papers are given below :

PAPERS ON CROP RESEARCH PRESENTED

Crops		No. of Papers
1. Cereals		181
2. Millets		114
3. Triticale		6
4. Pulses		180
5. Oilseeds		58
6. Vegetables		75
7. Tuber Crops		9
8. Medicinal and aromatic plants		10
9. Ornamentals		13
10. Fibre crops		80
11. Tree crops:	Fruit trees	5
	Forest trees	16
	Rubber	1
	Coconut	1
12. Other crops		32

The paper presented on rubber was "Comparative cytomorphological studies on spontaneous and synthesized triploids of *Hevea brasilensis* (Willd. ex Adr. de Juss.) Muell. Arg". The paper was well received by scientists from various other Research Institutes.

In his talk on biological diversity Dr. M.S. Swaminathan high lighted various biological activities and bioconservation. The extent of species diversity existing in our planet is not completely known. About 1.5 million species have been described by biosystematists so far. A global convention for saving and sharing biological diversity is currently being negotiated under the auspices of the United Nations Environment Programme. In the session on stress resistance both biotic and abiotic factors were discussed in crop improvement programme. Breeding strategies for future improvement of vegetatively propagated crops and biochemical aspects of improvement in field crops and effective use of chemical mutagenesis in plant breeding in USSR were also discussed. Impact of biotechnology in crop and animal improvement programmes was also covered in the discussion. Role of biotechnology in conservation of biodiversity and in shortening the breeding cycle in long generation tree species also came within the perview of discussion. Institutional requirements for teaching in genetics and plant breeding, course curricula with developing needs for teaching in genetics and intellectual property rights in plants-pros and cons, genetics and human health, genetics and society etc. were also discussed.

The plenary session was held on the evening of 15th February 1991. The chief guest of the session was Shri Mohan Dharia, Deputy Chairman of Planning Commission. Dr. M.S. Swaminathan chaired the session and Dr. V.P. Gupta presented a brief account of the scientific sessions. Reviewing the deliberations in the scientific sessions, the following conclusions were drawn:

Importance and relevance of basic research should be duly recognised and stressed by eminent scientists in their respective fields. Genetics will still be the most important tool for achieving optimal crop productivity with reduced cost. New methods to enhance the plant breeding process through breeding for resistance to insect pests and plant diseases have already paid dividends and the new tools of genetic engineering will further enhance the levels of resistance and reduce plant protection costs. Tolerance to stresses like cold and drought can be incorporated. The biochemistry of plant traits, and recombinant DNA technology will become important tools in enhancing the genetic potentials for crop productivity at low costs. Analysis of the germplasm accessions and strategies for assembling genes into optimal combinations using various tools and methods will eventually result in functionally transferred traits. Identification of physiological and biochemical determinants of metabolism, growth and development will further enhance opportunities for genetic manipulations. Progress in molecular genetics will provide powerful tools to plant breeders.

The symposium enabled the scientists in the various fields to share their experiences and achievements. It also provided an opportunity for the Indian participants to have an insight into the advances in the field of genetics and breeding research abroad.

GENETIC COMPLEXITY IN HEVEA BRASILIENSIS: SOME THEORETICAL CONSIDERATIONS

K.K. VINOD AND J. RAJESWARI MEENATTOOR
RUBBER RESEARCH INSTITUTE OF INDIA, REGIONAL RESEARCH STATION, AGARTALA - 799 006.

INTRODUCTION

Hevea brasiliensis (Wild. ex A. de Juss) Muell. - Arg., the natural rubber tree, is one of the domesticated wild forest trees, and is one among the least genetically manipulated crops of the world. The basic reasons for the lesser genetic manipulation were the extensive outcrossing nature of the tree along breeding cycle and narrow genetic base when compared to other cultivated species. Apart from these, the major economic output from the tree-the natural rubber-is of physiological and complex biochemical origin.

HEVEA BRASILIENSIS AND ITS CONGENERS

Cytogenetic studies on *Hevea* spp. accomplished so far had shown that all of them carry 2n = 36 with a base number of x = 18 (Majumder, 1964). However this is unlike to any other euphorbiaceous plants which either have a basic number of 7, 8, 9, 10 or 11. This made the researchers doubt that *Hevea* spp. may be natural tetraploid or amphidiploids, but no probable progenitor for *Hevea, has been so far traced out. The present discussion is limited to H. brasiliensis* alone, being the only *Hevea* species of commercial importance.

REPRODUCTION AND GENETIC CONSTITUTION

H. brasilensis is a monoecious, entomophilous (pollinated by insects) and allogamous (cross pollinated) tree, and the extent of self pollination may be around 14-28%. It flowers once or twice a year but this behaviour is highly location specific (Simmonds, 1989).

Being an allogamous species genetic consitution of *Hevea brasiliensis* is both heterozygous and heterogenous in progenies but is heterozygous and homogeneous when multiplied vegetatively (budding). When allowed to breed freely they are believed to produce a panmictic (Mendelian) population due to random mating.

In effect no Mendelian genetic analysis is done in rubber (Simmonds, 1989). A little is known about oligo (major) and poly (minor) genic control of different traits. However available information tells about more recessive genes (like yellow seedlings) than any major genes.

Carryover of undesired recessive like lethal or semi or sublethel genes is a peculiarity of the cross pollinated plants over generations. These genes are carried on in heterozygous conditions masked by their dominant alleles. The exhibition of heterosis and in breeding depression and survival of the Zygotes after fertilisation, therefore depend of the quantum of such recessive alleles carried forward over generations (Borojevic, 1990). In rubber, however the extent of their presence in the genome is uncertain.

THE CYTOPLASMIC ROLE OF THE LATEX

As mentioned earlier the economic product of the rubber tree-the rubber-is the product of some complex genetic regulatory mechanisms. Based on the principles of gene regulation and expression in eukaryotic (with true nucleus) organisms this complexity can be figured out. Rubber particles are the product of a biochemical pathway takings up a diversion from the catabolic pathway of carbohydrates (sugars) immediately after the glycolysis where acetyl coenzyme A is converted to aceto acetyl coenzyme A, instead of citric acid which should have been formed usually when the catabolism enters the TCA (tricarboxylic acid) cycle. Moreover the diverted pathway itself is not a catabolic one but an anabolic where isoprene monomeres are being synthesised (figure).

The isoprene synthesis pathway is controlled by specialised enzymes like acetoacetyl Co A acyl trnasferase, 3-hydroxy 3-methyl glutaryl co A synthetase, 3-hydroxy 3-methyl glutaryl Co a reductase, Mevalonate Kinase, phosphomevalonate Kinase, 5-diphosphomevalonate decarboxylase, isopentenyl diphosphate isomerase, prenyl transferase, and rubber transferase starting from the conversion of acetyl Co A to acetoacetyl Co A (Kekwick, 1989). Biochemically all enzymes are polypeptides and polypeptides are direct gene products. Polypeptide synthesis in eukaryotic system is always under complex genetic regulation (Lewin, 1990). In rubber tree all the regulatory units controlling the expression of all these gene products must be distributed among all of its 36 chromosomes. Every genome has its chromatin equilibrium, the equilibrium between the euchromatin and heterochromatin fractions in chromosomes and every mRNA (messenger RNA) is the product of a specialised splicing action, governed by more specialised splicing genes. These split genes work precisely on intron-exon junction and open reading frames (OR) of the parent DNA strand. Every regulatory unit of a gene comprises of may polycistronic polynucleotide sequences which function either as structural genes or regulator genes or promotor genes etc., which my be found together or distributed in different chromosomes (Crick, 1979; Sharp, 1981; Gilbert *et al.*, 1986). Hence, synthesis of every molecule of the enzymes involved must be under the control of different regulatory sequences and this clearly divulges the intricateness of the genetic regulation in producing every single enzyme in the anabolic pathway of isoprene monomeres.

Recent biochemical investigations reveal that the isoprene monomeres are being synthesised in laticifer system itself, as the latex is found rich in all the enzymes required for the biosynthetic track. However the conversion of pyruvate to acetyl co A is found to be distributed in and outside the mitochondria, which are retained in the laticifers even under the tapping flow (d' Auzac and Jacob, 1969). The presence of DNA and related rRNA (ribosomal RNA), tRNA (transfer RNA) and mRNA in the latex (Tupy, 1985) confirms this concept and that the rubber synthesis is self-regulatory and laticifer-specific.

Reconfirmation of this concept was evidenced recently by Kush *et al.*, (1990) through their in vitro translation studies of the translatable mRNA. They observed that laticifer mRNAs are 20 to 100 fold enriched with transcripts encoding enzymes involved in rubber synthesis. Thereby it can be presumed that laticifer - specific genetic regulation of isoprene synthesis will be under the control of nuclear and extranuclear genome of rubber. By and large, gene expression under such regulatory system follows a central dogma, that is there will be inter as well as intra communications between nucleus and extrachromosomal genetic organelles like chloroplasts and mitochondria, for that the attempts on artificial manipulation of the genes for bettering the efficiency of rubber production (higher yield) is hardly an easy task. Because, if mutation is induced this may impair many steps in the metabolic track ultimately resulting in accumulating more undesirable genes besides all the existing ones.

The cytoplasmic role of the latex is complete when one comes to know about the particles other than rubber found in it. Lutoids are membrane bound particles containing the B-serum, which are highly osmotic sensitive and play a major role in the plugging mechanism. The precise mechanism of plugging is now known to be both electrostatic and enzymatic.

Lutoids are considered to be polydispersed lysosomal vacuome containing osmosensitive protein bodies like hevein and ergothionein and lysosomatic muramidinases and chitinases (Tata *et al.*, 1983), esterases and a range of acid hydrolases. They also carry peroxidases and several lutoid peroxidases. The lutoids are thus lysosomes of the latex cytoplasm and even the membrane of the lutoid is proved to be a vacuolysosomal tonoplast (d' Auzac and Jacob, 1989).

COMPLEXITY IN RUBBER BREEDING

Nevertheless as in any crop plant, the economic trait and its contributing traits in rubber tree are also believed to be polygenetically controlled and selection on phenotypic value is the only successful breeding strategy so far put forth. But the prediction of breeding values of characters like combining abilities (both general and specific) and also the nature of genetic variances by which those characters are being fixed in a population, was done by quite a few workers and the information

available is too inadequate to bring out general conclusions.

Though a lot of inadequacies have been confronted everytime by the rubber breeder, he has been always trying to combine and recombine or even transgressing the desirable polygenes which may altogether produce either heterotic effects, transgressive segregation, rare recombinations or even combinations of all. And they are too optimistic to meet with any of such chances, because like all out breeders *H brasiliensis* too shows heterosis and inbreeding depression.

Severe selection pressure excerted by the breeders on *Hevea* populations, infact has been producing distortion of genetic variability since its domestication, for that the selected plants are always being propagated clonally and the unselected are always being discarded, severely cutting down the base of genetic variation. Hence the breeders have to keep in mind that they have to conserve the genetic variability all the while for their wide range of selection.

Due to the selection pressure quantification of genetic regulation fo characters using quantitative genetic tools becomes almost meaningless because it confronts with all the limitations in the Hardy-Weinberg's equilibrium of random mating populations. There will be considerable genetic drift or genetic flux and/or negligible natural heritable variations. Hence formulation of allelic testing designs always go beyond the Hardy-Weinberg's expectations, though the plants may be perfectly random mating.

Theoretically speaking, selections operating on genes which are partially or fully dominant with respect to the fitness tend towards the complete elimination of one or the other allel and finally the gene frequency. Hence the genetic equilibrium is being rather adjusted in fovour of the allel which has more selection efficiency (Falconer, 1989). However no clearcut information of overdominance of heterozygotes in rubber tree for any character, and hence the concept has no immediate relevance to the breeder.

Though not immediate a distant adverse effect can be envisaged in rubber breeding if the same selection pressure is allowed to exist sans giving priority to maintain the genetic variability.

In future this may create intermitting of genetically less flexible relatives, though they might have evolved in two distant centres as genetic variability is narrowing down, and will produce more unstable progenies which may exhibit 'genetic homeostasis' (Lerner, 1954). It is the effect when artificial selection is carried out and suspended before much of the variation has been lost by fixation, natural selection will tend to bring back the gene frequencies to an equilibrium resulting in the reversion of the means of the selected characters to its original magnitude. This effect however may not be a threat to the rubber breeding immediately as the selection products are propagated asexually. At present the concept of early fixation of characters is a reverie as far as rubber genetics is concerned.

CONCLUSION

With all the bottlnecks and intricateness in genetic constitution of *H. brasiliensis* in the fray breeders still have to go a long way to unfurl its mysteries. The discussion above is neither exhaustive nor implies that only rubber has such complex genetic regulation, and infact all the organisms have it in one way or the other. But considering the economic output of the tree and the yielding span more attention must be given in formulating future improvement programmes than relying upon the informations accumulated from other crop species. It is very easy to promulgate on utilisation of biotechnological tools in genetic manipulation of rubber, but rubber is said to be a recalcitrant species. On hand a little information is available so far how much resistance rubber genome may offer or how much lissom it is to the biotechnologist who attempts such manipulations at cellular level. Such responses will be very drastic as they are directly expressed in very few cells and tissues when compared to a whole organism.

Taking into consideration the various avenues where a rubber breeder and geneticist can work, one can be optimistic in knowing more about the genetic system in rubber. However a breeder should always keep in mind all these intricacies before framing future programmes.

SELECTED REFERENCES

d'Auzac, J. and Jacob, J.L. 1969, Regulation of glycolysis in latex of *Hevea brasiliensis*. J. Rubber Res. Inst. Malaya, 21: 417

d' Auzac, J. and Jacob, J.L. 1989. The composition of latex of

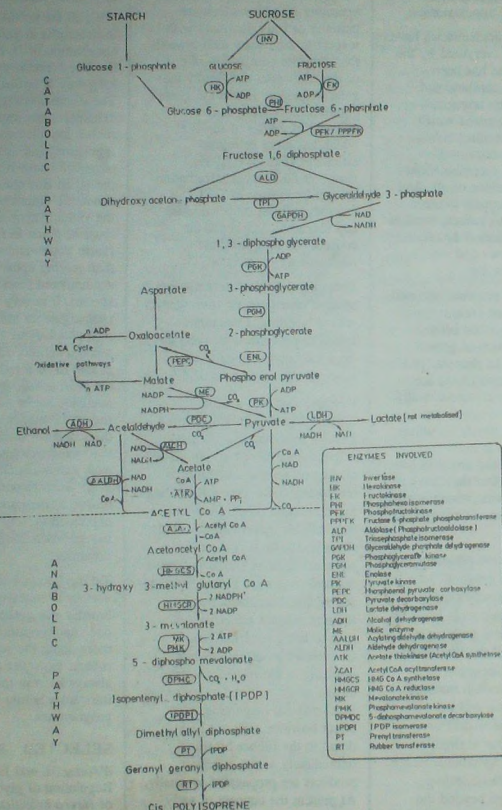


Fig 1: Pathways leading to the biosynthesis of rubber in Hevea brasiliensis

Hevea brasiliensis as a laticiferous cytoplasm. In Physiology of Rubber Tree Latex', J.d' Auzac, J.L. Jacob and J. Chrestin (eds). CRC Press, Florida, USA. p.59-88.

Borojevic,s. 1990. Principles and Methods of Plant Breeding. Elsevier Science Publishers, Amsterdam, The Netherlands.

Crick, F. 1979. Split genes and RNA splicing. Science, 204 : 264.

Falconer, D.S. 1989. Introduction to Quantitative Genetics. Longman Scientific and Technical, Essex, United Kingdom.

Gilbert, W., Marchionni, M. and McNight,G. 1986. On the antiquity of introns. Cell, 46 : 151.

Kekwick, R.G.O. 1989. The formation of isoprenoids in *Hevea* latex. In 'Physiology of Rubber Tree Latex', J.d' Auzac, J.L.Jacob and H. Chrestin (eds). CRC. Press, Florida, USA. p. 145-164.

Kush,A., Goyvaerts,E., Chye, M.L. and Chua, N.H. 1990. Laticfer specific gene expression in *Hevea brasiliensis*. Proc. Nat. Acad. Sci. USA, 87 : 1787.

Lerner, I.M. 1954. Genetic Homeostasis. Oliver and Boyd, Edinburgh, United Kingdom.

Lewin,B. 1990. Genes IV. John Wiley and Sons, New York, USA.

Majumder, S.K. 1964. Chromosome studies in some species of *Hevea*. J. Rubber Res. Inst. Malaya, 18 : 269.

Sharp, P.A. 1981. Speculations on RNA splicing. Cell, 23 : 643.

Simmonds, N.W. 1989. Rubber breeding. In 'Rubber', C.C. Webster and W.J.Baulkwill (eds). Longman Sceintific and Technical, New York, USA.

Tata, S.J., Beintema, J.J. and Balabaskaran, S. 1983. The lysosome of *Heveas brasilensis* latex, isolation, purification: enzyme kinetics and a partial amino acid sequence. J. Rubber Res. Inst. Malaysia, 31 : 1

Tupy, J. 1985. Some aspects of sucrose transport and utilization in latex producing bark of *Hevea brasilensis*. Biologia Plantarum (Prague), 21 : 51.

Rubber Pact Talks

The International Natural Rubber Organisation (INRO) which met in a two day session late last month failed to resolve the differences between the producers and consumers that comprise the organisation. In the crucial area of market stabilisation programme, both the parties were poles apart but unlike the acrimony that attended the meeting of INRO, the latest meeting was characterised by some degree of cordiality among the participants.

Though no concrete proposals emerged over the contentious issue of how to shore up natural rubber prices, the meeting agreed to establish an adhoc group of rubber market experts as soon as practicable to provide an independent view of the rubber market situation during the past two years. Analysts however believe that in practical terms, this move does not amount to much. This because, essentially, the new group is expected to no more than supplement the work already undertaken by the buffer stock committee of the INRO.

In terms of the agreement, producers and consumers are to nominate three members each to the new group which would evaluate the state of affairs pertaining to natural rubber and submit its report to the next meeting of INRO in May. In this ensuing meeting, producers are likely to be vocal in demanding early renegotiations of the rubber agreement, which according to them, has not lived up to its role of balancing the interest of both the groups. Their current disenchantment springs from the fact that, natural rubber prices has sought lower levels during the past two years and the efforts of the buffer stock manager to shore up prices has been both half-hearted and ineffective.

By the time of the INRO meeting in May, the delegates from the largest consuming nations namely the US, and the European Communities are likely to finalise their views on the time table for renegotiations of the rubber pact. Observers believe that without concessions from natural rubber consumers, the May meeting may not achieve much, except the restatement by both the factions of their position in regard to a new natural rubber agreement. Already, the producers are sore at the inordinate delay in the reform of the rubber agreement and may take recourse to radical measures to influence rubber prices.

Prior to the INRO meeting, producing countries had a meeting in Thailand to hammer a common strategy with the chief aim of preventing a fall in rubber prices below the lower intervention price provided for in the existing rubber pact. Unfortunately, this move met with stiff resistance from the consumer members at the regular INRO meet. They argued that market realities justified the current lower price bands for natural rubber. The irony is that, after the last INRO meeting in October, this body indicated that it would enter the market in a big way in the new year. But, although prices continued to dip, the purchase operations proved to be modest so that there was no fundamental change in the market situation.

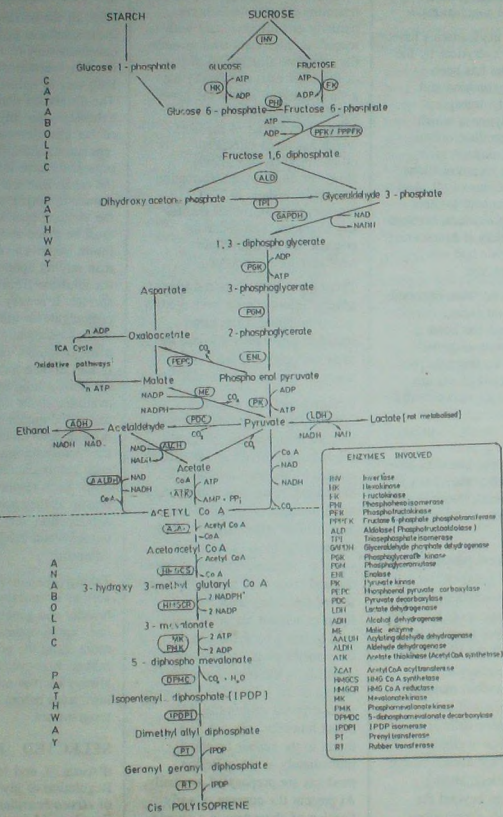


Fig 1: Pathways leading to the biosynthesis of rubber in Hevea brasiliensis

Hevea brasiliensis as a laticiferous cytoplasm. In Physiology of Rubber Tree Latex', J.d' Auzac, J.L. Jacob and J. Chrestin (eds). CRC Press, Florida, USA. p.59-88.

Borojevic,s. 1990. Principles and Methods of Plant Breeding. Elsevier Science Publishers, Amsterdam, The Netherlands.

Crick, F. 1979. Split genes and RNA splicing. Science, 204 : 264.

Falconer, D.S. 1989. Introduction to Quantitative Genetics. Longman Scientific and Technical, Essex, United Kingdom.

Gilbert, W., Marchionni, M. and McNight,G. 1986. On the antiquity of introns. Cell, 46 : 151.

Kekwick, R.G.O. 1989. The formation of isoprenoids in *Hevea* latex. In 'Physiology of Rubber Tree Latex', J.d' Auzac, J.L.Jacob and H. Chrestin (eds). CRC. Press, Florida, USA. p. 145-164.

Kush,A., Goyvaerts,E., Chye, M.L. and Chua, N.H. 1990. Laticfer specific gene expression in *Hevea brasiliensis*. Proc. Nat. Acad. Sci. USA, 87 : 1787.

Lerner, I.M. 1954. Genetic Homeostasis. Oliver and Boyd, Edinburgh, United Kingdom.

Lewin,B. 1990. Genes IV. John Wiley and Sons, New York, USA.

Majumder, S.K. 1964. Chromosome studies in some species of *Hevea*. J. Rubber Res. Inst. Malaya, 18 : 269.

Sharp, P.A. 1981. Speculations on RNA splicing. Cell, 23 : 643.

Simmonds, N.W. 1989. Rubber breeding. In 'Rubber', C.C. Webster and W.J.Baulkwill (eds). Longman Scientific and Technical, New York, USA.

Tata, S.J., Beintema, J.J. and Balabaskaran, S. 1983. The lysosome of *Heveas brasilensis* latex, isolation, purification: enzyme kinetics and a partial amino acid sequence. J. Rubber Res. Inst. Malaysia, 31 : 1

Tupy, J. 1985. Some aspects of sucrose transport and utilization in latex producing bark of *Hevea brasilensis*. Biologia Plantarum (Prague), 21 : 51.

Rubber Pact Talks

The International Natural Rubber Organisation (INRO) which met in a two day session late last month failed to resolve the differences between the producers and consumers that comprise the organisation. In the crucial area of market stabilisation programme, both the parties were poles apart but unlike the acrimony that attended the meeting of INRO, the latest meeting was characterised by some degree of cordiality among the participants.

Though no concrete proposals emerged over the contentious issue of how to shore up natural rubber prices, the meeting agreed to establish an adhoc group of rubber market experts as soon as practicable to provide an independent view of the rubber market situation during the past two years. Analysts however believe that in practical terms, this move does not amount to much. This because, essentially, the new group is expected to no more than supplement the work already undertaken by the buffer stock committee of the INRO.

In terms of the agreement, producers and consumers are to nominate three members each to the new group which would evaluate the state of affairs pertaining to natural rubber and submit its report to the next meeting of INRO in May. In this ensuing meeting, producers are likely to be vocal in demanding early renegotiations of the rubber agreement, which according to them, has not lived up to its role of balancing the interest of both the groups. Their current disenchantment springs from the fact that, natural rubber prices has sought lower levels during the past two years and the efforts of the buffer stock manager to shore up prices has been both half-hearted and ineffective.

By the time of the INRO meeting in May, the delegates from the largest consuming nations namely the US, and the European Communities are likely to finalise their views on the time table for renegotiations of the rubber pact. Observers believe that without concessions from natural rubber consumers, the May meeting may not achieve much, except the restatement by both the factions of their position in regard to a new natural rubber agreement. Already, the producers are sore at the inordinate delay in the reform of the rubber agreement and may take recourse to radical measures to influence rubber prices.

Prior to the INRO meeting, producing countries had a meeting in Thailand to hammer a common strategy with the chief aim of preventing a fall in rubber prices below the lower intervention price provided for in the existing rubber pact. Unfortunately, this move met with stiff resistance from the consumer members at the regular INRO meet. They argued that market realities justified the current lower price bands for natural rubber. The irony is that, after the last INRO meeting in October, this body indicated that it would enter the market in a big way in the new year. But, although prices continued to dip, the purchase operations proved to be modest so that there was no fundamental change in the market situation.

AVAILABILITY OF NATURAL RUBBER IN TECHNICALLY SPECIFIED FORMS BY 2000 A.D. AND THEIR OPTIMUM USE *

C.M. GEORGE, PROJECT OFFICER (Retd.) &
GEORGE JACOB, DY. DIRECTOR (Marketing)
RUBBER BOARD

INTRODUCTION

The rubber products manufacturing industry like any other industry in the country must face the realities of modern technology with a view to ensuring its healthy development. In this connection, it is important to mention that modern technology ensures quality both in respect of modern materials and consistency. It is only in appropriate to ensure that natural rubber (NR); which is the most important raw material used by the rubber products manufacturing industry in India, is made available to the industry as modern materials in technically specified forms guaranteeing quality and consistency in quality. Recognising this, the Rubber Board has been striving hard to modernise the processing and presentation of NR produced in the country, in order to make available NR as technically specified modern materials, guaranteeing quality and consistency in quality with the help and assistance of the Bureau of Indian standards. As a result, about 5.8% of the total NR produced in the country today is now processed and marketed as modern materials. The details regarding the various forms in which 297,300 M.T of NR produced in the country during 1989-90, is made available to the industry are given below:-

Forms of NR	Quantity in M.T	% of the total production
Conventionally processed and visually graded sheet rubber	207,180	69.69
Conventionally processed and visually graded crepe rubbers	36,050	12.12
Latex concentrates	36,910	12.42
Technically specified block rubber and Speciality rubbers	17,160	5.77
Total	297,300	100.00

From the above figures, it can be seen that there is a clear need for accelerating the efforts directed towards modernising processing and presentation methods of NR produced in the country with a view to ensuring that NR is made available to the rubber goods manufacturing industry in the country as modern materials guaranteeing quality and consistency in quality. Therefore, it is only appropriate to discuss the strategies being taken by the Rubber Board in increasing the availability of NR as technically specified modern materials with a view to finding out the availability by 2000 A.D and the areas where they can be profitably used as against conventionally processed and visually graded forms of NR.

PRODUCTION OF NR AS MODERN MATERIALS

As a result of the extensive and intensive R & D efforts of various research organisations in the major NR producing countries, a number of technological advances are made in the processing and

* Paper presented at the seminar at Kochi organised by AIRIA.
Theme : " The availability and growth of rubber in India by 2000 AD".

presentation of NR as modern materials. The most important among these advances, is the development of new processing methods which allow NR to be presented as

* Well defined grades with levels of contaminants specified for each grade

* compact blocks, neatly wrapped with polythene combatible with rubber

* technically specified material of assured uniformity and consistency in quality

* small bales which can be easily handled, transported and stored

* an industrial raw material offering assured processability and value for money

The new process involves the conversion of the rubber in the latex and/or in the scrap forms, into granular forms, in contrast to the sheets or crepes of the conventional processes, principally as an aid to rapid and efficient drying, but with advantages also in that properties could more easily be controlled by chemical treatments. The granules after about four hours drying at about 100°c is pressed into small blocks and wrapped in light polythene. The resulting block rubbers are technically specified adopting the standards fixed by the Bureau of Indian Standards, which are evolved mainly taking into consideration the requirements of the rubber products manufacturers. The BIS have specified now six Indian standard Natural Rubber grades, namely ISNR-3CV, ISNR-3L, ISNR-5 ISNR-10, ISNR-20, AND ISNR-50. The specifications fixed for each grade are given below:-

Physical and Chemical requirements for NR

Sl.No.	Characteristic	Requirements for					
		ISNR 3CV	ISNR 3L	ISNR 5	ISNR 10	ISNR 20	ISNR 50
1.	Dirt content, % by mass, Max	0.03	0.03	0.05	0.10	0.20	0.50
2.	Volatile matter, % by mass, Max	0.80	0.80	0.80	0.80	0.80	0.80
3.	Ash. % by mass, Max	0.50	0.50	0.60	0.75	1.00	1.50
4.	Nitrogen, % by mass Max	0.6	0.6	0.6	0.6	0.6	0.6
5.	Initial plasticity	40+5	30(Min)	30(Min)	30(Min)	30(Min)	30(Min)
6.	Plasticity Retention Index (PRI), Min	60	60	60	50	40	30
7.	Colour (Lovibond scale), Max	–	6.0	–	–	–	–

Technical specification is done by taking samples from selected bales representing each lot and testing for the various parameters mentioned in the specification. After ascertaining the grade, the blocks are packed in high density polythene bags marked with the grade and net weight. Each bag contains two blocks of 25 kg each. It is obligatory on the part of the producer of any form of Technically Specified Natural Rubber (ISNR) to grade and market his produces in conformity with such standards as are specified by the BIS from time to time.

It is now widely accepted that TSR is the rubber for tommorrow. The Rubber Board has drawn up an ambitious programme to enhance the production of TSR in a phased manner so that by the turn of the century, 100,000 M.Tonne of NR will be in the form of TSR. While striving hard to achieve this target, it is equally important to take proper care to ensure that when TSR is produced in bulk, quality standards are continued to be scrupulously followed and further improvements and rationalisation are also brought about. To bring about this, the Rubber Board has already provided the required infrastructural facilities.

The measures include, technical control in the production of new process rubbers by individual processors. All the factories producing technically specified rubbers are inspected periodically by the Specification Officers of the Board and officials of the Bureau of Indian standards and samples are drawn, tested and certified by the Rubber, Board. Also, all these units have either their own laboratory or arrangements for testing and certification by an approved outside laboratory. Thus, every bale of TSR marketed in the country will be guaranteed for its

quality and the rubber goods manufacturers can take advantage of this position. Also the Board runs courses to train personnel in quality control of technically specified rubbers besides providing advisory services to assist producers in factory operation and laboratory testing and certification.

The development of new processes for production of the above referred technically specified rubbers, has also opened the door for further improvements in the processing and presentation of NR as speciality rubbers that can meet the special requirements of the rubber consumers. The important speciality rubbers thus developed and which are having great significance and relevance to the rubber based industrialisation of the country are the following:-

* General Purpose Rubbers
* Superior Processing and Process Aid Rubbers
* Grafted Rubbers
* Deprotenised Rubbers
* Cyclised Rubbers
* Oil Extended Rubbers
* Epoxidised Rubbers

The salient features of these speciality rubbers are the following:-

GENERAL PURPOSE RUBBERS

These are viscosity stabilised rubbers meant for large volume application such as in tyre, conveyor beltings and hose pipes manufacturing. These rubbers are produced from a blend of deliberately coagulated latex rubber (a minimum of 40% by weight) and field coagulum. The parameters suggested for this grade of rubber are as follows:-

Parameters	Specification limits
Dirt content	(%) max - 0.10
Volatile matter	(%) max - 0.80
Ash content	(%) max - 0.75
PRI	min - 50
Nitrogen	(%) max - 0.60
Mooney Viscosity ML (1+4) 100°c	- 65±7
Accelerated storage hardening Δ P (max)	- 8units

SUPERIOR PROCESSING / PROCESS AID RUBBERS

These are rubbers prepared by coagulating a blend of prevulcanised rubber and normal latex. SP Rubbers contain 20% vulcanised rubber and 80% unvulcanised rubber whereas Process Aid rubbers generally marketed as PA-80, contains 80% vulcanised and 20% unvulcanised rubber. The advantage of SP Rubbers are in the manufacture of extruded and calendered products for obtaining better finish, lower die swell and higher dimensional stability.

GRAFTED RUBBERS

Grafted rubbers are produced as Methyl methacrylate and/or as styrene grafts. The Methyl methacrylate grafted rubbers are known as MG rubbers. These rubbers consist of polymethyl methacrylate chains grafted to the natural rubber molecule and are produced in two grades, MG-30 containing 30% and MG-49 containing 49% polymethyl methacrylate. They are mainly used as self- reinforcement elastomers and in adhesives. The styrene grafted rubbers consist of styrene molecules grafted to the NR molecule and the graft can be used in place of high styrene SBR type of synthetic rubber.

DEPROTENISED RUBBERS (DPNR)

DPNR is a highly purified form of NR with low non-rubber contents. Due to the low non-rubber contents, water absorption of DPNR is very low and hence its electrical properties are better.

CYCLISED RUBBERS

The hard resinous materials obtained when NR is treated with acidic reagents such as con.sulphuric acid, paratoluene sulphonic acid etc. is known as cyclised rubber. This material can be blended with NR to produce vulcanisates having high hardness and good technological properties.

OIL EXTENDED RUBBER (OENR)

Natural rubber extended by suitable type of petroleum oils like Naphthenic or aromatic oil, is known as OENR. OENR reduces or dispenses the use of peptisers in rubber compounding and reduces the crystallisation tendency of rubbers at low temperatures. Normally OENR contains 10-25 parts of oil.

EPOXIDISED NATURAL RUBBER (ENR)

ENR is a chemically modified form of natural rubber prepared by the in situ epoxidation of natural rubber in the latex stage using formic acid and hydrogen peroxide. Compared to natural

rubber, ENR has high oil resistance, less air permeability, better wet skid resistance and low rolling resistance. The potential applications for ENR are in tyre industry for the manufacture of passenger car tread, motor cycle tyre tread, tubeless tyre inner liners, inner tubes, adhesives, oil seals, gaskets, etc.

FACILITIES AVAILABLE AT PRESENT FOR PRODUCTION OF TECHNICALLY SPECIFIED NR GRADES

There are at present 22 factories producing technically specified block rubber and during 1989-90 these factories produced a total quantity of 17160 M.Tonne of ISNR grades. Out of this 22 factories, 6 factories are in the co-operative sector, 3 in the public sector and 13 in the private sector. Also the installed capacity of these 22 units is estimated to be 37200 M.Tonne par annum and the average capacity utilization during the year 1989-90 was only about 46%. The poor capacity utilization is due to several factors such as lack of availability of raw materials, disruption of power supply, labour absenteeism and/or unrest.

Though the response for the adoption of the modern processing methods was initially poor in the country, the situation has changed in recent years and as per the information available, about 24 licences which include 5 public sector units and 19 private sector units, have already been issued by the Rubber Board during the last two year. The installed capacities proposed for these 24 units are estimated to be of the order of 37800 M.Tonne. Based on the licences already issued, it would appear that most of the new units may be set up in the next two to three years and thus there will be a total installed capacity of over 75,000 M.Tonne of TSR by 1994-95. Also assuming that atleast two new units each having an installed capacity of 2500 M.Tonne per annum would be set up during the 9th plan period, the installed capacity for production of TSR can be estimated to be of the order of 100,000 M.Tonne per year by 2000 A.D. The year- wise figures of production projected during the period 1990-'91 to 1990-2000 are given below:-

Estimated production of Technically Specified Rubbers from 1990-91 to 1999-2000

Year	Estimated production of TSR (in M.Tonne)
1990-91	20,000
1991-92	25,000
1992-93	37,000
1993-94	48,000
1994-95	56,000
1995-96	64,000
1996-97	73,000
1997-98	81,000
1998-99	90,000
1999-2000	100,000

Besides producing the ordinary grades of technically specified rubbers for which BIS standards are already available, it is to be mentioned that steps are also underway for the production of speciality rubbers in the country. Already two units have been set up for production of PA-80 rubbers and four of the co-operative factories have already started production of GP rubbers. A new factory of 10 tonne per day capacity of GP rubber also is being set up by a company sponsored by the Rubber Board and the Rubber Producers' Socleties and the factory may start production early 1991. In respect of other speciality rubbers already mentioned, the Rubber Board has already taken steps to standardise the procedure for their commercial production and production of sample quantities for supply to selected consumers. If the response to these speciality rubbers is found to be enthusiastic, new units for the production of all these speciality rubbers may be set up in the years to come and by 2000 A.D, it may be possible to make available atleast some 10,000 M.Tonne of speciality rubbers.

OPTIMUM USE OF TECHNICALLY SPECIFIED AND SPECIALITY RUBBERS

It is well established that technology improvement in the case of rubber goods manufacture centres around mostly on the designing of the rubber compound for each product and on the selection of the right type and grade of polymer for the right product. Since NR is the main polymer available in India for the manufacture of rubber products and bulk of the NR Produced in the country is made available as visually graded sheets and or crepes which lack uniformity, there is a case for making available well defined grades of NR with technical specifications to rubber goods manufacturers with provision of after sales services to enable them to take right decisions on the type and

grade of NR to be used for individual applications. Recognising this fact, the Rubber Board has already taken steps for increasing the production of different grades of technically specified rubbers and speciality rubbers and made arrangements for the provision of after sales services to consumers wherever required. Rubber goods manufacturers can take advantage of these efforts by interacting closely with the Rubber Board. However, it is felt that it will be worthwhile to give some tips for the optimum use of different grades of technically specified rubbers and speciality rubbers for enabling the rubber goods manufactures to pick and choose the right type and grade of rubber for the right product. The tips for optimum use of the different grades are given below:-

ISNR–3CV

This grade of rubber can profitably be used in all applications where superior dynamic properties are required. For instance, in aero tyres, steel belted conveyors and engine mounting, the use of this grade of rubber can ensure reduction in energy consumption in mixing and compounding.

ISNR–3L

This grade of rubber being a pure light coloured material can be the best choice for the production of all coloured products particularly light coloured and transparent articles. The specific products for which this grade of rubber can be made optimum use of are pharmaceutical closures, high grades of footwears, hot water bottles and surgical sundries, chlorinated rubber, white side wall of tyres, rubber tubings and hospital sheetings.

ISNR–5

This grade of rubber can effectively substitute RMA IX & I in all applications with cost benefit. The specific areas where this can be profitably used are production of automobile tubings, high grade conveyor belts, and moulded and extruded products requiring high dynamic properties.

ISNR–10

This grade of rubber can effectively substitute RMA III and IV and EBC IX. The areas where this grade of rubber can be made optimum use are tread and carcass of automobile tyres, cycle tubes, conveyor belts, hoses, and black moulded and extruded products.

ISNR–20

This grade is preferred for the production of automobile tyre components particularly the tread and carcass due to techno-economic considerations. The specific areas where this grade of rubber can be made optimum use are the following:-

(1) production of the tread and carcass of automobile tyres

(2) Manufacture of off the road tyres, ADV tyres and cycle tyres

(3) Production of black coloured moulded and extruded products.

ISNR–50

This grade of rubber is preferred for use in the manufacture of cheap products requiring low service properties. The products where this grade of rubber can profitably be used are cheap footwear items, cycle tyres, hand made hoses, floor tiles and black moulded and extruded products requiring low service life.

GP RUBBERS

This grade of rubber is ideal for use in large volume applications. By the use of this grade of rubber in the production of tyres, the practice of blending of sheet grades with estate brown crepes, remilled crepes etc. for cheapening the compound, could be avoided. Since the viscosity of rubber is stabilized in GP rubbers, there is no need for premastication. Also the uniform consistency in viscosity enables better processability. The savings in energy by the use of GP rubber can be substantial. Also use of GP rubber reduces the need for continual factory process adjustments among batches resulting in a lower reject for the final product. The specific products where GP rubber can be used with cost benefits are (1) Automobile tyres (2) Conveyor belts, particularly steel belted conveyor and (3) Hoses.

SUPERIOR PROCESSING RUBBERS

The grades of rubber coming under this category, are preferred for the manufacture of extruded and calendered products because in such applications, better finish, lower die swell and higher dimensional stability are warranted. Therefore, for the manufacture of extruded and calendered items requiring better finish and dimensional stability these grades of rubber are recommended.

GRAFTED RUBBERS

These grades of rubbers can be used profitably as substitutes for high styrene rubbers and/or for

use as self-reinforcement elastomers and also in the manufacture of adhesives.

CYCLISED RUBBERS

This rubber can be blended with NR to produce vulcanisates having high hardness and good technological properties.

OIL EXTENDED NATURAL RUBBER (OENR)

OENR can be profitably used for the production of tread of passenger car tyres since tyres produced from OENR based tread shows improved skid resistance.

DPNR

DPNR being a highly purified form of NR, is the ideal for electrical applications and for the production of medicinal stoppers where purity is very important.

EPOXIDISED RUBBER

Epoxidised natural rubber have high oil resistance and less air permeability and hence are preferred for use in oil seals, O-rings, gaskets, diaphrams and also in place of butyl rubber.

CONCLUSION

The technological advances already made in the production of NR in technically specified modern forms, geared to meet consumer requirements, are very relevant and important for the healthy development of the rubber products manufacturing industry in the country. Recognising the situation, the Rubber Board as a part of a planned modernisation programme, is striving for modernisation of processing and presentation of NR. As a result, it is expected that by 2000 A.D it will be possible to make availabale substantial quantities of technically specified rubbers and speciality rubbers for use of the rubber goods manufacturers in the country. The rubber goods manufacturing industry must appreciate this fact and should make sincere efforts directed towards translating the new developments and the efforts made by the Rubber Board into application, thereby helping the industry to make optimum use of the technological advances made in processing and presentation of NR

Rubberised Coir Industry

Soon after the IInd World War, the rubberised coir industry originated in Austria. In the following years it spread to other parts of Europe and the world. In India, the rubberised coir industry entered in the field of coir industry in the early 1960's. Now, in India, there are about 25 rubberised coir producing units. These units are producing about 8000 tonnes of rubberised coir products valued at nearly Rs. 33 crores.

Rubberised coir finds the following end applications.

a) Domestic upholstery – mattresses and cushions.

b) Industrial cushioning – Bus seats, Automobile cushioning, Railway seats.

c) Air filteration in Industries.

d) Industrial packaging.

e) Carpet underlays.

f) Acoustic insulation.

The domestic upholstery sector constitutes more than 75% of the sales of Rubberised Coir Industry. In India there is still ample scope to treble the sales of rubberised coir mattresses.

The Industrial cushioning sector constitutes about 15% of the total sale of rubberised coir products. It is mainly dominated by latex foam rubber and Ployurethane (PU) foam.

In the light of various independent surveys made by the industrialists, they found that there is still ample scope to increase the sales of rubberised coir products in India. According to them, the estimated potential demand is in between 20,000 tonnes and 30,000 tonnes valued at about Rs. 70 crores to Rs. 100 crores.

Rubberised Coir Industry is highly technologically intensive. Automatic machinery is completely used in the different process of manufacture.

REPORT OF THE STUDY ON THE MARKET ACCEPTANCE OF LATZ LATEX

S. MOHANKUMAR, K.S. GOPALAKRISHNAN,
TECHNICAL CONSULTANCY DIVISION,
RUBBER BOARD

SYNOPSIS

In the past two three decades or so research and development in the latex processing industry and its application to produce different end products have enabled the industry to provide better and less expensive standard products. The work actively being pursued by Malaysia in this regard particularly to improve the properties and qualities of latex concentrate is remarkable. Because of the relentless efforts, the country has developed different types of latices like LATZ latex, Hydroxylamine treated latex, High drc latex etc. which are suited to the changing requirement of latex consuming industry. Of this, LATZ latex concentrate was well received by the consumers. Statistics of concentrated latex in Malaysia shows that more than 60% is of high ammonia type (HA) in past, and in recent years the trend has been towards the use of low ammonia latices (LA), mainly LATZ type. Recognising the merits of using this latex, the Rubber Board in India at its centrifuging factory has developed know how suited to Indian conditions for the production of low ammonia preserved latex (LATZ latex) and started its commercial production. This low ammonia latex possesses all the desirable qualities of HA latex concentrate without the adverse effects of high ammonia. Some of the consuming units have already started using this material regularly. However, this does not mean that LATZ latex has been readily welcomed and widely accepted in the market. Still there is quite a lot of ignorance about this rubber, particularly about its advantages among the small and medium consumers. Similarly there are people yet to be convinced about the need for change in latex processing. In order to dispel such doubts and to make the consumers aware of this product a market study was conducted and its findings are summarised in this report.

LATZ LATEX

Low Ammonia-TMTD/Zinc oxide Latex popularly known as LATZ is a modern marketable form of 60% concentrated latex with certain distinct advantages over the standard high ammonia latex concentrate. The specifications of LATZ latex are exacting. It has the same properties of concentrated latex and allow the consumers free from hazards.

ORIGIN AND GROWTH

The research work done in latex processing industry by Malaysia bore fruitful results and they came out with LATZ latex in 1975. However, the product was developed and popularised only in eighties. In 1980, the annual consumption of low ammonia latex exceeded 40,640 tonnes (dry weight). Now it has increased and understood that over 15% of the total concentrated latex produced in Malaysia is in the form of LA latices.

LATZ IN INDIA

The Pilot Latex Processing Centre, owned and operated by the Rubber Board, is the first factory that produced LATZ latex in India. It started its commercial production in April 1990 and produced about 375 MT drc of LATZ latex till December 1991. Since then two public sector units have also joined in the production of LATZ latex. Another unit in the estate sector and one in private sector are now in final stage of producing this latex. Efforts are also being made to extend the production in other processing factories.

PRODUCTION OF LATZ LATEX

Among various low ammonia preservative systems developed, LATZ is effective for preserving both field latex and concentrated latex. As per the procedure standardised at the Rubber Board, field latex is preserved with 0.2% ammonia, 0.025% TMTD and 0.025% Zinc oxide by weight of latex. TMTD and Zinc oxide are added as 33% and 50% dispersion respectively. The quantity of

chemicals required for 100 kg field latex is given in Table 1.

The LATZ preserved field latex is centrifuged using processes similar to those used in HA method. After centrifuging, the latex is ammoniated to 0.2% by wt. and MST is boosted by the addition of 0.075 lauric acid.

ADVANTAGES OF LATZ LATEX

LATZ latex possesses certain specific advantages over HA latex in both processing and manufacturing.

A. ADVANTAGES IN PROCESSING

1. Improvement in quality of centrifuged latex and preserved latex - The preservation of field latex and centrifuged latex using ammonia, TMTD and Zinc oxide system actually produces a sterile latex. The control of VFA is excellent with this system.

2. Savings in cost of preservatives - quantity of chemicals required for processing latex with this system is low.

3. Savings in consumption of ammonia-There is also considerable savings in the consumption of ammonia, about 80%, by the new method.

4. Savings in production cost of skim crepe - Since the ammonia in skim latex is low, less amount of sulphuric acid is required for coagulation.

5. Savings in effluent treatment - As less sulphuric acid is used for skim coagulation, residual chemicals present in the effluent will be low which leads to savings in effluent treatment.

A comparative study of the processing cost of 100 kg drc HA and LATZ cenex produced in a typical unit during 1991 is given in Table 2. The table shows that there is 33% savings in processing cost with the LATZ system.

B. ADVANTAGES IN MANUFACTURING

1. LATZ technology for processing cenex assures low VFA.

2. As LATZ is completely sterile, it can be stored for longer periods.

3. Zinc oxide and TMTD added to LATZ are compounding ingredients for most of the latex products and hence do not interfere with the compounding behaviour.

4. LATZ can be consumed without deammoniation process which is necessary during the manufacture of some of the latex goods while using HA latex.

5. Use of LATZ latex helps the manufacturers to control and reduce pollution and environmental problems.

6. Lastly, manufacturers are benefited in production cost, since they can do away with the deammoniation step.

LATZ LATEX AND THE CONSUMERS

In order to assess the specific advantages accruing to the rubber consumers by using it, we have collected their view through a questionnaire. Since foam rubber is the single largest user of latex concentrate (its share of total latex usage is 48% in 1989- 90) details were collected from the manufacturers of foam rubber alone. There are 329 licensed units in India to produce foam rubber, distributed all over the country - the pattern of distribution of units is given in Table 3. Though questionnaires were sent to all the foam manufacturers, only 75 units have furnished completed details in time. In addition, a few have responded well and enquired more clarification on this product.

From the details collected it is found that there are still difference of opinions about this latex. Some of the units who already started using this material regularly, have reported that its performance is better than the standard HA latex. Many units have undertaken trial production with LATZ latex and found the same better but are of the opinion that they will use this product regularly only after knowing its constant availability. Another group of consumers who are far-sighted enough to forsee some of the changes in the latex processing industry welcomed and evinced interest to switch over to this product if it is technically and economically suitable. A few showed subdued interest and enthusiasm because they are the people who are engaged in black marketing and tax evasion. Some units which are not considering about the quality and other aspects are very sceptical as they are happy with the conventional form of latex. To substantiate this argument further, it is pointed out that they are not interested to take any risk in changing the raw material due to the non-availability of testing facilities.

There are also lot of suggestions made by the consumers. Some reacted strongly about the quality of latex. They have an inferiority that they are in a typical situation of having no alternative choice except to buy and use anything they get as latex. It is rumoured that even some non ISI units are

also marketing their latex as ISI. Therefore, for ensuring standardisation of quality, they suggested to produce and market LATZ latex strictly as ISI product.

Some consumers required detailed information on chemical content of LATZ latex, the percentage of dre, price, its availability and despatch position. They evinced more interest on LATZ latex because of its low ammonia content, and suggested to supply this product at a fixed price for a period of atleast one year.

While the above suggestions are in favour of LATZ latex, some consumers who have used this latex for trial production went further ahead and argued against it on the following ground that high ammonia content (0.75-0.80%) is generally required for manufacturing most of the foam products. To strengthen this argument they added that, if ammonia is low, stability decreases and at the same time foaming time increases which affects the quality of finished good. They also pointed out the difficulties in procuring LATZ latex as its landed price is comparatively high owing to high transportation cost when compared to the landed price of concentrated latex as the former is now available only at Chethackal and Punalur.

FUTURE OUTLOOK

A. *Supply*

Though PLPC, PCK and RPL are the only three units engaged in production of LATZ latex, efforts are being made for setting up of more such factories in corporate and estate sector. Some of the existing units processing 60% concentrated latex have welcomed this move and prepared to convert a sizeable share of their production to LATZ latex. Therefore, an economic analysis of latex processing industry is necessitated to get an idea of the production possibility of this new type of latex.

In order to assess the strength and weakness of this industry, a study was conducted by the Rubber Board, and the report of the study revealed that there were 28 units in operation for processing centrifuged latex during 1985-86. The achievable capacity of the industry was estimated to 52500 MT and the capacity utilisation is 48% of the achievable capacity. Since then 5 units in private sector have joined the production line in 1989 and increased the achievable capacity to 61100 MT. In addition, licenses were issued for 16 new units. Some existing units have also enhanced the installed capacity. The report estimated that capacity utilisation of the industry will increase by 7 to 8% in the coming years. Taking into account the emergence of new units and expansion programme of the existing units and assuming 57% and 48% capacity utilisation, the supply position is projected and is given in Table 4. From the table we can see that projected supply of concentrated latex for the year 1990-91 would be 47652 MT. when 57% utilisation and 40128 MT when 48% utilisation. But the production figures published by the Rubber Board for the corresponding period is only 39440 MT which is lower than what we have projected. This difference may be due to the suppression of actual production by the private sector units as explained in earlier studies.

B. *Demand*

Demand for latex is said to be derived demand in nature since it depends on demand for the end products. The important products manufactured from latex are foam rubber, elastic thread and dipped goods like gloves, toys, balloons, teats, bladders and so on. There are about 1200 factories engaged in production of different latex based goods scattered all over the country. Product-wise consumption of latex for the period 1975-76 to 1990- 91 is given in Table 5.

The consumption figure in Table 5 shows that the industry has registered an annual growth rate of 12% over the 16 year period. Assuming the same growth rate, the estimated demand for the year 1991-92 will be 44650 MT and for the year 1994-95 it will be 62730 MT. It is also expected that the growth rate of demand for concentrated latex will not change in the near future since the newly established gloves manufacturing units are importing latex from abroad. Moreover, some of the manufacturers have now started to substitute good quality creamed latex and preserved latex for concentrated latex.

An analysis of the consumption figures provided by the 75 foam units included in the study shows that their requirement of LATZ latex for the next two years will be in the order of 58% and 60% of the total latex requirement. Based on this we can estimate the total demand for LATZ latex in the foam industry and the estimated figures are 14490 MT for 1992-93 and 17068 MT for the year 1993-94. This is only a rough indication of the future demand pattern showing there is exciting prospects for LATZ latex. However, the techno-economic considerations suggest that the consuming industry would prefer at least 20 to 30% latex consumption in the form of LATZ latex and therefore

the processing industry will be in a position to expand its production to meet this demand. The companies interested in tapping this market should then take several steps for the successful operation. An attempt is made here to suggest a few important measure to be undertaken before starting the venture.

MEASURES

1. As LATZ latex is a new product, make it known to the public at large including people in the same industry is important. Similarly, measures should be taken to create a new awareness about the need for incorporating industrial safety measures.

2. It is also essential to undertake more practical demonstrations in major latex consuming centres. This will enable the consumers to get full details of its chemical structure and the changes if any required while using latex for producing different type of latex based items.

3. Since majority of the consumers are small scale units, LATZ latex should be supplied in potential areas through regional depots so that the small buyers can directly purchase it from depots without involving much paper work and other formalities.

4. Arrangements should also be made for the sale of LATZ latex in small quantities since the working capital of small units is very low.

5. Lastly, price which is the most deciding factor of purchase in small factories, should be fixed on a definite criteria taking into account the actual cost involved for processing this latex plus a nominal margin.

TABLE 1

Quantity of Chemicals required for processing 100 kg. field latex with LATZ system.

Chemicals	% by wt. of latex
Ammonia	0.200
Zinc oxide (Zno)	0.025
Tetra Methyl Thiuram Disulphide (TMTD)	0.025

TABLE 2

Processing cost of 100 kg. (drc) Cenex using HA and LATZ systems

FIELD LATEX : 117 kg (drc) = 390 kg. (wet wt)

Preservatives	H.A.		LATZ	
	Qty. (kgs)	Cost (Rs.)	Qty. (kgs)	Cost (Rs.)
Ammonia	3.900	39.39	0.975	9.84
DAHP	0.200	4.12	0.200	4.12
ZnO	–	–	0.0975	5.85
TMT	–	–	0.0975	9.75
		43.51		29.56
CENEX: 100 kg (drc) = 167 kg (wet wt)				
Ammonia	0.835	8.43	0.125	1.26
Lauric Acid	0.033	4.65	0.125	17.62
		13.08		18.88
SKIM PRODUCED: 13 kg. drc.				
H_2SO_4	4.000	10.40	1.300	3.38
EFFLUENT TREATMENT				
Fe Cl_3	0.300	4.90	0.300	4.90
Lime	7.500	10.50	3.750	5.25
		15.40		10.15
TOTAL COST		82.39		61.97

TABLE 3
State-wise distribution of units manufacturing foam rubber (1989-90)

State	No. of units	Total licensed quantity of natural rubber (MT)
Andhra Pradesh	14	699
Gujarat	21	945
Haryana	14	835
Karnataka	35	3020
Kerala	50	2445
Madhya Pradesh	14	640
Maharashtra	19	1175
Punjab	27	980
Tamil Nadu	28	3507
Uttar Pradesh	36	1605
West Bengal	10	334
Delhi	44	4516
Others	17	1473
TOTAL	329	22174

Source: Directory of Rubber Goods Manufacturers in India-1989.

TABLE 4
Projected supply of Concentrated Latex

Year	Achievable capacity (MT)		Total	Supply (MT)	
	Existing	Proposed		57% Utilisation	48% Utilisation
1990-91	61100	22500	83600	47652	40128
1991-92	61100	32250	93350	53210	44808
1994-95	61100	32250	93350	53210	44808

TABLE 5
Product-wise consumption of Concentrated Latex (Qty. in tonnes)

Year	Latex foam	Dipped goods	Others	Total
1975-76	2033	3478	841	6352
1980-81	5753	4945	3122	13820
1985-86	12396	7602	1447	21445
1986-87	13100	10150	1625	24875
1987-88	14400	11590	2200	28190
1988-89	15230	12236	2954	30420
1989-90	17783	14052	4955	36790
1990-91	NA	NA	NA	39865

[NA = data Not Available]

Source: Indian Rubber Statistics, 1991.

ACKNOWLEDGMENT

The authors are grateful to Dr. E.V. Thomas, Director [P & PD] for providing the opportunity to initiate the study and for publishing the report. They are also thankful to Smt. G. Rajammal, S/Sri. K.G. Sreenivasan and P.V. Raveendran Nair for the help rendered at the various stages of the study.

AGRICULTURAL HOLDINGS AND OFF-FARM INCOME OF THE RUBBER GROWERS – A FARM FAMILY APPROACH :

P. RAJASEKHARAN

INTRODUCTION

The percapita rubber holding size in Kerala is a misleading variable in policy analysis. The total resources under a single management unit in a farm family may be considered as a relevent one for analysis. In studying the profit maximisation motive of the growers this is the relevent concept. The importance of off-farm sources of income cannot be ignored in any farm management analysis. The sources and magnitude of the total on farm and off- farm incomes of the farm families have to be integrated in the framework. This study is an attempt towards this direction.

METHODOLOGY

The study was conducted in Taliparamba taluk of North Kerala and Kanjirappally taluk of Central Kerala, being the two older areas of rubber cultivation in the state. The appropriate unit of investigation for the study was the farm family rather than farm operator or the head of the family. The rationable is that the farm family plays a primary role in determining resources allocation such as land, family labour between on farm and off-farm employment, capital etc. The farm family is not only a consumption unit but also an important decision making unit for factor supplies and resource adjustments.

One hundred and twenty farm families were selected for the study and data were collected through a pre-tested schedule by personal interview. Lorenze curves and Gini ratios were worked out to find out the concentration of land holdings. Income from off-farm sources were analysed separately. The data were collected during 1990 and 1991, keeping the reference period of the study as 1989 - '90-.

HISTORICAL LAND UTILISATION PATTERN

In Taliparamba taluk ninety one percent of the sample growers were migrants from the erstwhile Central Travancore region and on an average the growers migrated 27 years back. During the initial years of migration the farmers got cultivation rights from the intermediaries. In the erstwhile Malabar region due to the concentration of land ownership in the hands of Jenmi households the majority of cultivating households hold land under the usual tenancies, viz, kanam, kuzhykanam and Verumpattam (Varghese, 1970). The punam cultivation and lemongrass cultivation were prevalent in earlier years followed by a combination of crops like tapioca, cashewnut, pepper coconut and arecanut. Natural rubber was introduced in later years. The average years of experience of growers in agricultural was 31 years and that of rubber cultivation was only 16 years. The crops introduced in the different parts of the taluk varied depending on the previous experience of the growers in the erstwhile Central Travancore region. The amendment to the Land Reforms Act in 1969 conferred full ownership on the tenants in respect of land in their possession and brought them into direct relationship with the state by the abolition of all intermediary rights (Oommen, 1975).

In Kanjirappally taluk the crops prevalent were tapioca, coconut, pepper and rubber. Natural rubber was introduced from very early times and all the growers interviewed have replanted rubber. The average years of experience of the growers in agriculture and rubber cultivation was 38 years and 35 years, respectively.

LAND AQUISITION PATTERN

The percentage of growers who got land by purchase or through Land Reforms Act was found to be the highest category in Taliparamba, (Table 1).

TABLE 1
Land aquisition pattern (per cent of growers)

Taluk	Inherited	L.R.Act/purchased	Both inherited and purchased
Taliparamba	26	62	12
Kanjirappally	31	28	41

A group of migratory growers was also found in the region who disposed the land in one location and purchased it in another, mainly through capital gains, though the percentage was negligible. The percentage of growers who got land by inheritance combined with purchase was found to be the highest in the Kanjirappally region. However the percentage of growers who acquired land additionally during the last five years was only 10 and 7 respectively, in Taliparamba and Kanjirappally taluks.

STRUCTURE OF AGRI-CULTURAL HOLDINGS

The concept of farm family is used to denote the land resources held by all family members whose incomes were pooled together under a single management unit. For practical purposes the whole farm family should be considered as the valid unit of analysis.

Kerala agricultural household is characterised by a typical multicrop environment. The crop mixture grown in Taliparamba were mainly coconut, cashewnut, pepper, arecanut, rubber and banana. The study revealed that on an average 50% of the agricultural land was devoted to rubber and the remaining 50% to other crops (Table-2). The major crop replaced by rubber was cashewnut and three reasons were attributed for this replacement. The first and foremost reason was the institutional effort of the Rubber Board. The second reason mentioned was the absence of a well developed marketing strategy for cashewnut and the third was the advantage of realising distributed income for rubber throughout the year as against three months for cashewnut.

TABLE 2
Average l and holding of farm families (Ha)

Taluk	Immature rubber	Mature rubber	Area under othercrops	Total area
Taliparamba	0.65	0.41	1.07	2.13
Kanjirappally	1.08	0.83	0.15	2.06

On a farm family basis the share of land allocated to rubber in Kanjirappally was 93 per cent. This percentage of land allocation to rubber clearly indicates its importance in the household economic structure. The land allotted to crops other than rubber was only 7 per cent in Kanjirappally region.

The diffusion of innovations is a pre requisite for any technology adoption. The planting materials and other complementary inputs and institutional assistance were more readily available in Central Kerala than in North Kerala. The spread of the devastating disease of coconut (Root wilt), one of the major competing crops for land was cited as another reason. The third reason pointed out was that the spread of a single perennial crop in the surrounding region influenced the growers to switch over to that crop. Above all a grower will cultivate a crop provided the relative profitability of the crop is high. The growers mentioned that the relative profitability of rubber was on the higher side compared to other competing crops.

CONCENTRATION OF LAND HOLDINGS

The Lorenz curves indicating the concentration of land holdings are shown in figures 1 and 2. Gini ratios were worked out. The ratios were 0.39 for Taliparamba and 0.38 for Kanjirappally taluks which indicates that the concentration on land holdings is almost similar in the two regions.

INTERCROPPING

The intercrops cultivated in rubber small holdings wer ginger, sweet potato, colocassia, sesamum, tapioca and banana.

Ten per cent of the growers did not resort to intercropping owing to non-economic reasons. However the scenario was different in Kanjirappally taluk. Twenty four percent of the growers had not planted intercrops. Lack of managerial input (for 6%) and possible influence of agricultural and non-agricultural incomes (for 18%) were stated to be the reasons for not planting the intercrops. The practice of intercropping for profit maximisation motive was less

pronounced in the region possibly due to higher on farm and off-farm sources of income. Such type of growers may give more weightage to utility maximisation than profit maximisation.

STRUCTURE OF INCOME OF THE FARM FAMILIES

The study revealed that the farm families depending on agricultural income alone was found to be 48 and 34 per cent respectively, in Taliparamba and Kanjirappally taluks (Table 3).

TABLE 3

Sources of income of the farm families (percent of growers)

Taluk	depending on agricultural income alone	more than 50% income from rubber	income from rubber alone	other gainfull activities
Taliparamba	48	15	0	52
Kanjirappally	34	66	3	66

The percentage of farm families to whom total income was more than 50 per cent from rubber cultivation alone was sizeable in Kanjirappally region. This indicates that the entire economic activity of an agricultural household is closely interlinked with the productivity and the price of natural rubber. The situation is slightly different in Taliparamba region where the typical multicrop economy persists. The percentage of growers depending on rubber alone was on the lower side. From the point of view of risk, crop diversification is an added advantage and it may act as a cushion in difficult times.

OFF- FARM INCOME OF THE FARM FAMILIES:

Off-farm income is a common feature in developed countries. Off- farm work is prevalent among 47% of US farm families, 72% in Japan, 40% in Taiwan and 50% in Kenya (Paul Shaw,1979). The off- farm income of farm families in Japan accounts for over 90% of the total income (Hayami, 1990). It tends to reduce vulnerability of farmers to wide swings in farm prices and net farm income by providing a more even cash flow for capital deepening or debt servicing. The study revealed that 52 per cent of the farmers in Taliparamba and 66 per cent of farmers in Kanjirappally were having other gainful activities (OGA). (Table 3). Even though 52 per cent of the farm families in Taliparamba were having other gainfull activities, 20 per cent were engaged in work in other farms as agricultural labourers or tappers. Excluding this group 32 per cent of the farm families were found to have off-farm work while the percentage in Kanjirappally was the entire sixty six.

SOURCES OF OFF-FARM INCOME

The sources of off-farm income shows certain distinct differences in the two regions. The sources for the highest percentage of growers came from Govt.or private employment in Taliparamba (Table 4).

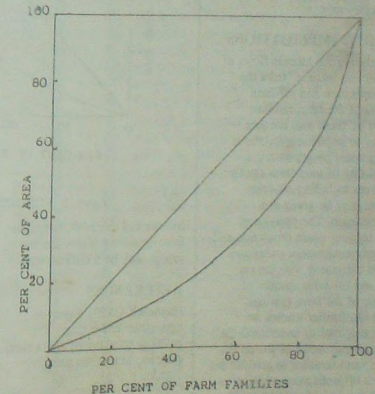


Figure 1 - LORENZE CURVE (KANJIRAPPALLY)

TABLE 1
Land aquisition pattern (per cent of growers)

Taluk	Inherited	L.R.Act/purchased	Both inherited and purchased
Taliparamba	26	62	12
Kanjirappally	31	28	41

A group of migratory growers was also found in the region who disposed the land in one location and purchased it in another, mainly through capital gains, though the percentage was negligible. The percentage of growers who got land by inheritance combined with purchase was found to be the highest in the Kanjirappally region. However the percentage of growers who acquired land additionally during the last five years was only 10 and 7 respectively, in Taliparamba and Kanjirappally taluks.

STRUCTURE OF AGRI-CULTURAL HOLDINGS

The concept of farm family is used to denote the land resources held by all family members whose incomes were pooled together under a single management unit. For practical purposes the whole farm family should be considered as the valid unit of analysis.

Kerala agricultural household is characterised by a typical multicrop environment. The crop mixture grown in Taliparamba were mainly coconut, cashewnut, pepper, arecanut, rubber and banana. The study revealed that on an average 50% of the agricultural land was devoted to rubber and the remaining 50% to other crops (Table-2). The major crop replaced by rubber was cashewnut and three reasons were attributed for this replacement. The first and foremost reason was the institutional effort of the Rubber Board. The second reason mentioned was the absence of a well developed marketing strategy for cashewnut and the third was the advantage of realising distributed income for rubber throughout the year as against three months for cashewnut.

TABLE 2
Average l and holding of farm families (Ha)

Taluk	Immature rubber	Mature rubber	Area under othercrops	Total area
Taliparamba	0.65	0.41	1.07	2.13
Kanjirappally	1.08	0.83	0.15	2.06

On a farm family basis the share of land allocated to rubber in Kanjirappally was 93 per cent. This percentage of land allocation to rubber clearly indicates its importance in the household economic structure. The land allotted to crops other than rubber was only 7 per cent in Kanjirappally region.

The diffusion of innovations is a pre requisite for any technology adoption. The planting materials and other complementary inputs and institutional assistance were more readily available in Central Kerala than in North Kerala. The spread of the devastating disease of coconut (Root wilt), one of the major competing crops for land was cited as another reason. The third reason pointed out was that the spread of a single perennial crop in the surrounding region influenced the growers to switch over to that crop. Above all a grower will cultivate a crop provided the relative profitability of the crop is high. The growers mentioned that the relative profitability of rubber was on the higher side compared to other competing crops.

CONCENTRATION OF LAND HOLDINGS

The Lorenz curves indicating the concentration of land holdings are shown in figures 1 and 2. Gini ratios were worked out. The ratios were 0.39 for Taliparamba and 0.38 for Kanjirappally taluks which indicates that the concentration on land holdings is almost similar in the two regions.

INTERCROPPING

The intercrops cultivated in rubber small holdings wer ginger, sweet potato, colocassia, sesamum, tapioca and banana.

Ten per cent of the growers did not resort to intercropping owing to non-economic reasons. However the scenario was different in Kanjirappally taluk. Twenty four percent of the growers had not planted intercrops. Lack of managerial input (for 6%) and possible influence of agricultural and non-agricultural incomes (for 18%) were stated to be the reasons for not planting the intercrops. The practice of intercropping for profit maximisation motive was less

pronounced in the region possibly due to higher on farm and off-farm sources of income. Such type of growers may give more weightage to utility maximisation than profit maximisation.

STRUCTURE OF INCOME OF THE FARM FAMILIES

The study revealed that the farm families depending on agricultural income alone was found to be 48 and 34 per cent respectively, in Taliparamba and Kanjirappally taluks (Table 3).

TABLE 3
Sources of income of the farm families (percent of growers)

Taluk	depending on agricultural income alone	more than 50% income from rubber	income from rubber alone	other gainfull activities
Taliparamba	48	15	0	52
Kanjirappally	34	66	3	66

The percentage of farm families to whom total income was more than 50 per cent from rubber cultivation alone was sizeable in Kanjirappally region. This indicates that the entire economic activity of an agricultural household is closely interlinked with the productivity and the price of natural rubber. The situation is slightly different in Taliparamba region where the typical multicrop economy persists. The percentage of growers depending on rubber alone was on the lower side. From the point of view of risk, crop diversification is an added advantage and it may act as a cushion in difficult times.

OFF- FARM INCOME OF THE FARM FAMILIES:

Off-farm income is a common feature in developed countries. Off- farm work is prevalent among 47% of US farm families, 72% in Japan, 40% in Taiwan and 50% in Kenya (Paul Shaw,1979). The off- farm income of farm families in Japan accounts for over 90% of the total income (Hayami, 1990). It tends to reduce vulnerability of farmers to wide swings in farm prices and net farm income by providing a more even cash flow for capital deepening or debt servicing. The study revealed that 52 per cent of the farmers in Taliparamba and 66 per cent of farmers in Kanjirappally were having other gainful activities (OGA). (Table 3). Even though 52 per cent of the farm families in Taliparamba were having other gainfull activities, 20 per cent were engaged in work in other farms as agricultural labourers or tappers. Excluding this group 32 per cent of the farm families were found to have off-farm work while the percentage in Kanjirappally was the entire sixty six.

SOURCES OF OFF-FARM INCOME

The sources of off-farm income shows certain distinct differences in the two regions. The sources for the highest percentage of growers came from Govt.or private employment in Taliparamba (Table 4).

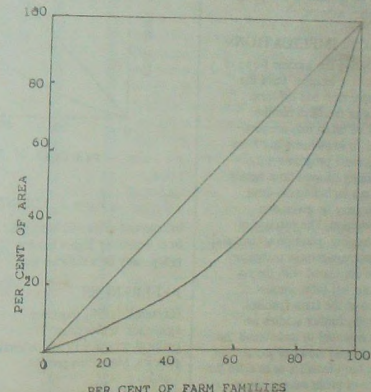


Figure 1 - LORENZE CURVE (KANJIRAPPALLY)

TABLE 4
Sources of off-farm income (Per cent of growers)

Taluk	Govt/private employment	Non-agril. labour	Business	Gulf employment	others
Taliparamba	32	19	24	8	17
Kanjirappally	40	0	50	10	0

The non-agricultural labour sources of income comprises skilled and semi skilled labour in the non-agricultural sector, mainly in the construction sector. The percentage of farmers engaged in business constituted the second largest source of off-farm income. However the structure of off-farm income is different in Kanjirappally. The largest source of off-farm income was from business followed by employment. The income from non-agricultural labour was absent in the region. The off-farm income sources cannot be ignored in analysing any policy aspects.

POLICY IMPLICATIONS

In analysing the income flows of the growers income from the farm operation and off-farm sources of the farm families should be taken into account. Inorder to implement any farm management programme the availability of total farm family resources including off-farm income may be given due consideration. The practice of daily tapping, plant protection and the agromanagement techniques can be correlated with the on farm and off-farm amount of income of the farm families. However, further studies are infact essential to understand the structure and flows of the income of the farm families to analyse the motive of profit maximisation vs utility maximisation of the rubber growers. But data extraction on income and economic behaviour from especially higher income group may be a difficult task.

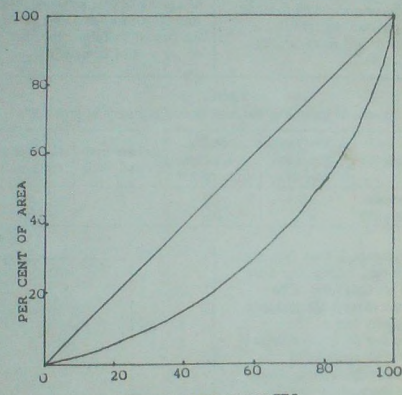


Figure 2 - LORENZE CURVE (TALIPARAMBA)

REFERENCES

Hayami,Y (1990). Japanese agriculture under siege: The political economy of agricultural policies. Macmillan press, London.p 145

Oommen, M.A (1975). A study of Land reforms in Kerala. Oxford and IBH publishing Co, New Delhi.pp 14-38

Shaw,Paul,R (1979). Canadian farm and non-farm family incomes. American Journal of Agricultural economics 61 (4), pp 676 - 682

Varghese,T.C (1970). Agrarian change and economic consequences.

Allied publishers, New Delhi.pp 160-161

ACKNOWLEDGEMENTS

The critical comments offered by Dr.M.R.Sethuraj, Dr.V.Haridasan and Dr.A.O.N.Panikker are gratefully acknowledged.

RUBBER BOARD BULLETIN
Vol. 26 Number - 4 April - June, 1991

Chairman
(Smt.) J. Lalithambika I.A.S.

CONTENTS

Published by :
THE RUBBER BOARD

Editor :
K.A. Aravindakshan Nair
Dy. Director
(Publicity and Public Relations)

Asst. Editors :
P.N. Narayanan Nair,
K.V. Varkey.

Cover : **SOMU**

THE QUARTER

While addressing the 34th Assembly of the International Rubber Study Group, Tan Dr. B.C. Shekhar observed that an integrated World elastomer community is on the anvil. It is to be shaped in such a manner that it provides development benefits on a global basis.

The rubber plantation industry continues to be dominated by the small holding sector across the globe. There is also the socio-economic factor which plays a dominant role in this process. If we examine the rubber scenario in India, we will find that here also the picture is not different. There are over six lakh small growers now in India who serve as a powerful base in rubber plantation industry.

While the Indian rubber growers form an important segment of the world elastomer community as visualised by Dr. Shekhar, our primary concern should always be to enhance production from the existing holdings. Since there is quantitative increase in the small holding sector there must be qualitative upgradation in crop processing. While we make earnest attempts for the expansion of rubber cultivation in non-traditional areas, simultaneous efforts to enhance production from the existing holdings have been taken up by the Rubber Board through improved agro management practices and processing techniques in order to make our onward journey towards self-sufficiency by 2000 AD smooth and satisfying. Let our planting community wholeheartedly co-operate with these efforts and advance themselves to the concept of a World elastomer community.

TABLE 4
Sources of off-farm income (Per cent of growers)

Taluk	Govt/private employment	Non-agril. labour	Business	Gulf employment	others
Taliparamba	32	19	24	8	17
Kanjirappally	40	0	50	10	0

The non-agricultural labour sources of income comprises skilled and semi skilled labour in the non-agricultural sector, mainly in the construction sector. The percentage of farmers engaged in business constituted the second largest source of off-farm income. However the structure of off-farm income is different in Kanjirappally. The largest source of off-farm income was from business followed by employment. The income from non-agricultural labour was absent in the region. The off-farm income sources cannot be ignored in analysing any policy aspects.

POLICY IMPLICATIONS

In analysing the income flows of the growers income from the farm operation and off-farm sources of the farm families should be taken into account. Inorder to implement any farm management programme the availability of total farm family resources including off-farm income may be given due consideration. The practice of daily tapping, plant protection and the agromanagement techniques can be correlated with the on farm and off-farm amount of income of the farm families. However, further studies are infact essential to understand the structure and flows of the income of the farm families to analyse the motive of profit maximisation vs utility maximisation of the rubber growers. But data extraction on income and economic behaviour from especially higher income group may be a difficult task.

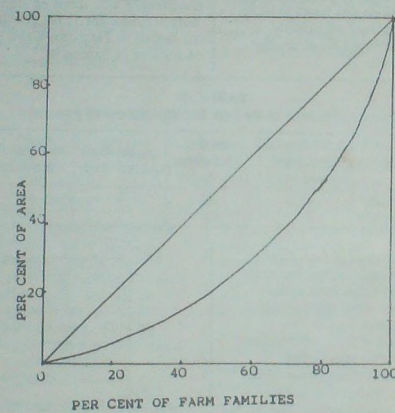


Figure 2 - LORENZE CURVE (TALIPARAMBA)

REFERENCES

Hayami,Y (1990). Japanese agriculture under siege: The political economy of agricultural policies. Macmillan press, London.p 145

Oommen, M.A (1975). A study of Land reforms in Kerala. Oxford and IBH publishing Co, New Delhi.pp 14-38

Shaw,Paul,R (1979). Canadian farm and non-farm family incomes. American Journal of Agricultural economics 61 (4), pp 676 - 682

Varghese,T.C (1970). Agrarian change and economic consequences.

Allied publishers, New Delhi.pp 160-161

ACKNOWLEDGEMENTS

The critical comments offered by Dr.M.R.Sethuraj, Dr.V.Haridasan and Dr.A.O.N.Panikker are gratefully acknowledged.

RUBBER BOARD BULLETIN
Vol. 26 Number - 4 April - June, 1991

CONTENTS

Published by :
THE RUBBER BOARD

Editor :
K.A. Aravindakshan Nair
Dy. Director
(Publicity and Public Relations)

Asst. Editors :
P.N. Narayanan Nair,
K.V. Varkey.

Cover : **SOMU**

THE QUARTER

While addressing the 34th Assembly of the International Rubber Study Group, Tan Dr. B.C. Shekhar observed that an integrated World elastomer community is on the anvil. It is to be shaped in such a manner that it provides development benefits on a global basis.

The rubber plantation industry continues to be dominated by the small holding sector across the globe. There is also the socio-economic factor which plays a dominant role in this process. If we examine the rubber scenario in India, we will find that here also the picture is not different. There are over six lakh small growers now in India who serve as a powerful base in rubber plantation industry.

While the Indian rubber growers form an important segment of the world elastomer community as visualised by Dr. Shekhar, our primary concern should always be to enhance production from the existing holdings. Since there is quantitative increase in the small holding sector there must be qualitative upgradation in crop processing. While we make earnest attempts for the expansion of rubber cultivation in non-traditional areas, simultaneous efforts to enhance production from the existing holdings have been taken up by the Rubber Board through improved agro management practices and processing techniques in order to make our onward journey towards self-sufficiency by 2000 AD smooth and satisfying. Let our planting community wholeheartedly co-operate with these efforts and advance themselves to the concept of a World elastomer community.

RUBBER EXPO '92

Dr. A.K. Krishnakumar, Jt. Rubber Production Commissioner emphasised that rubber plantation would help in the socio-economic uplift of the undeveloped rural areas in the North Eastern Region since they were highly labour intensive. He said a preliminary assessment of the Rubber Board put the total area available in the nontraditional areas at 1.2 million hectares of which the North Eastern Region accounted for about 5 lakh hectares. He was speaking at the Third International Conference and Exhibition known as Rubber Expo-92 held at Park Hotel in Calcutta on 13th & 14th November 1992. It was organised by the Calcutta Branch of the Indian Rubber Institute in association with the Eastern Regional Office of the All India Rubber Industries Association. The conference was attended by over 300 delegates from all over India apart from a couple of delegates from Malaysia and Sri Lanka participating in it.

Mr. Prabir Sengupta, the Minister for Small and Cotager Industries, Government of West Bengal was the Chief Guest on the occasion which was presided over by Shri Indranil Biswas, the President of the AIRIA, in his capacity as the Chairman of the organizing committee of the Rubber Expo-'92.

In his welcome address Mr. Indranil Biswas gave a bird's eye view of the industry in the process of which he touched upon some of the problems faced by the industry.

The essence of progress lies in the assessment of one's own situation in comparison to what is being newly developed elsewhere in the field to which one belongs. Such assessment at regular intervals can reveal how much efforts, energy and planning are needed; commercial or technical to bridge the gap and overcome the hurdles to reach the goal. This was the theme with which the conference was organized and it must be said to the credit of the organizers that they succeeded in their efforts in good measure. The number and quality of papers were an eloquent testimony to bring home this point, apart from the sustained interest the delegates maintained till the very end.

Mr. Prabir Sengupta, Minister for Small and Cottage Industries, West Bengal, urged the Centre to adopt a total rubber production plan to benefit growers all over the country. "Why should Kerala alone produce 90 per cent of the total rubber available in the country?" he said. He promised support by the State Government to help the industry grow.

During the past 14 months 263 entrepreneurs have submitted the Industrial Entrepreneur Memos to set up industries in West Bengal, said Dr. Bikram K. Sarkar, Secretary, Ministry of Commerce and Industry, West Bengal, while delivering the keynote address at the conference of the Indian Rubber Institute. He said the proposed investment was of the order of Rs.6,300 crores, and would create 64,000 jobs.

He said 117 acres had already been allotted for rubber plantation in Jalpaiguri district and more land had been identified for the purpose. The theme of the conference was "Develoment and growth opportunities in rubber processing and application". Reviewing the growth potential of the rubber industry he said it offered direct employment to 300,000 people yielding an annual turnover of Rs.5,000 crores. The total consumption came to 500,000 tonnes a year. ●

Dr. Krishnakumar addressing the Third National Conference

Sree Dharmastala Veerendra Hegde inaugurates the conference.

the rubber cultivation systematic and scientific, right from the beginning so that the maximum profit can be realised. Sri Hegde appreciated the Rubber Board for its sincere efforts to expand rubber cultivation in Karnataka. He stated that the 'Dharmastala Rural Development Project' has spent about 8 lakhs rupees for the development of rubber plantations in Belthangady taluk. He added that 700 families, reeling under the poverty line were brought into the field of rubber cultivation by this venture.

Chairing the inaugural session, Smt. J. Lalithambika, IAS, Chairman of the Rubber Board

STATE LEVEL RUBBER GROWERS' MEET IN KARNATAKA

Rubber cultivators representing various rubber growing tracts of Karnataka were called together at 'Ujire' - a small village in Dakshina Kannada on 27th November 1992. This one day meet was jointly organised by 'Karnataka Rubber Cultivators Association, Belthangady Taluk Rubber Marketing and Processing Society and the Rubber Board'.

The conference set off to a rousing start with the lighting of a traditional lamp by Sri Veerendra Hegde, a noted public figure, a rubber planter and the patron of 'Dharmastala Devastana' and several other institutions. In the inaugural address he appealed to the growers in Karnataka to make

View of the audience

pointed out that the country requires more rubber these days.

"It is the responsibility of farmers to increase the production on a par with the demand for the commodity. This year, India may be able to produce about 4 lakh tonnes of natural rubber. By 2000 AD our minimum demand is anticipated to be 6.75 lakh tonnes. India's present per capital consumption of rubber is about 1/2 a kilogram. This is likely to increase even upto one kilogram. Most of our people are not in the habit of using foot wears. If only they start using rubber made chappals, the demand of this commodity will more than double" - she said.

"Rubber cultivation has a glorious future. Karnataka is very much potential to expand rubber cultivation. It has plenty of land, innocent, hard-working and resourceful people and favourable climate. If all these factors are taken into consideration, I can say that the State of Karnataka, now enjoying the 4th position among the natural rubber producing States in the country can easily achieve a position not below the second". She offered all the necessary assistance from the Rubber Board for expanding cultivation.

In a very interesting and candid presentation Sri. P.K. Narayanan, Rubber Production Commissioner explained the economic and social benefits that can be derived out of rubber cultivation. He stated that the Rubber Board has identified 1 ½ lakh hectares of unutilised land, suitable for rubber

Rubber Board's exhibition pavilion

cultivation in Karntaka. He urged the farmers of Karnataka to make these lands productive by raising lush green rubber gardens which can bring about environmental improvement. The Commissioner also demonstrated with the help of his colleagues the technique of processing the rubber latex. He assured the rubber growers that the graded quality rubber will fetch more attractive price than the ungraded low quality rubber. Sri S.D. Meena, IAS, Managing Director of Campco, also spoke.

The meeting congratulated Sri G.N. Bide, Founder President of Belthangady Taluk Rubber Marketing and Processing Society and the President of Karnataka Rubber Cultivators' Association, a grand old man in his eighties, who took initiative to popularise rubber cultivation in Dakshina Kannada District. Sr. B. Narayana Naik, Ex M.L.C and President of District Farmers Forum made a congratulatory address.

In the afternoon session, an informative discussion between the rubber growers and the resource personnel was held. Dr. M.A. Nazeer, Dr. Kuruvilla Jacob, Sri T.R. Chandrasekhar (all scientists from Rubber Research Institute of India), Sri K.F. Shetty (District Lead Bank Manager), Sri Sree Padre (Editor, Adige Pathrike farm magazine) Sri M.V. Damodaran (Development Officer, Rubber Board) Sri C.D. Dyagayya (D.F.O) and Sri Varnasi Krishnamurthy initiated the discussions. The questions raised by the participants were answered.

Rubber Board also participated in the exhibition arranged in connection with the growers' meet.

The one day exercise really instilled confidence and hope in the minds of Karnataka rubber farmers.

K.R. Suresh Kumar,
Asst. Development Officer
(Extention & Publicity) Manglore.

THE NR INDUSTRY OF THE 21ST CENTURY – WHAT IS NEW?

THE KEY-NOTE ADDRESS DELIVERED
BY TAN SRI Dr. B.C. SEKHAR
SECRETARY - GENERAL, IRSG
AT THE INTERNATIONAL NATURAL
RUBBER CONFERENCE INDIA - 1992
HELD AT BANGALORE

(Continued from Volume 26 No. 3)

and curative measures established, except for the virulent diseases endemic in the Amazon basin. This is not to say that the pathologists and mycologists have worked themselves out of their jobs. The need, as is being done, is to exchange information, review and monitor conditions in the different growing environments and keep a 'fire brigade service' operating. Plant breeders and selectionists are already attempting to weed out susceptible material early in the breeding programmes in cooperation with the pathologists.

HEVEA FOR TIMBER

It is now well established that properly treated, Hevea can be an effective source of hardwood timber for a wide variety of applications. One hectare of Hevea can provide over 25 CuM of sawn timber. In 1989-90, Malaysia for example, produced and exported sawn timber worth 99 million Rgt and furniture approximating 215 million Rgt. The problem is one of logistics. If Hevea is grown for the dual purpose latex and timber in plantation type integrated operations, latex yield can be a by- product for 15 years and timber the main product at the end of a 20 year cycle. With environmental concerns and global warming problems now appearing on the horizon, Hevea as a timber source can assist in restraining indiscriminate forest destruction.

LATEX TECHNOLOGY

Well over 50% of the world's NR production is processed into technically specified rubbers while the remainder, apart from latex concentrate production; is processed into IRQPC greenbook grades and presented in conventional form. New process and presentation techniques enable NR to be marketed in convenient bales and consistent technically specified characteristics. The process lends itself to improved process ability and consistency. However the market and consumers continue to provide conflicting signals on their requirements. Proliferation of country based specifications and the multiplicity of grades in production inhibit producers from obtaining optimum value for the produce. Notwithstanding the fact that millions of trees are involved, Hevea rubber can be a more uniform and consistent elastomer in comparison with SR, provided that collection, blending in large quantities and processing through modern equipment are exercised. Appropriate technologies and innovations are available. Subjective practices exerted by producer-suppliers and consumer-buyers have retarded or inhibited the move towards greater uniformity, consistency and interchangeability irrespective of origin.

NEW END USES

SPECIAL PURPOSE NATURAL RUBBERS

The ability to tailor make natural rubber for specific end uses is certainly inhibited as the tree exudes the product in polymeric form. However the NR polymer molecule has the versatility to be

modified chemically and in blends. Through the years a wide variety of special purpose NRs have been produced. They include chlorinated and hydrochlorinated NR, cyclised rubber, superior processing rubbers, low temperature rubbers, peptised rubbers, powdered NR, deproteinised NR, Methyl Methacrylate grafts, CV rubbers, liquid NR, oil-extended NR, TPNR, epoxidised NR and so on. With EV and semi EV systems of vulcanisation newer characteristics have also been imparted to NR vulcanisates. However, none of these developments have made a major impact on the market, except for CV rubbers which are coming into vogue in the general use area. Deproteinised rubbers for engineering applications and TPNR and epoxidised NR for thermoplastic applications are at present showing great potential. Perhaps the special purpose natural rubbers appeared too early and have suffered from inadequate market promotion efforts.

ENGINEERING APPLICATIONS

Thanks to its unique combination of properties, NR has established a distinctive market niche in the engineering area. With deproteinisation the versatility of NR is further expanded. Bridge bearings, anti-vibration mounts, noise abatement devices, rail pads, earthquake vibration isolation devices for buildings are but a few in the extensive list of uses which continues to expand.

THERMOPLASTIC APPLICATIONS

With the advent of TPNR from a special admixture of NR and polypropylene under defined conditions, NR is now also able to benefit from this newly emerging dynamic usage area. Of particular importance is the thermoplastic characteristics of blends containing epoxidised natural rubber which are in the offing.

ELASTOMER BLENDS – ALL SEASON TYRES

Most elastomers are used in blends. A better understanding of the microstructure at the interface of blends is enabling the development of unique blends for specific enduses. The latest development which could provide a volume use in the future is the use of oil extended NR in combination with synthetic rubbers for all season tyres.

The conference will be considering the latest developments on these and many more aspects in the next three days more effectively presented by the relevant experts. What I have tried to do is to highlight examples which indicate that there are considerable 'unused muscles' still available for the rubber industry.

It is now necessary to consider what the NR industry is likely to be facing at the turn of the century.

CHALLENGES & REQUIREMENTS OF THE 21st CENTURY

There is no doubt that there will be a vastly increased market for elastomers at the turn of the century. Taking into account the changes taking place in Eastern Europe and more particularly in the former USSR region as well as the accelerated growth in the Asia Pacific area already manifest, supply requirements for NR are likely to be in excess of 8 million tonnes, an increase of over 3 million tonnes from today's situation. Vehicle population per capita shown in Tables 1 and 2 for several regions of the world for 1989 and 1990, displays the potential.
The challenges that will be posed relate not simply to the generation of adequate supply, but also arise from the issues of globalisation, environmental and quality factors, marketing and changing technologies. Let me elaborate.

GLOBALISATION

The world has adequate experience in the operations of multinationals. The global player is perhaps a more recent phenomenon. With transnational mergers, the global players are market driven and must necessarily adopt a global attitude to location of production facilities, quality considerations, productivity and environmental standards. While in the developing world, the multinationals were reluctant brides to be wooed and courted, the global players are compelled by market forces to do the wooing and courting. In taking on this global outlook, standardisation and quality assurance become compelling. Irrespective of the location of manufacture, safety, consistency and quality assurance standards must be uniform. ISO 9000 will pervade all nooks and crannies of the world.

Asia Pacific holds nearly 50% of the world's population and in this region the largest players will be China, India and Indonesia apart from the established position of Japan. Global manufacturing locations will be decided not only

TABLE 1
PERSONS PER VEHICLE, 1989

	Cars ('000)	Persons per Car	Total Vehicles ('000)	Persons per Vehicles	Population (million)
WORLD	**423,383.6**	**11.5**	**555,492.0**	**8.8**	**4,868.9**
AMERICA	**183,159.2**	**3.6**	**240,469.8**	**2.7**	**659.4**
Brazil	10,250.0	13.2	12,650.0	10.7	135.3
Canada	12,435.0	2.0	16,395.0	1.5	24.9
Mexico	5,400.0	14.5	7,800.0	10.00	78.3
U.S.A.	144,375.0	1.6	188,699.0	1.2	231.0
AFRICA	**8,866.6**	**65.3**	**13,600.1**	**42.6**	**579.0**
Cameroon	90.0	121.0	170.0	65.3	10.9
S.Africa	3,246.8	10.0	4,583.3	7.1	32.5
ASIA	**50,390.0**	**55.5**	**86,824.4**	**32.2**	**2,796.6**
Bangladesh	32.8	3050.0	67.1	1500.0	100.1
China	1,100.0	1055.0	4,350.0	265.0	1,160.5
India	1,650.0	455.0	3,150.0	240.0	750.8
Indonesia	1,199.7	137.6	2,591.1	63.7	165.1
Israel	786.3	5.6	944.2	4.7	4.4
Japan	32,621.0	3.7	55,093.1	2.2	120.7
Korea Rep. of	1,557.7	27.0	2,658.6	15.8	42.1
Malaysia	1,200.0	14.0	1,555.0	11.0	16.8
Sri Lanka	163.8	96.7	300.4	52.7	15.8
Thailand	550.0	100.0	1,300.0	42.0	55.0
EUROPE	**171,708.0**	**4.8**	**202,828.2**	**4.1**	**824.2**
EEC	**125,981.4**	**2.6**	**142,786.0**	**2.3**	**327.6**
Germany West	30,152.4	2.0	32,079.6	1.9	60.3
Irish Republic	773.4	4.6	912.3	3.9	3.6
Portugal	1,474.3	6.9	1,908.2	5.4	10.2
Spain	11467.7	3.4	13675.3	2.8	39.0
United Kingdom	22,427.7	2.5	25,737.4	2.2	56.1
EFTA	**13,027.4**	**2.5**	**14,493.1**	**2.2**	**32.6**
Sweden	3,578.0	2.3	3,887.5	2.2	8.2
Switzerland	2,900.3	2.4	3,161.3	2.2	7.0
REST OF EUROPE	**32,699.2**	**14.2**	**45,549.0**	**10.2**	**464.3**
Bulgaria	1,100.0	8.1	1,250.0	7.2	8.9
Germany East	3,750.0	4.4	515.0	3.9	16.5
Malta	97.6	3.5	116.9	3.0	0.3
Soviet Union	13,500.0	21.0	22,500.0	12.5	283.5
OCEANIA	**9,259.7**	**2.7**	**11,769.5**	**2.1**	**25.0**
Australia	7,442.2	2.2	9,489.5	1.8	16.4
Guam	120.0	1.1	148.0	0.9	0.1

Note: Population is estimated using the first two columns

TABLE 2

PERSONS PER VEHICLE, 1990

	Cars ('000)	Persons per Car	Total Vehicles ('000)	Persons per Vehicles	Population (million)
WORLD	**441,954.9**	**11.4**	**579,103.9**	**8.7**	**5,038.3**
AMERICA	**186,759.7**	**3.6**	**244,833.5**	**2.8**	**672.3**
Brazil	10,250.0	14.0	12,650.0	11.4	143.5
Canada	13,210.0	1.9	16,774.0	1.5	25.1
Mexico	5,425.0	16.0	7,825.0	10.6	86.8
USA	**147,000.0**	**1.5**	**192,000.0**	**1.2**	**220.5**
AFRICA	**9,233.5**	**66.0**	**14,105.6**	**43.2**	**609.4**
Cameroon	90.0	115.0	170.0	60.0	10.4
S.Africa	3,375.3	10.0	4,797.5	7.0	33.8
ASIA	**54,495.3**	**52.8**	**92,594.7**	**31.1**	**2,877.4**
Bangladesh	35.4	2950.0	86.6	1210.0	104.4
China	1,236.7	940.0	4,776.4	245.0	1,162.5
India	2,481.0	321.0	3,972.0	200.0	796.4
Indonesia	1,293.8	135.2	2,771.8	63.1	174.9
Israel	790.0	5.6	950.0	4.7	4.4
Japan	34,924.2	3.5	57,697.7	2.1	122.2
Korea Rep. of	2,074.9	20.2	3,394.8	12.4	41.9
Malaysia	1,225.0	13.8	1,585.0	10.7	16.9
Sri Lanka	165.0	100.0	305.0	55.0	16.5
Thailand	825.0	68.0	2,250.0	25.0	56.1
EUROPE	**182,012.4**	**4.6**	**215,539.7**	**3.8**	**837.3**
EEC	**131,928.6**	**2.5**	**149,685.0**	**2.2**	**329.8**
Germany West	30,695.1	2.0	32,697.8	1.9	61.4
Irish Republic	796.4	4.4	948.6	3.7	3.5
Portugal	1,605.0	6.5	2,198.0	4.7	10.4
Spain	11,995.6	3.3	14,374.3	2.7	39.6
United Kingdom	23,123.4	2.5	26,411.8	2.2	57.8
EFTA	**13,245.8**	**2.4**	**14,782.0**	**2.2**	**31.8**
Sweden	3,600.5	2.4	3,924.6	2.2	8.6
Switzerland	2,993.5	2.2	3,297.2	2.0	6.6
REST OF EUROPE	**36,838.0**	**12.9**	**51,072.2**	**9.3**	**475.6**
Bulgaria	1,200.0	7.5	2,000.0	4.5	9.0
Germany East	3,898.9	4.3	4,348.9	3.8	16.8
Malta	114.7	3.0	135.9	2.6	0.3
Soviet Union	16,000.0	17.6	25,500.0	11.0	281.6
OCEANIA	**9,454.1**	**2.6**	**12,030.4**	**2.1**	**24.6**
Australia	7,672.3	2.2	9,776.6	1.7	16.9
Guam	130.0	1.1	160.0	0.9	0.1

Note: Population is estimated using the first two columns.

on the basis of the market, but also by the availability of requisite resources as well as the receptiveness of the commercial environment. The globalisation so far in train is perhaps the first steps towards a world without borders for economic and industrial activity and trade. The challenge for developing countries is to evolve and install the necessary environment for the emerging global players to move in with confidence and operate effectively.

QUALITY ASSURANCE AND THE ENVIRONMENT

No economic activity will be free from the issues of quality and environment. The requirements are clear. The endusers (the automotive industry) are imposing ISO 9000 standards on tyre manufacturers and they in turn will impose these requirements on their raw material suppliers. Raw natural rubber will have to be presented to the markets contamination free, consistent in quality, technically specified, interchangeable irrespective of source and marketed in a form amenable to automation and computer process control.

Germany has already established legislation concerning packaging and recycling. The requirements that suppliers of rubber must meet include the removal and disposal of all packaging materials. Other members of EC are expected to adopt such measures. Existing practices for export of NR will have to undergo drastic changes. Along with environmental legislation, improvements to the quality of the work (environ–mental legislation, improvements to the quality of the work) environment in the developed world could in time impose further restrictions, for example in the use of carbon black powder etc. This may induce the migration of tyre manufacture to locations with less restrictive legislations. It will not be unrealistic to expect the Asian region to be the first beneficiary of this translocation process. The problems will be one of shipment and freight costs, but these may be contained by global co-operation.

MARKETING

Marketing and price determination remain the 'achilles heel' of the NR industry. The commodity marketing system has failed to evolve in consonance with changes in production and consumption factors. Global players anxious to ensure quality control of their raw material supplies are increasingly turning to direct purchases, bypassing official markets. The need to assure and ensure markets for their rubber also encourages producers to establish direct links with consumers. Along with this, national aspirations are driving producing countries to establish separate individual markets. Fragmentation of the commodity markets is drastically reducing liquidity in each market. Apart from Japan, there is little futures activity in other markets. The existence of INRO is alleged to be responsible for the absence of speculation and hedging. The sum total of all these factors is reflected in the inadequacy of the price determining mechanism operated by the organised markets which is used as the reference price in direct trading operations. This is a major challenge to the NR industry as a whole.

At the 1983 international marketing conference in Kuala Lumpur, Mr J Flannery, then Chairman of UNIROYAL in his keynote address said that the intrinsic value of a kilogramme of NR was worth more than 4 Malaysian Ringgit to the tyre manufacturer, but he will only pay the market price. In the last three years, demand was chasing supply and world stocks of NR were rundown but yet the market price remained in the doldrums. Natural rubber has evolved from an agricultural commodity into an industrial performance material. Marketing of natural rubber has to reflect this vital change.

The evolving situation in other areas of endeavour can also pose challenges for example:-

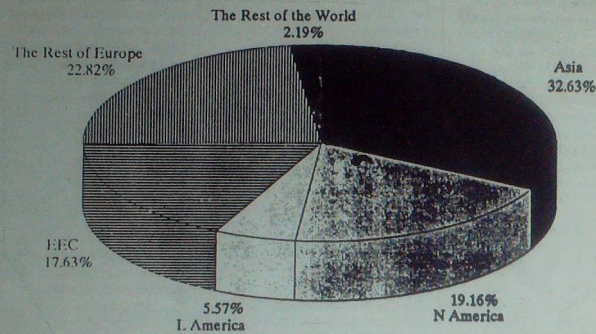
PETROLEUM PRICES

There are conflicting expectations on market price for petroleum in the 21st century. Significant price escalation would spur the automotive industry to accelerate the development and use of electrically powered cars. Such automobiles will require a new design of tyres and this will have a significant effect on tyre life. If this development materialises, it will pose a real challenge to NR producers to devise the appropriate new technologies.

CONTINUOUS MIXING

Many years ago, the DELPHI report predicted that in the 1980s, continuous mixing will come into vogue and anticipated the need for elastomers to become available in powder or other forms amenable to this mixing technology. In the event, the prediction was not fulfilled. With globalisation of the tyre industry and the compelling pressure on safety, quality and performance assurance demanded by endusers,

FIGURE 1
ELASTOMER CONSUMPTION BY REGION 1990



automated continuous mixing is once again heralded as the state of the art technology for the 21st century. The natural rubber industry can ill afford to ignore this possible development.

SR COMPLEMENTATION

With Asia Pacific becoming the largest consumer of elastomers (See Figure 1) and displaying the highest growth rate, SR requirements in Asia will escalate. At present only Japan, China, Korea, Taiwan and India produce SR. Availability of SR to underpin manufacturing growth expected both indigenously and globally induced will have to be met across Asia. The SR oversupply situation of the West will have to be rectified by the migration of production capacity location to the East.

RECYCLING REQUIREMENTS

The automotive industry is already moving into the phase of recycling. Every component in the vehicle is to be recycled by the turn of the century and elastomeric components will be no exception. Thermoplastic elestomers have a great advantage over thermosets in this respect. The NR industry will have to rise to this challenge to keep its traditional markets.

I could perhaps go on enumerating further anticipated developments and challenges, but enough has already been discussed to distill out what the NR industry must be prepared to do in the coming two decades.

THE NECESSARY NR INDUSTRY RESPONSE

1. The primary requirements relate to cost and quality efficiency. This demands fundamental changes in approach and attitudes. NR must be viewed as an industrial performance material and not an agricultural commodity. Cost is related to productivity and agronomic management. Relevant technologies are already available and new innovations will become available to cater for the diverse socioeconomic environments in the producing areas. Developments that must become manifest to meet these requirements are:

a) In the context of the proven high-yielding planting materials available and agronomic and physiological techniques already developed to boost productivity, rubber plantings in the 21st century should have a minimum annual yield of 2 tonnes per ha. Soil and climatic deficiencies will have to be compensated for by higher yielding planting materials and appropriate agronomic management.

b) Labour intensity should reflect each socioeconomic

environment. The availability of a spectrum of tapping techniques including automation, frequency of extraction and collection could easily cater for the different situations to balance labour cost differentials and labour availability.

c) An integrated approach to Hevea cultivation should become manifest. Hevea can be grown to yield hard wood timber at the end of a 20 year cycle while providing latest as a by-product in the last 15 years.

2. NR quality issues

a) Processing and marketing of Hevea latex should be carried out in large control factories with state of the art machinery and quality assurance measures implemented at all stages in keeping with the requirements of ISO 9000.

b) The number of grades and types of natural rubber will have to be drastically reduced for general purpose use. Such grades, irrespective of factory and country of origin, should be fully interchangeable. What is essentially needed is uniform and consistent standard natural rubbers.

3. Marketing

The marketing system should enable the primary producer to realise as near as possible the intrinsic value of natural rubber to the consumer. The present fragmented commodity marketing system will need to be substantially overhauled. Reduction of grades and types and interchangeability could be factors assisting such a change.

4. SR-NR interaction

The traditional bipartisan attitudes of the NR and SR sectors will have to give way to complementation and catalytic interaction. Blends and alloys are the way for the future and this can only be optimised by the combined expertise of the two elastomer sectors.

5. Integration of Elastomer Production and Manufacture

Finally the 21st century challenges will require bold and innovative integration of the production processes of NR and SR with that of manufacture. Issues of energy conservation, environmental protection, labour, quality of life and quality assurance requirements will combine to make such a co-operative approach compelling.

Obviously, the presentation I have given is a general one and would impact on each producing country environment in a different manner consonant with the resources and circumstances. I will perhaps not be doing justice to the invitation given by the organisers if I do not in conclusion say something specific and relevant to the Indian subcontinent.

THE UNIQUE INDIAN ENVIRONMENT

The Indian population is expected to breach the 1 billion mark by the turn of the century. Even if only a quarter of this population has the necessary buying power, one is catering for a market of 250 million consumers. This is a powerful domestic market base to spring into the export market.

Only Brazil, China and India have the combined three activities. I am referring to production of NR, production of SR and a significant manufacturing base. Brazil is handicapped in NR production by endemic and virulent leaf diseases. China has typhoons and lower temperatures to contend with in NR production expansion. There are no insurmountable problems in India as clearly shown by the recent surge of NR production in India.

The situation of the SR industry in India is however not as satisfactory. It barely meets the requirements of a manufacturing base attuned and compelled to use an NR/SR ratio of approximately 4 to 1. The export market and relevant technological developments in support would require a significantly higher proportion of SR usage. The necessary SR production expansion facilities would need to be generated if India is to welcome the global players for an international market.

India is in the fortunate position of having adequate skilled labour, the necessary engineering expertise, the requisite infrastructure, a significant industrial base and given the political will, the requisite raw material resources can be generated.

The different sectors of the elastomer industry ie producers of NR, producers of SR and the manufacturing sector have all however evolved in the context of a market generated by import substitution. The cutting edge of a global free market economy has yet to hone and shape the technologies, cost efficiencies, quality of the products, quality of the work environment and productivity.

Even with the co-existence of all three endeavours in the same environment, there is little, if any, interactive catalysis at present.

With the more recent liberalisation measures taken by the Government of India, the emerging situation in India is pregnant with potentials for the elastomer industry. Drastic changes in attitude are however called for on the part of all the sectoral players. National and international quality standards will have to merge into the global standard that is now demanded. China, India and Indonesia have the opportunity to share the advantages of the global market for elastomer goods that will undoubtedly open for Asia in the 21st century. Given the combination of advantages India distinctively can exploit, it will be the political will and changes in attitude of those who operate the elastomer industry that will spell success and prosperity.

I thank you. ●

Earthworms Enhance Soil Fertility

Earthworms, long regarded as the friends of farmers and natural tillers of soil, have come to be recognised as efficient bioconverters of organic residues into high-grade compost. Vermicomposting, as the technique of using earthworms systematically to turn a farm wastes into valuable biofertilisers is called, is simple, inexpensive and a rewarding avocation for the farmers.

"Vermiculture using the indigenous species of earthworms is an environment-friendly technique. It yields rich organic manure with 0.72 per cent nitrogen, 0.25 per cent phosphorus and 2.74 per cent potash. Up to 750 kg of vermicompost can be got from a pit of two metres long, one metre wide and one metre deep in about 60 days," says Dr. Sultan Ahmed Ismail, department of zoology at New College, Madras.

ECONOMIC BREEDING

Dr. Ismail have developed a simple and inexpensive technology for rearing native species of earthworms, and has demonstrated it to several farmers in Chengalpattu-MGR district of Tamil Nadu. This method can be used for treating municipal garbage, sewage sludge and industrial effluents.

"All organic wastes from crop residues, manures and household wastes can be processed by the simple technique using native species of earthworms. The use of native species will avoid interference with the native biodiversity, and locally adapted worms will grow faster in the conducive environment," explains Dr. Ismail.

IDEAL FOR VERMICOMPOST

There are more than 300 different species of earthworms, and about six of them have been identified in and around Madras. Of them, *Lampito mauritii*, a medium-sized hardy species is the most common. It has been found to be the ideal earthworm for sandy and sandy-loam soils. *L. Mauritii* with bioluminescence (a beautiful green glow) makes vertical burrows and comes to the surface for feeding. It is also quick growing species.

Another worm, *Octochaetona serrata*, is a non-pigmented type commonly seen in red and clayey soils. This too burrows and comes to the surface for feeding. These two species have been found ideal for vermicomposting in the Madras region, says Dr. Ismail.

The simple vermicomposting pit designed by Dr. Ismail can be of a convenient dimension. It can be made of brick and mortar too in the backyard. The most convenient pit for easy handling should be two metres long, one metre wide and one metre deep. A five centimetre layer of broken bricks or pebbles and sand should form the base of the pit. Another layer of 15 cm of loamy soil should come above this, and on this, small lumps of fresh cattle dung should be sprinkled at random.

COMPOSING PIT

This forms the active ground for earthworm activity and is called the vermibed. About hundred earthworms collected from the fields should be put in the bed which should be kept sufficiently moist. A layer (about five centimetres thick) of straw, leaf litter and a variety of farm residues including cattle dung should be dumped on this, and after sprinkling water the entire bed can be covered with either palmyrah or coconut leaves. The pit should be kept constantly moist but never flooded.

After about a month, the palmyrah (or coconut leaves) should be removed and layers of organic wastes not exceeding six centimetres should be added every alternate day. Watering should continue with each filling. When the pit is nearly full, the wastes should be turned-in using a pitchfork. On the 30th day, the heap will be ready for harvest with lots of vermicastings. The dug out vermicompost should be heaped in an open place. Once the worms find their way to the bottom, the top layers can be removed, dried and sieved for application in the main fields.

Dr. Ismail is also developing simple methods for growing the worms along with vegetables in trenches. About five tonnes of the vermicompositing should be applied per hectare for most crops. Besides the major nutrients, the vermicompost is known to contain a host of plant growth-promoting compounds. The worms can be put to a variety of use, and are used in native medicine. They are known to have anti-inflammatory properties. The worms grow fast and can be reared all round the year. But peak activity is noticed during monsoon, says Dr. Ismail.

G. Venkataramani

RUBBER CAN BE GAINFULLY CULTIVATED IN THE KONKAN

BY T.R. CHANDRASHEKAR
RUBBER RESEARCH INSTITUTE OF INDIA
KOTTAYAM - 686 009, KERALA.

During the last three decades, a lot has been talked, written and experimented on the development of Konkan. Various seminars and conferences have been conducted to formulate appropriate developmental activities for sustainable development. However, experience has shown that many developmental activities planned for the development of Konkan either have failed or have failed to produce expected results. In these days of high ecological consciousness, an alternate development strategy which will not scar nature so badly is always welcome.

It is, therefore, necessary to create awareness of rubber cultivation as one of the alternatives for the development of Konkan. With this background in view, an attempt has been made in this paper to explain the prospects of rubber cultivation and its direct and indirect benefits for the development of Konkan.

In India, the consumption of natural rubber has been increasing consistently during the last many years. The production in the year 1990-91 was 330,000 metric tonnes while the consumption was 365,000 metric tonnes, the shortage met by import. The demand for rubber in the country is increasing year after year thereby widening the existing gap between demand and supply.

It has been estimated that by 2000 A.D. the demand for natural rubber is expected to cross 650,000 tonnes.

The traditional rubber growing tract in India extends from Kanyakumari (8°N) to Mangalore (12°N). The total production from the region is not sufficient to meet the country's growing demand. Further expansion of area under rubber in the zone to increase the production is not feasible due to dearth of suitable land. Therefore, rubber cultivation was extended to other less congenial but potential areas. One such region where rubber is being tried is the Konkan region of Maharashtra State.

The Konkan region, stretching from North to South lies between 15° and 20° North latitude, comprising of a narrow strip of land on the Western ghats of Maharashtra. The area is distributed in four districts namely Sindhudurg, Rathnagiri, Raigad and Thane. Indiscriminate felling of the forest cover and shifting cultivation practiced by the local people has completely denuded vast tracts of land. The undulating topography, erratic rainfall associated with prolonged drought period have rendered the land unsuitable for cultivating annual agricultural crops, leaving vast area uncultivated.

To take up the work relating to development of rubber plantations in Konkan, the Rubber Board has initiated a Trial Rubber Plantation Project at Dapchari, with the help of the State Government of Maharashtra in the year 1981. The State Government has allotted an area of 50 ha. land to the Rubber Board under the Konkan Area Development Scheme. The Plantation is about 145 km away, towards north of Bombay on the Bombay Ahmadabad national highway. Encouraged by the initial growth response to rubber trees the Board has elevated the Trial Plantation to the status of Regional Research Station from 1986, to look into all aspects of rubber cultivation in the region. The station is slowly metamorphosing into a full fledged Regional Research Station.

Rubber has been grown in the region on small scale and on non-commercial bases as early as 60 years ago. Near Sawanthawadi one such planting was done by the late Shivaram Raje Bapusaheb Bhonsle, Maharaja of Sawanthawadi. The vegetative growth of the trees is comparable to the growth of trees in traditional area and is indicative of good potential. Unfortunately, the trees have not been subjected to any systematic tapping. But, about 20 years ago first commercial scale planting was

done by Mr. R.G. Ketkar at Parali, about 100 kms south west of Bombay near Khopoli. The vegetative growth of plants is good. The plantation is under regular tapping and according to Mr. Ketkar the plantation is yielding more than 1000 kg of rubber per hectare per year. In a private plantation near Goa, first year of tapping has yielded about 700 kg per hectare.

Observation from these pioneer plantations and the encouraging results obtained from the Board's own research plantations, it appears probable that by use of drought tolerant clones, combined with good crop husbandry, which involves timely establishment of polybagged plants, mulching and protection against wind and sunscorch could ensure the establishment of productive rubber plantations in the area. Once into maturity any significant area of rubber will exert a beneficial effect on local microclimate, the trees providing mutual protection against wind damage and sunscorch.

COST OF RUBBER CULTIVATION

The direct cost of land preparation and maintenance up to maturity of a hectare of rubber plantation is estimated at Rs. 35,000/-. The net return from a moderately yielding plantations would be from Rs. 10,000 to 15,000. Well maintained plantations would yield an average of 15,00 kg of dry rubber per hectare per year. Economically productive period is 25 years starting from the 8th year of planting. At the prevailing price of Rs. 20/- per kg., the gross income would be around Rs. 30,000/-. Cost of production of rubber could be relatively low in view of the good availability of land and infrastructural facilities, reasonable cost of labour etc. As Bombay is a major rubber consuming centre in the country, rubber produced in the Konkan can enjoy a better market than the traditional areas.

A major disincentive for spread of rubber is its 7 to 8 years of gestation period and relatively high capital expenditure for maintaining a plantation till it starts generating income. Keeping in view the above facts, the Rubber Board has formulated an unique attractive financial assistance scheme for helping potential cultivators. Under the scheme, the cultivator is eligible for various cash subsidies and bank loans. Non-returnable financial assistance include cash subsidies Rs. 5000/- per hectare for plantation raising, latex processing, plant protection equipments, Rs. 1000-4000 per ha for boundary protection, Rs. 2500/- per ha limited to 50,000/- for irrigation, and Rs. 875 to 1225/- for bee-keeping. Growers belonging to SC/ST categories are eligible for enhaced rates of subsidies compared to general category growers. Apart from these, the Board has made arrangement with M/s National Insurance Co., Ltd., to provide comprehensive insurance cover for rubber plantations.

ADVISORY, EXTENSION AND TRAINING

The Board offers free advisory and extension services at all stages of planting, maintenance and production. Various training activities are also undertaken for enterpreuners and workers. The fields of training cover management of estates, small holder cultivation and production, budgrafting and nursery techniques, tapping and allied activities, crop processing, grading and packing of raw rubber and rubber goods manufacturing technology. Most of the training is given on levy of moderate fees. However, training for workers in budgrafting and tapping are not only free but supported by suitable stipends and free unfurnished accomodation.

ECONOMIC AND SOCIAL BENEFITS

Rubber planting is one of the highly labour intensive agricultural vocations. A hectare of plantation will provide regular daily on-farm employment to 0.7 man power. In the initial years of planting there are several operations such as clearing of land, lining, pitting, raising of cover crops, fertilising, plant protection, etc., which absorb labour at an average of 0.5 mandays per ha per day. Out of the Rs. 35,000/- to be spent for planting and maintaining a hectare of plantation to the bearing stage, Rs. 21,000/- is the cost of labour ie., 60% in terms of man power it is around 800 mandays. In the case of mature plantations also, around 60% of the recurring expenses incurred for upkeep, tapping and processing is for labour. These are only for direct agricultural operations.

Rubber plantations also provide timber, oil, oil cake and honey. The average timber yield from one hectare of rubber plantation at the close of the 33 years of economic life is 200 cubic metres. Rubber trunk wood is gaining widespread global acceptance for furniture, packing cases, plywood

and construction needs. Rubber can meet some portion of the total timber requirements, and therefore, to that extent it can help to conserve our precious forest resources.

These are some of the activities that could generate additional employment and income in rural areas, if rubber cultivation is adapted on a large scale. Once the rubber planting assumes large proportions, a lot of ancilliary activities can also emerge.

ECOLOGICAL BENEFITS

Rubber is a natural forest tree, which besides providing an excellent and thick cover to the land, serves other objectives as well. Thus it can help in bringing back the already upset ecological equilibrium. The rubber tree is a major source of fuel wood in South India, and most of the rubber growing countries. The timber, after borax treatment and seasoning, can be used for furniture making and construction purposes.

Studies conducted on biomass production by rubber plantations revealed that *Hevea brasiliensis* is comparable to any fast growing tropical forest tree species in regard to biomass production. An annual biomass production of 35 tonnes has been reported from rubber plantations. Being a deciduous tree, the tree adds to the soil leaf litter, estimated to the tune of 4 to 7 tonnes. Under domestication, this tree is cultivated on properly built contour terraces and is grown usually with a leguminous cover crop which adds another four tonnes of dry matter per hectare.

It has been reported that soil moisture conservation and water use efficiency of rubber is of a higher order when compared to most of the other forest trees. The amount of radiant energy reaching the soil surface is low which results in lower soil temperature of the order of 8°C compared to open area. This helps in reducing oxidation of organic matter. The build up in organic matter improves the soil texture, reduces the evapotranspiration losses and volatalisation of nitrogen. The well developed surface root system of *Hevea* gives good soil binding and minimises soil erosion. the rainfall interception is comparable to teak and is around 50% more than that of *Eucalyptus*.

A good number of flora and fauna are known to thrive in rubber plantations. More than 100 species are commonly seen. Such growths are not seen with other plantations. Many shade loving medicinal herbs also grow very well in the rubber plantations. A Comparison of soil characteristics,water uptake etc., in areas intensively planted with rubber with those of denuded forests of where a forestation has been made exotic species such as *Eucalyptus*, etc., have revealed thar *Hevea brasiliensis* is certainly a better option for effective afforestation.

Rubber cultivation is still awaiting exploitation by the people of Konkan. It is a crop which could be gainfully cultivated in areas with good soil depth and light irrigation potential. Any development activity has to satisfy three conditions. it should be economically feasible, socially beneficial, and ecologically acceptable. Rubber satisfies all the three. From the foregoing thesis it can be said that by use of suitable agrotechnology, which involve timely establishment of polybag plants, mulching, irrigation etc., productive plantations can be established in the area. ●

Rubber Honey

Rubber tree is a prolific producer of honey. In the rubber tree, honey is found at the extra-floral nectory glands at the end of the petiole where the leaflets join. It is estimated that honey from rubber plantations form around 40 per cent of the total Indian production of honey. Studies show that about 15 hives can be placed in a hectare of rubber plantation. In a normal year about 10 kg of honey can be obtained from one hive.

Honey is a saturated solution of sugars. Rubber honey contains three major sugars viz. fruit sugar, grape sugar and cane sugar. Cane sugar forms only a very small percentage and hence rubber honey is devoid of the harmful effects associated with cane sugar.

A STATUS REPORT ON THE RUBBER SMALLHOLDINGS OF TRIPURA

TOMS JOSEPH & P. RAJASEKHARAN
RUBBER RESEARCH INSTITUTE OF INDIA
KOTTAYAM - 686 009, KERALA.

INTRODUCTION

Among the North Eastern states Tripura pioneered the development of rubber plantation. The Government of Tripura considered rubber as one of the ideal crops to rehabilitate the nomadic tribals. As the infrastructure facilities existing in the state are insufficient industrial development has been lagging. Agriculture is the main source of income and hence the Government has to accelerate the tempo of agricultural development. However most of the cultivators are illiterate and financially handicapped. It is in this context that Rubber Board in association with the State Government designed and implemented various schemes for the development of small holdings. Tripura accounts for 52 percent of the total planted area of North Eastern region. The target fixed for Tripura for the period 1990-91 to 1994-95 is 18,500 ha., which comes to be 37 per cent of the target for the entire North East. Yet the present achievement amounts to only around 17 percent of the area declared available for rubber cultivation.

OBJECTIVES

The main thrust of the study is to report the present status of small rubber growers of Tripura. The management practices of the growers and the extent of resource use are investigated. Special attention has been laid to point out the specific problems faced by small growers with regard to cultivation, processing and marketing. The study documents the historical background of the agricultural system of Tripura and the introduction and development of natural rubber with special reference to small holding sector.

DATA SOURCE

The study uses both primary and secondary information. A field survey was undertaken to generate primary data covering all the three districts of Tripura during February-March 1991. The sample was fixed as 60 randomly selected units. The survey covered only holdings planted during 1979-84 period and reached tapping stage.

Secondary information were collected from the Rubber Board Regional Office at Agartala and Udaipur. Since it is a maiden attempt, to understand the problems of small growers discussions were held with field staff at various levels. Discussions were also held with dealers, leading cultivators and other knowledgable persons. The qualitative information generated in such discussions are extensively used in this report.

HISTORICAL BACKGROUND

The 'Jhooming' cultivation viz., primitive shifting cultivation was the only form of agricultural practised by the tribals of Tripura until the 15th Century. From the beginning of the 15th century Bengalee settlers started plough cultivation. Though paddy was the main crop, the turn of the present century witnessed the development of cash crops such as tea, sugarcane and jute. The migration of Bangalees during the early decades of the 19th Century accelerated the tempo of land utilisation in Tripura. The erstwhile royal Government of Tripura also had various schemes to rehabilitate the 1jhoomias. Consequently, the extent of net sown area rose from 1,24,975 ha. in 1937-38 (15.6% of the total land) to 2,31,0090 ha. in 1964-65 (28.9% of the total land). The cropping pattern of Tripura during the middle of the 19th century was as follows. In the plains paddy, sugar cane, jute, oil seeds and tobacco were cultivated. Cotton, sesameum and vegetables accounted a major share of the cultivated land in the hills and in the hill slopes pineapple, orange, lichi banana etc. were cultivated. The Manipuri villages of Tripura

had arecanut cultivation on a massive scale.

INTRODUCTION OF RUBBER CULTIVATION

In 1963 natural rubber was initially planted in the State. Tripura situated between 22° and 24° North Latitude does not lie within the conventional rubber growing zone. But the near tropical geographic conditions reflected in the extent and pattern of rainfall, temperature, soil characteristics, humidity etc., in this sub-tropical region are found to be suitable for rubber cultivation. Upto the end of 1970's rubber planting was confined to the Departmental farms and Corporations plantations.

DEVELOPMENT OF SMALLGROWERS RUBBER CULTIVATION

The New Planting Development Scheme of 1979 and the Rubber Plantation Development Scheme of 1980 paved the way for small growers to take up rubber cultivation in Tripura. However, the growth of the small holdings sector was insignificant during the Phase I period of the RPD Scheme (1980-84). The implementation of the project "Accelerated Development of Rubber Plantations in North Eastern Region" in 1984-85 brought about a break through in rubber cultivation by small growers. (See Table 1).

As can be seen from the table the share of holdings in rubber area for the period after the implementation of the project is 51.6 per cent while before its implementation it was only 15.2 per cent. The share of Tripura in NE Region is declining year by year as rubber cultivation is being increasingly popularised in other North Eastern States.

Upto 1983-84 the average size of a holding rose gradually revealing enhanced cultivation in larger plots. But since the implementation of the project more and more holdings with lower size are planted with rubber. This fact suits well for both Agartala and Udaipur regions (See Table 2).

TABLE 1

Development of rubber cultivation in Tripura (area in ha.)

Planting Period	Estate sector	Small holding sector	Total	Share of small holding sector (in%)	Share of Tripura in North Eastern region (in %)
Upto 1983-84	4200	750	4950	15.2	61
1984-85	350	500	850	58.8	74
1985-86	500	600	1100	54.5	61
1986-87	650	1300	1950	66.7	65
1987-88	910	1240	2150	57.7	47
1988-89	1340	850	2190	38.8	39
1989-90	1850	1475	3325	44.4	43
Total	9800	6715	16515	40.7	52

Source: Rubber Board.

TABLE 2

Average size of a rubber holding - Over years. (size in ha.)

Period	Agartala Region	Udaipur region	All Tripura
1979-80	1.17	0.86	1.10
1981-82	1.25	1.08	1.20
1983-84	1.36	1.23	1.33
1985-86	0.86	0.86	0.86
1987-88	0.70	0.69	0.70
Total	1.04	0.94	1.01

Source : Rubber Board.

BACKGROUND OF RUBBER GROWERS

Most of the small growers who had cultivated rubber during the reporting period had land area below 2 ha. and they were mostly peasant farmers with subsistence farming or petty business (See Table 3). Relatively large growers emerged from the business community. They have invested the surplus generated from business in purchasing new land and cultivating rubber. Most of the traditional agriculturalists have land area between 2 and 4 ha. The salaried classes are grouped under 'others'.

TABE 3
Background of sample rubber growers

(% of growers) Main source of livelihood.

Size Class (in ha.)	Peasant Farming & Petty business	Big business	Traditional Agriculture	Others	Total
0 – 2	87	–	–	13	53
2 – 4	—	42	50	8	20
4 and above	—	56	13	31	27
Total	47	23	13	17	100

Most of the small growers, especially those who have planted rubber in recent years are financially handicapped. Practically they cannot undertake any farm activity without outside financial help. Hence, Rubber Board channalises more funds per unit area in North East compared to traditional area.

Around 60 per cent of the growers were illiterates and near cent per cent illiteracy is reported in the lowest size class. Propagation of a new crop, particularly a perennial one in such a situation requires relentless extension service. Hence in 1985 Nuclear Rubber Estate and Training Centre (NRETC) was established at Agartala to serve as the king pin for advisory and extension activities. NRETC imparts training in scientific farm practices through its demonstration plots and regular training programmes. The field staff attached to the Regional Offices are also expected to carry out extension work. But due to the overload of work originating from the remoteness of the area, lack of proper infrastructure facilities scattered nature of plantations and multiplicity of schemes, the field staff get only very limited time to spend on advisory service. The field staff visits a farm only once in a year and then also due to the tight schedule to reach target they will not get ample time to listen the queries of the grower patiently. Measures are to be taken to extend the present level of extension and advisory service.

Earlier Rubber Board published a monthly newsletter in Bengalee. The regular publication of such newsbulletins and pamphlets covering various aspects of cultivation and processing in Bengalee and other prominent tribal languages would no doubt fruit positively.

PROFILE OF SMALL GROWER RUBBER CULTIVATION

In Table 4 the details regarding subsidy disbursement are

TABLE 4
Details of subsidy disbursement

(Percentage of area for which subsidy disbursed)

Year of planting	No subsidy	Ist year only	Upto IInd year	Upto IIIrd year	Upto IVth year	Upto Vth year	Upto VIth year	Upto VIIth year	Total Area (inha.)
1979	--	2	4	-	-	-	-	94	26.39 (24)
1980	--	7	24	-	9	5	4	51	56.13 (51)
1981	1	16	10	3	4	15	18	33	170.89 (150)
1982	19	16	5	5	9	11	11	24	578.86 (474)
1983	3	11	11	9	23	16	11	16	455.27 (355)
1984	9	3	16	7	15	18	9	23	388.04 (279)
Upto 1984	10	11	11	6	13	14	11	24	1675.58 (1333)
1985	--	4	29	13	25	22	7	--	217.53 (182)
1986	--	23	35	13	19	10	--	--	438.49 (583)
1987	1	39	30	22	8	--	--	--	229.84 (392)
1988	8	44	41	7	--	--	--	--	246.72 (288)

Source: Rubber Board. Figures in parenthesis indicate the Number of holdings

presented. As per norms, the subsidy amount has to be disbursed in seven instalments from the year of planting. The amount for a particular year is disbursed only if the rubber plantation has attained satisfactory growth as per the stipulated norms. But in Tripura due to the poor management practices, the subsidy instalments are often with held. Normally, area planted upto 1984 should receive full subsidy by 1990. But only 24 per cent of the area has received the subsidy amount fully so far. (This does not include the area of public sector plantation corporations under rehabilitation schemes.) It is found that 49 per cent of the 1980 planted area remains to be paid their subsidy even after 10 years of planting.

The subsidy disbursement details depict the situation of the rubber small holdings of Tripura. Most of the holdings as suggested in the inspection reports are found to be in an abandoned stage or the existing stand is considerably lower than the stipulated one. Hence the mature area available in the holdings sector will obviously be lower than the actual area planted.

On an average 8.7 years have been taken by the holdings to reach maturity and only 40 per cent of the trees acquired tappable girth. As years advance the average gestation period declines revealing improvement in cultural practices. There are reported cases where holdings took only seven years to reach tapping stage. For instance the sample holdings planted during 1984 reached tapping stage by seven years and 61 percent of the trees acquired tappable growth during the first year of tapping. It may be noted that these growers had relatively larger holdings as seen in Table 5. These cases reveal that if scientific management and cultural practices are followed, rubber plantations in Tripura have the same potential to grow and yield as in the traditional areas.

The figures for entire Tripura compiled from the records of fully paid subsidy files also show the same picture. It may be noted that 63 percent of the trees of holdings planted in 1983 and received full subsidy has not yet attained tappable girth i.e. after 8 years of planting.

TABLE 6
Girth attainment of mature trees

Year of planting	% of trees attained tappable girth	Range of girth (in cm)
1980	56	50-70
1981	55	31-70
1982	49	40-60
1983	37	22-50

Source: Rubber Board

EXTENT OF RESOURCE USE

The development cost as incurred by the sample growers is presented in tables 6 and 7. The development cost figures are computed for the first eight years since the sample holdings took on an average 8.7 years to reach maturity (see Table 5). The total resource use by the growers in Tripura amounts only 61 per cent of the reported development cost of traditional area. (Expenditure on fencing is deducted from the

TABLE 5
Salient features of the small grower cultivation

Year of planting period	Average gestation holding	Average size of a per ha.	Initial stand per ha. holding	No. of trees tapped	4as %of 3	Extent of vacancy filling (No./ha.)
	(1)	(2)	(3)	(4)	(5)	(6)
1979	10.0	1.12	500	357	71	155
1980	10.00	0.50	531	221	42	180
1981	9.3	1.38	500	244	49	210
1982	9.0	2.76	525	141	27	103
1983	8.1	1.29	519	206	40	129
1984	7.0	4.25	500	303	61	125
Total	8.7	1.97	514	205	40	158

Source: Field survey

TABLE 7
Development cost (material) incurred by the small growers (Rs. per ha.)

Items	Years 1	2	3	4	5	6	7	8	Total
1. Planting materials	1028	180	88	40	-	-	-	-	1336
2. Fertilizers	375	525	625	615	615	615	615	615	4600
3. Manures	312	188	128	75	75	75	75	75	1003
4. Covercrop	20	12	12	-	-	-	-	-	44
5. Lime	19	28	35	25	20	-	-	-	127
6. Fencing materials	415	315	255	100	100	100	100	100	1485
Total	2169	1248	1143	855	810	790	790	790	8595

TABLE 8
Development Cost (labour) incurred by the small growers (Rs. per ha.)

Items	Years 1	2	3	4	5	6	7	8	Total
1 Clearing	375	-	-	-	-	-	-	-	375
2 Soil conservation	375	300	-	-	-	-	-	-	675
3 Lining pitting and refilling	1475	-	-	-	-	-	-	-	1475
4 Planting	375	-	-	-	-	-	-	-	375
5 Vacancy filling	-	375	125	75	-	-	-	-	575
6 Weeding and mulching	1400	1400	1400	1000	1000	500	350	350	7400
7 Manuring	250	250	250	200	200.	150	150	150	1600
8 Cover crop	50	50	50	-	-	-	-	-	150
9 Fire belt	125	50	50	50	50	50	50	50	475
10 Fencing	500	450	400	275	200	150	100	100	2175
11 Others	200	200	200	125	125	125	125	125	1225
Total	5125	3075	2475	1725	1575	975	775	775	16500

development cost of Tripura for comparison since the development cost estimate in traditional area does not account fencing.) Lower levels of input application imply lack of proper and consistent management practices.

FERTILIZER & MANURE APPLICATION

The small growers used only limited quantities of fertilizers. Instead they applied cowdung twice or more depending upon its on farm availablity. Larger growers made use of cowdung only once i.e. at the time of planting. The supply of fertilizers is imperfect due to the absence of a network of fertilizer dealers and retail shops. The villagers have to solely depend on the office of the Village level worker (VLW) through which the government of Tripura provides fertilizers at subsidised prices.

Normally they do not issue fertilizers to rubber growers since the supply is primarily meant for paddy and vegetable cultivation. Hence, big growers who had or have paddy and vegetable cultivation have accessibility to VLW office. But small growers who do not have any cultivation other than rubber practically cannot get fertilizers from VLW office. Even if fertilizer supply is obtained since it is not regular and systematic, balanced mixing and timely application cannot be done.

Around 90% of the holdings were RRIM 600 and GT 1 mixed planting. In recent years RRII 105 is also being planted but due to the recurring storms GT 1 and RRIM 600 are preferred.

Only 26 per cent of the growers had adopted covercropping and the area covercropped comes to

45 per cent implying that larger growers only had adopted. Around 75% of the growers had not white washed the trees during summer.

Weeding cost is the single major item of development cost. Since covercropping is not adopted extensively, the need for weeding becomes crucial. The fast growing grass 'Chan' (sungrass - Imperata Cylendrica) widely seen in Tripura makes weeding necessary at least five or more rounds per year during the initial years.

Fencing accounts for a major share in the development cost. Most of the rubber holdings are not adjesant to the growers' households. The unquestionable practice of the villagers to allow cattle to roam and graze freely makes proper fencing unavoidable. It may be recalled that the extent of vacancy filling of the sample growers was around 30 per cent of the initial planting (see Table 5) and the main cause was damage due to cattle grazing. Most of the growers use bamboo fencing since it is cheaper compared to barbed wire fencing due to the unlimited local supply of bamboo and cheap labour. During the initial years fencing has to be renovated fully and, there after repair and maintenance work has to be done year by year. The number of trees reaching tapping stage is low mainly due to the lack of proper fencing and consequent damage by cattle. Many holdings were to be replanted fully after one or two years of planting due to cattle grazing as reported in the inspection files.

Spraying expenditure is nil since plant protection chemicals are not applied in Tripura.

LABOUR USE

The share of labour in the total cost is 66 per cent. The share of market labour comes to around 60 per cent of the labour use. The growers with lower size holdings who depend fully on family labour do not maintain the farm properly and hence the volume of labour input is insignificant compared to growers with larger size who depend mainly on hired labour. The share of female labour is negligible. The average wage rate is found to be Rs. 25/- per day.

TAPPING

In most cases tapping is done in an unscientific manner. For the majority of them who lack enough expertise, tapping is just cutting of the bark at pleasure.

There are reported cases where due to unscientific tapping, the whole tapping panel got spoiled within a few months after opening. The tappers are either locals or migrants from Kerala. Most of the Keralites are good tappers but there are complaints that certain persons from Kerala work as tappers claiming adequate expertise but do not have any experience. The growers who are not at all aware of the scientific methods get easily deceived.

Keralite tappers are working mainly in large holdings.

The tapping task of local tappers is 225 trees while Keralites tap around 300 trees per day. Accordingly Keralite tapper gets a monthly salary of Rs. 1,200/- to Rs. 1,500/- while locals get only Rs. 700/- to Rs.900/-. In the majority of the cases tappers are given monthly fixed payments. Certain locals are also engaged with daily payment where average wage rate is Rs. 35/- per day.

PROCESSING

Processing of rubber in Tripura by small growers is as unscientific as tapping and hence the sheet rubber produced is of an inferior quality. There are even cases where sheet is made by trampling and then sun drying.

TABLE 9
Availability of rollers and smokehouses

Size Class (in ha.)	Rollers (% of growers)	Smokehouse (% of growers)
0 - 2	13 (4)	6 (2)
2 - 4	75 (9)	50 (6)
4 and above	100 (16)	100 (16)
Total	48 (29)	40 (24)

Figures in parentheses indicate the number of growers
Source: Field survey

Table 9 shows the availability of rollers and smokehouses. The big growers are in a position to process good quality rubber but since they cannot get a premium price for the quality, they are discouraged. The smaller ones have neither rollers nor smoke houses. In Kerala such growers can avail the roller facility of nearby growers at a nominal rate. But such a practice is absent in Tripura. Instead such growers sell their produce either to other

growers or to tappers at an average price of Rs. 3.50 per litre.

Most of the growers sundry their sheets. Around 15 per cent of the growers has smokehouses made of indigeneous materials. The walls are made of mud and the roof is thatched with grass. The roof is to be replaced in every four years. Such a smoke house costs only Rs. 1,500/- while to construct a smoke house as per norms the cost will be around Rs. 6,500/-. But smokehouses built with thatched roof are liable to the risk of fire and home cannot be considered for subsidy. However smokehouses made out of mud walks but with proper roofing and which are found capable of producing quality sheets are paid subsidy.

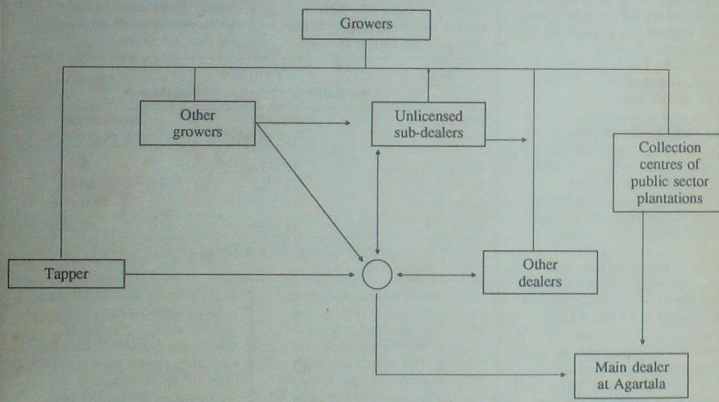
MARKETING

The marketing channel of small rubber growers is outlined in the chart. It can be seen that there is near monopoly in the NR market in Tripura where one big dealer at Agartala controls the entire market. Though dealer's licenses are issued to a few more persons most them are not in operation. There are unlicensed sub dealers who have around the households and purchase rubber at spot. They pay a lower price and get nominal commission from the licensed dealers. Large growers transport rubber to Agartala and sell directly to the main dealers.

Again due to the monopoly situation payment of price is often delayed by 20 to 30 days. The small growers who sell rubber in latex form to either tappers or other growers also face delay in payment. But the unlicensed subdealers who purchase rubber at doorstep make ready payment, but the price is always lower than the market price. The public sector latex collection centers are few in number and hence the volume of latex they collect from small growers is insignificant. The main dealer at Agarthala transports rubber to culcutta by road.

The pattern of market outlet dependence of small growers is presented in Table 10. Big growers sell major chunk of their produce at Agartala market and fetches a higher price. The smaller ones mainly sell rubber to other growers in latex form and realise only Rs.14/- per Kg. (Rs. 3.50/ per time). The unlicensed subdealers mainly purchase rubber from the middle class growers and the average price is Rs. 18.50

MARKETING CHANNEL OF NR OF SMALLGROWERS



per Kg. None of the sample growers have sold rubber to public sector collection centres.

TABLE 10
Destination of primary sale

Size-Class (in ha.)	Agartala market	Unlicensed sub-dealers	Other growers	Tapper
0 - 2	3	16	50	31
2 - 4	39	41	20	--
4 & above	94	6	--	--
Total	35	18	30	17

Source : Field Survey

In the Agartala market the average price was Rs. 20.50 per Kg. for sheet rubber and Rs. 8/- per Kg. for scrap rubber during 1990. Taking into view the imperfect market situation and inferior quality of the produce, the price reported is reasonable. Explanation for this must be sought in the extent of margin that a dealer may get in the terminal market. He can get a higher margin since the transportation cost of rubber from Agartala to Culcutta is relatively low (below Rs. 1.50 per Kg.) compared to that from Cochin to Calcutta (around Rs.4/- per Kg.). It is rumoured that natural rubber is being smuggled out to Bengladesh where the price is considerably high.

ACCESSIBILITY TO CREDIT

Since planting is done by smallgrowers at the behest of Rubber Board, all of them who have valid land documents avail subsidy. Around half of the sample growers had availed bank loan. As seen in Table 11, as the size of the holding increases the extent of borrowing also has risen. During the reported period it was the category of growers with big business that availed bank credit mainly. The smaller growers with petty business also had availed bank loan. It is a paradox that it is the group of traditional growers that did avail bank loan the minimum.

TABLE 11
Details of the Availing of Bank loan.

Size-Class (in ha.)	%of growers availed bank loan	Background of borrowers			
		Peasant farming & petty business	Big business	Traditional Agriculture	Others
0 - 2	47	53	--	--	47
2 - 4	50	--	66	44	--
4 & above	56	--	78	--	22
Total	50	26	37	7	30

Source: Field Survey

This is the picture seen during the phase I period of the RPD Scheme. But during the recent years it has been told that the non-availability of credit by smaller growers has increased significantly. Absence of proper land documents makes banks shy to lend to smallgrowers. Growers with "Khasi" land (i.e. land under possession without documents) cannot avail either subsidy or bank finance. When such land is converted into "joot" land (land with ownership title) subsidy is disbursed in total. On the one side the financially tight growers cannot maintain the farm upto that stage and on the other side bank credit is blocked. Hence, the state Government should enact and implement measures to confer ownership title so that the growers will get proper land records to satisfy Rubber Board and other financial institutions.

NON-AVAILABILITY OF MATERIALS

Due to the lower levels of demand manufacturers will take years to open selling points in Tripura. Of course Rubber Board has evolved schemes to provide plantation requisites through its offices with subsidy element. But the supply is often lagged and its volume does not correspond demand. The rubber cultivation in Tripura suffers a lot due to the absence of adequate and timely supply of fertilizers as mentioned earlier. If Rubber Board can implement schemes to ensure timely supply of fertilizers and other materials it will be widely welcomed and will boost the

growth of rubber plantation in Tripura.

ABSENCE OF GROWERS FORUMS

The growers of Tripura are unorganised. It is quite natural taking into account the level of literacy and awareness. The only smallgrowers Association is manned by the business group that has monopolised the NR market of Tripura. If a net work of growers' forums can be organised (as RPSs in Kerala) a lot of problems could be solved. But the experience of Board's development staff is that attempts in such direction are often nipped in but itself due to the existing aggressive political rivalry and social factors. It must be looked into whether in such a situation, Rubber Board can intervene more actively in the input and output markets taking into account the specific conditions of Tripura.

CONCLUDING REMARKS

The various facets of rubber plantation development such as the adoption of the crop, cultivation, processing, and marketing, pattern of labour use, conditions of plantation workers are subjects which are to be investigated in detail to enrich our limited information on the status of rubber plantation in non traditional areas. Year by year more and more peasants are attracted and hence the intensity of the problems would mulüply. The designing of schemes and framing of policy are to be based on reliable information. Tripura is a a potential state where agro-climatic conditions permit us to convert the fertile barron tracts of waste land into yielding rubber plantations if backed by proper and regular technical and financial support. This will not only help us in reaching self sufficiency in rubber but also aid in imparting a new culture of cultivation among the nomadic tribals whose experience in systematic farming is nil. Moreover, the propagation of rubber will help in alleviating the abject poverty of the masses of Tripura.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. M.R. Sethuraj for the encouragement given. The valuble comments offered by S/S Joy P Korah and A.V.Thankappan Nair, Joint RPCs, Dr. V. Haridasan, Dy Director and Dr. Tharian George, MRO are acknowledged with thanks. The help rendered by Dr. A.K. Krishna kumar and Rubber Board staff posted at Agartala and Udaipur is thankfully acknowledged.

REFERENCES

1. Bhattacharya, A.C. (1980) "Progressive Tripura"
   Inter India Publications, New Delhi (reprinted in 1985)
2. Chawdhari Jagdish Jan (1980) "Tripura" Land and its People, Leeladevi publications, Delhi.
3. (1985) "A Political History of Tripura", Inter India Publications, New Delhi.
4. Das Jyotish Chandra (1984) "An Introduction to the History of Tripura" Book Home, Calcutta.
5. Department of Education (1975) "Tripura District Gazetter", Government of Tripura, Agartala.
6. National Council for Applied Economic Research (1980)
   "Ten Years Perspective Plan for Rubber 1980-81 to 1989-90", NCAER, New Delhi.
7. Rubber Board (1980) "Rubber Plantation in Tripura"
   Rubber Board Bulletin Vol. 14 No. 1 & 2, Rubber Board, Kottayam.
8. Rubber Board (1990) "Rubber Plantation Development in North Eastern Region: A Report", Rubber Board, Guwahati.

Rubber Wood

In recent years rubber wood has assumed importance as a source of raw material for various industries in India. Studies indicate that around 1.2 million cmt. of rubber wood is produced annually from the replantings of rubber; sixty per cent of that quantity is stem wood (round wood) and the rest is branch wood. The branch wood is used as fire wood. Out of the round wood of 0.72 million cmt. (60% of total), 0.42 million cmt. is used in packing case manufacturing industry and 0.08 million cmt. is used for manufacturing low quality plywood and splints and veneers for safety matches. A small quantity is used in the manufacturing of textile accessories and furniture.

COMPARATIVE STUDIES ON THE ROOT SYSTEM OF STEM CUTTING AND BUDGRAFT OF RUBBER AT 15 YEARS GROWTH

C.K. SARASWATHY AMMA, JOSEPH G. MARATTUKALAM, VINOTH THOMAS and M.J. GEORGE
RUBBER RESEARCH INSTITUTE OF INDIA

The current conventional method of propogating clones of *Hevea* is by budgrafting on to the seedling stock. Effect of root stocks in improving growth and productivity of scion is considerable. But a certain amount of heterogenity is noted in the root system. Hence, variation among the plant population from a single clone can be attributed to root stock excluding the environmental variables. Development of plants on its own root system is one of the major means to have more uniform planting materials. With this object in view, various Rubber Research Institutes in the world are engaged in experiments on rooting of cuttings.

Attempts were made to root cuttings as early as 1878. Initially researchers were able to root cuttings from young seedlings only. The cuttings taken from young rubber seedlings were known to root quite easily, whereas shoots from mature budding or from seedlings which had reached flowering stage rooted much less easily. Due to pronounced genetic variations among the seedlings, it is more desirable to produce rooted cuttings from clonal materials, the performance of which are more predictable. Earlier attempts to produce clonal materials of *Hevea* by cutttings were not successful.

Fig 1. Root system of stem cutting at 15 year's after planting.

The successful rooting of cuttings of clones of rubber was reported first from Malaysia (Rubber Research Institute of Malaya 1959, 1962). This was made possible only by the introduction of a special technique - propagation under a mist spray. Collection of suitable cuttings from the correct source and the use of chemicals also help to induce root initials.

In order to have the full realisation of the potentialities of the clones, performance of the clones on its own root system has to be evaluated. Rooted cuttings from a single clone produce more uniform planting material for experimental and research work. However, a comparative study of the root systems of mature budgrafts with the rooted cuttings of the same age has not so far been reported. This communication deals with the comparative studies on the root system of a stem cutting with that of a budgraft at the age of 15 years after planting.

MATERIALS AND METHODS

During 1976, stem cuttings were taken from the young budgrafted plants of PB 5/51. The cut ends were dipped in water and then in Seradix No. 2 and planted in polybags, filled with top soil, for rooting. These plants were planted along with the normal budgrafts at Central Experiment Station, Chethackal during 1977. At the age of 15 years nature of the root system of cutting as well as budgrafts was studied by excavating the mature plants in the field. Girth of the stem 20 cm above the collar and tap root (pseudo tap root in the case of cutting) 20 cm above the collar as well as the number and girth of lateral roots were recorded.

RESULTS AND DISCUSSION

The root system of stem cutting and budgraft are shown in Fig. 1 & 2 respectively. Girth of the stem is more for the cutting (157 cm) compared to the budgraft (132 cm). Total number of lateral roots are 23 for cutting and 24 for budgraft. The length of main root (tap root) is more for the budgraft (127 cm) in comparison to that (pseudo tap root) of cutting (97 cm), whereas the mean girth of the lateral roots are more for the cuttings (36) compared to the budgrafted plant (32). In the stem cutting very large lateral roots are developed. In the case of cutting several roots growing parallely and vertically downwards have grafted together forming a pseudo/false tap root doing the functions of a normal tap root. In the case of budgrafted plant tap root is very well developed

Fig 2. Root system of bugraft at 15 year's after planting

compared to that of cutting. with regard to budgrafted plants if the soil depth is very good the development of the root system is also very good. If there is any rock or hindrance to the proper development of root system, the tap root retards its growth and normally result in uprooting of the plant. In the root system of the budgrafted plant there are two well developed whorls of lateral roots.

In the case of stem cutting one or two lateral roots grow very well and support the whole tree. If the soil is deep the root system develop well as in the case of budgrafts. Eventhough the number of cuttings planted is only three no wind damage is so far noticed for these plants suggesting the proper development of the root system.

It is reported (Leong and Yoon 1984) that the rooted cuttings are prone to wind damage during 2nd and 3rd year. The major defect of rooted cuttings was the absence of a tap root to anchor the trees to the ground.

This preliminary observation indicated the possibility of proper development and anchorage of the root system of cuttings. The only thing is the success of initiation of roots on the cuttings depends on various factors. By providing mist as well as growth hormone like Indole butric acid (IBA) or Seradix the root development in cuttings can be enhanced. Since these plants are growing on its won root system interaction of stock scion is nullified. Hence these rooted cuttings are valuable research rools.

One of the most important requirement for the successful rooting of cuttings is a reliable hormone to induce rooting. Trade name along with the component chemicals of a few materials are furnished below:

Seradix No. 1 - 0.1% Indole butric acid (IBA) in talc

Seradix No. 2 - 0.3% Indole butric acid (IBA) in talc

Seradix No. 3 - 0.8% Indole butric acid (IBA) in talc

Seradix L 15 - 1.5% Indole butric acid (IBA) in talc

ACKNOWLEDGEMENTS

The authors are grateful to Dr. M.R. Sethuraj, Director of Research, Dr. S. Narayanan Potty, Joint Director (G & RS) and Dr. A.O.N. Panikkar, Joint Director (R & T) for their encouragements. They are also thankful to Shri P.J. Joseph, Assistant Farm Superintendent, CES and also the Field staff of Botany division for their assistance in the study.

LITERATURE CITED

The Rubber Research Institute of Malaya. 1959. Developments in the propagation of *Hevea*. *Planter's bulletin* No. *45*: 143 - 146.

The Rubber Research Institute of Malaya 1962. Propagation of *Hevea* by cuttings. *Planter's bulletin* No. *63*: 162 - 163.

Leong S.K. and Yoon P.K. 1984. The rate of cuttings and clonal root stocks in *Hevea* cultivation. *Int. Rubb. Conf. Sri Lanka*, 1984 pp. 71-85.

Forum to Protect Genetic Resources

A joint forum of farmers' associations have demanded a Central legislation declaring India's resources as "national property" to safeguard indigenous genes and plant resources from patenting as suggested in the Dunkel Draft.

The forum, being convened by the "Gene Campaign" gruop, has threatened mass action by farmers from all over the country to retain control of the genetic resources belonging to India.

In a statement the forum demanded removal of the restriction on processing, movement and trade of farm products; spending of 75 per cent of the Plan expenditure exclusively on the rural sector; ban on entry of multinational companies in the agriculture sector and protection of genetic resources by rejecting patents and monopolistic forms of intellectual property protection demanded in international negotiations.

The signatories to the statement include Mr. Bhanu Pratap Singh, Mr. Nanjundaswamy of the Karnataka Farmers' Association. Mr. Lakhanwal of the Bhartiya Kisan Union, Punjab, Mr. Pishora Singh of the All-India Bhartiya Kisan Union and Ms. Suman Sahai of the Gene Campaign.

FERTILITY STATUS OF THE RUBBER GROWING SOILS OF KERALA

M. KARTHIKAKUTTY AMMA, A.N. SASIDHARAN NAIR,
M. MATHEW and C.K. CHACKO

Optimum nutrient supply to any crop can be ensured only through judicious fertiliser application and a knowledge of the nutritional status of soil is vital in economic and efficient use of fertilisers. Although many techniques are available to determine the nutrient requirements of crops, soil testing has emerged as the procedure most often utilised in established cropping systems. In our country several soil testing laboratories have been set up during 1960's and the Soil Test Crop Response Correlation Coordination Unit of the Indian Agricultural Research Institute, New Delhi, has prepared fertility maps showing the available nitrogen, phosphorus and potassium status of Indian Soils. (Ramamoorthy & Bajaj 1969).

Soil testing service for rubber cultivation was initiated in the Rubber Research Institute of India (RRII) from 1965 onwards. The laboratory however had only limited facilities and was capable of handling only limited number of samples too insufficient to meet the demands from the large number of growers. But this unit also could cover only a small portion of the total number of holdings and as a result three more laboratories with mobile soil and tissue testing unit were started at Kozhikode, Muvattupuzha and Nagercoil during 1986. Five more laboratories have been set up at Mangalore, Taliparamba, Trichur, Palai and Punalur in 1990-91, extending soil testing service to more areas. The laboratory at the RRII serves as the Central Laboratory co-ordinating the activities of the mobile and regional units. For collection of samples the services of field staff of Rubber Production Department is also utilised. Soil samples received in these laboratories are processed and analysed for diagnostic purpose. Fertility status of rubber growing soils in Kerala is discussed in this communication in the light of data generated in these laboratories on soil samples collected from small holdings.

In routine soil testing for advisory purpose, the samples are tested for their reaction (pH), available P, K and Mg. For available nitrogen, the assessment is made through the estimation of organic carbon. Fertiliser recommendation offered were based on soil test crop response correlation studies carried out along with the soil testing work in respective regions. The periodical progress in soil test programme is given in Table 1. During the period 1986 to 1990 the total number of soil samples analysed and fertiliser recommendations issued were 43701 and 22558 respectively. After analysing these samples the soil test values were classified as low, medium and high for organic carbon, available phosphorus, potassium and magnesium. The nutrient rating followed in the present work are reproduced in Table 2.

The soil test data collected during 1989 and 1990 were summarised districtwise and soil test summaries for individual districts were prepared based on 19,000 samples. The nutrient indices in respect of organic carbon, available P, K and Mg were prepared as follows:-

The percentage of samples (out of the total number of samples analysed for a district) falling into low category with respect to any nutrient is multiplied by a factor 1, those falling into medium category by 2 and those falling into high category by 3. The sum of these is divided by 100 and the value obtained is the nutrient index for that particular district with respect to that particular nutrient.

For mapping the nutrient status of soils of a district, the nutrient index value was taken as a basis. A district with a nutrient index value of 1.67 is considered low, between 1.67 and 2.33 as medium and above 2.33 as high.

The soil test values for individual nutrients in different districts are

summarised in Table 3. For Kottayam district, talukwise summaries were also prepared. (Table 4). Fertility map for organic carbon, available P available K and available Mg was also drawn for Kottayam district (Figure 1 - 4).

ORGANIC CARBON STATUS

A review of the soil test summaries (Table 3) reveal that Organic Carbon is high for soils of Kasargod, Kannur, Kozhikode, Idukki and Kottayam districts. The index values for organic carbon for these districts was found to range from 2.77 for Kasargod to 2.36 for Idukki district. Organic Carbon status is in the medium range for Malappuram, Palakkad, Trissur, Eranakulam, Kollam and Trivandrum. The annual recycling of nutrients through leaf fall and establishment of cover crop in early years may be attributive to the medium to high organic matter status in rubber growing soils. Approximately 45 - 90 Kg N, 3 - 7 Kg, P, 10 - 20 Kg K and 9 - 18 Kg Mg is added through annual leaf, branch and fruit fall in one hectare of rubber plantation. The total amount of nutrients returned to soil by different cover crops over five years of immaturity period is reported to be 226 - 253 Kg nitrogen, 18 - 27 Kg phosphorus, 85 - 131 Kg potash and 15 - 27 Kg magnesium, whereas nutrient removal through latex from a hectare of rubber plantation having an yield of 1400 kgs of dry rubber is only 9.4 kg N, 2.3 kg P, 8.3 kg K and 1.7 kg Mg (Planters Bulletin, 120).

AVAILABLE P STATUS

Soils of rubber in general are deficient in available P. (Table 3). This may be due to the lateritic nature of the rubber growing soils and correction of this condition may be more difficult due to the high P fixation capacity of these soils.

TABLE 1

Progress in soil testing of rubber growing soils of Kerala

Year	No. of soil samples analysed	No. of fertiliser recommendation
1986	3280	1750
1987	7742	3985
1988	8372	4216
1989	13885	7145
1990	10422	5462

AVAILABLE K STATUS

Out of eleven districts, where the study was conducted, only the soil in Trichur district has medium levels of available K. All other districts show low K status. High rainfall together with kaolinitie type of clay mineral and the presence of lattice and organic bound K which are not available to plants may be attributed to the low K status in rubber growing soils. The necessity of applying potassic fertilisers to rubber plants is evident from the low potassium status observed.

AVAILABLE MG STATUS

For Mg the index values are high for Kasargod,Kannur, Kozhikode, Malappuram, Palakkad and Trichur districts. In Eranakulam, Idukki, Kottayam, Kollam and Trivandrum available Mg status is in the medium range. Since the soils of northern districts are having high levels of available Mg, it is evident that Mg requirement of rubber plants in these districts will be met from soil itself.

FERTILITY STATUS FOR KOTTAYAM DISTRICT

For Kottayam district index values were worked out for all the Taluks (Kottayam, Vaikom, Meenachil, Kanjirappally and Changanacherry) with a view to explore the possibility of taluk-wise fertiliser recommendation. In Kottayam, Meenachil and

TABLE 2

Fertility rating for classifying soil into low, medium and high

Element	Medium values
Organic Carbon (%)	0.75 - 1.5
Available P & Mg mgm/100 gm soil	1.00 - 2.5
Available K mg/100gm soil	5.00 - 12.5

(Hand book on Natural Rubber Cultivation 1980)

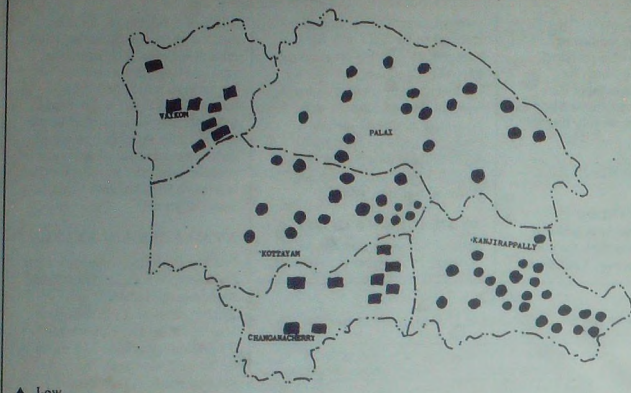


Fig. 1 OrganicCarbon

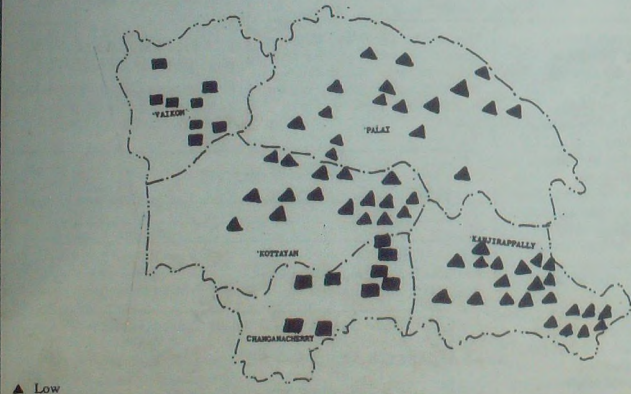


Fig. 2 Available P

Fig. 3 Available K

Fig. 2 Available Mg.

TABLE 3
Nutrient Index of rubber growing districts of Kerala

District	No. of samples	%OC	Av.P.	Av.K	Av.Mg
Kasaragod	497	2.71 (H)	1.14 (L)	1.53 (L)	2.88 (H)
Kannoor	2973	2.61 (H)	1.17 (L)	1.29 (L)	2.76 (H)
Kozhikode	1404	2.60 (H)	1.15 (L)	1.43 (L)	2.51 (H)
Malappuram	994	2.30 (M)	1.10 (L)	1.27 (L)	2.73 (H)
Palakkad	1037	2.15 (M)	1.13 (L)	1.48 (L)	2.71 (H)
Trissur	1054	2.11 (M)	1.26 (L)	1.84 (M)	2.88 (H)
Eranakulam	1848	1.91 (M)	1.36 (L)	1.36 (L)	2.27 (M)
Idukki	550	2.36 (H)	1.18 (L)	1.29 (L)	1.76 (M)
Kottayam	3432	2.38 (H)	1.55 (L)	1.43 (L)	2.05 (M)
Kollam	4111	1.98 (M)	1.37 (L)	1.43 (L)	2.15 (M)
Thiruvananthapuram	1550	2.09 (M)	1.23 (L)	1.36 (L)	1.96 (M)

TABLE 4
Talukwise nutrient index values of Kottayam District

Taluk	% Organic Carbon	Av.P	Av.K	Av.Mg
Kottayam	2.38 (H)	1.55 (L)	1.43 (L)	2.05 (M)
Vaikom	2.03 (M)	1.69 (M)	1.34 (L)	2.31 (M)
Meenachil	2.40 (H)	1.47 (L)	1.50 (L)	2.08 (M)
Kanjirappally	2.47 (H)	1.46 (L)	1.43(L)	1.97 (M)
Changanacherry	2.27 (M)	1.89 (M)	1.34 (L)	1.97 (M)

Kanjirappally taluks organic carbon status is found to be high while it is medium in Vaikom and Changanacherry. Available P status is found to be low in Kottayam, Meenachil and Kanjirappally and medium in Vaikom and Changanacherry taluks. Available K status is medium in all the five taluks. For available Mg, medium levels are obtained in all the taluks.

SUMMARY

Available nitrogen and magnesium status of soils of rubber small holdings of Kerala is found to be maintained at medium levels. In available K status, only low levels are observed and hence application of phosphate and potassic fertilisers is required. The information on fertility status of rubber growing areas will be useful guide for reference.

REFERENCE

B. Ramamoorthy and J.C. Bajaj (1969)

Fertiliser News Vol. 14, No. 8 Page 25 - 36.