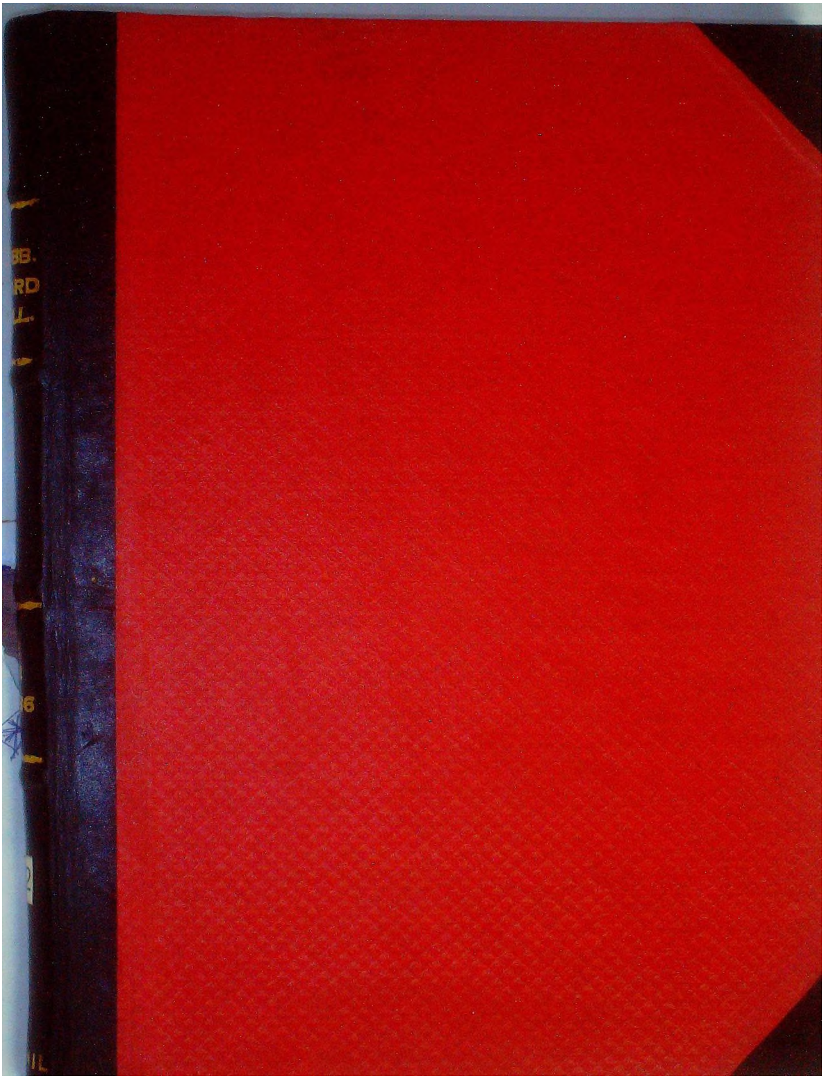

Rebinding

RUBBER BOARD Bulletin

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THE RUBBER BOARD
KOTTAYAM 686 001 INDIA

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THE QUARTER

The clone RRII 105 has been proved to be a top yielder of natural rubber. More than 90% of the planting done in the eighties is with this material obviously due to its high yield. But the large scale adoption and exploitation of this variety have revealed that this clone is susceptible to Brown bast even when tapped under the 'alternate daily system'. Rubber small growers, who have been mainly instrumental in popularising this variety much faster than the Rubber Board wanted it, are complaining in one voice of the 'Brown bast-proneness' of this clone despite its high output, and other desirable secondary characters.

Brown bast is a physiological disorder which is caused largely due to excessive exploitation. As even under the s/2 d/2 system RRII 105 is affected by this disorder, the Rubber Board has decided to advise the rubber growers to put their trees to the s/2 d/3 system, so that the interval between 2 tappings is increased to 72 hours from 48 hours. Studies have shown that reduction in frequency of tapping does not adversely affect the yield, but improves the resistance of the trees to Brown bast. Therefore holdings planted with RRII 105 and tapped under s/2 d/2 will do well if they switch over to s/2 d/3.

RUBBER PLANTING MATERIALS APPROVED FOR 1987

The Rubber Board has approved the materials listed below for planting during 1987. As in the previous years, the materials are brought under three categories based on the recommendations given for their use.

Materials under Category I are recommended for planting on wide scale. When large scale plantings are undertaken, it is advisable to adopt use of as many of the materials under this category as is practicable. It is also desirable for large estates to reserve upto 20% of the total area for planting older clones of proven local performance, newer promising material and experimental clones.

Category II consists of old clones which still enjoy localised popularity owing to their sustained good performance in the areas concerned and new promising clones. Limitation in planting of these clones to within 20% of the total area in large estates is advised in view of the desirability of progressively replacing older clones with modern high yielding clones of established performance and of minimising the risks involved in the use of clones which are not fully tested.

Clones recommended for experimental planting are brought under Category III. These clones are released on the strength of encouraging results obtained over limited periods, in the small scale trials conducted by the Rubber Research Institute of India or in view of the fact that they have been imported into India on account of their good performance in other countries. Growers should exercise care to limit planting of clones of this category to small experimental or observational plots, not exceeding 10% of the total area.

Polyclonal seedling trees are found to be highly susceptible to Brown bast and hence they are to be tapped on half spiral, once in three days (S/2, D/3-67%) system. Small growers who are not in a position to adopt this low intensity tapping system are advised to avoid the use of polyclonal seedling material.

Category I

Buddings of clones RRII 105, RRIM 600 and GT 1.

Category II

a) Buddings of clones PR 107, Tjir 1, GI 1, PB 86, PB 5/51 PB 5/139, PB 6/9, PB 28/59, RRIM605, RRIM 623, RRIM 628, RRIM 701, RRIM 703 and RRII 118.

b) Polyclonal seeds derived from the seed gardens of Arasu Rubber Corporation Ltd in Kanyakumari District of Tamil Nadu and other polyclonal seed collection areas approved by the Board.

Category III

a) Buddings of clones RRII 116, 203, 206 and 208 RRIM 704, 705, 706, 707, PB 206, 213, 215, 217, 230, 235, 240, 242, 252, 253, 255, 260, 280, 5/76, 28/83, 310, 311, 312, 314, 330, RRIC 7, 36, 45, 52, 100, 102, 104 and 105, CH 153, Harbel 1, Nab 17, Wagga 6278, RRII 1, 2, 3, 4, 5, 6, 43, 44, 300, 308, KRS 25, KRS 128, KRS 163, SCATC 88-13, SCATC 93-114, Haiken 1.

b) Other promising clones and clonal seeds specially approved by the Chairman, Rubber Board, on merits, under request in individual cases.

Note: Modern clones like RRII 300 and 308 are also n yet released for comm planting.

The Rubber Research Insti of India has a programme o luating experimental clone released for commercial pl in estates. The clones will coded and their identity w be released. The choice o estate will be made by the For details, the Director o may be contacted.

Short Notes on some of Clones

1. RRII 105

A clone evolved by the Ru Research Institute of India currently enjoying maxim popularity in India. Parents Tjir I and GI I. Stem tall a straight. Branching good, g union. Canopy dense, mo restricted to the top. Foli dark green; leaves glossy. before and after tapping av Virgin bark and renewed b thickness above average.

Very high initial and subs yield. Steady yield trend. estimated yield from the sm scale trial during 15 years tapping is 2880 kg /ha/yr. mated yield in large scale ten years of tapping is 24 ha/yr. Encouraging yield is reported from commer plantings, showing an av yield of 1570 kg/ha/yr ov first three years of tapping

This clone has fair degre tolerance to Abnormal lea disease under normal prop measures. Highly suscept to Pink. Fairly tolerant to depression during drou Free from any serious wi age if branch developme

RUBBER PLANTING MATERIALS APPROVED FOR 1987

kept balanced. s/2, d/3 system of tapping is preferable as susceptibility to Brown bast is reported in certain cases.

2. RRIM 600

A high yielding clone evolved by the Rubber Research Institute of Malaysia. Parents are Tjir I and PB 86. Tall straight stem, moderate to fairly heavy branches and branch unions weak. Young plants show spindly growth and late branching with occasional leaning. Narrow broom shaped crown, foliage sparse, small yellowish green leaves. Virgin bark thickness below average, renewed bark above average; bulges above tapping cut. Vigour at opening below average, after tapping above average.

The clone shows rising yield trend. Initial yield good, subsequent yield very high, high summer yield. Commercial yield over 14 years in Malaysia is 1819 kg/ha/yr. Commercial yield in India over 10 years is 1317 kg/ha/yr. Latex unsuitable for concentration. Highly susceptible to Phytophthora and Pink diseases and hence requires efficient protective measures when planted in areas where these diseases are prevalent. Tolerant to Powdery mildew.

3. GT 1

An outstanding clone developed in Indonesia. Upright and slightly kinked stem. Variable branching habit. Main branches long and acute angled, secondary branches light. Narrow globular crown, dense dark green glossy foliage. Virgin bark thickness average, renewed bark below average, vigour at opening above average to average, girth increment on tapping average.

This clone shows rising yield trend. Summer yield fairly high. Commercial yield in Malaysia during 15 years is 1615 kg/ha/yr. In India it is 1359 kg/ha/yr during 10 years of tapping.

Good tolerance to Pink disease and Brown bast, average to above average tolerance to Oidium and wind damage, avarage tolerance to Phytophthora. Withstands higher intensities of tapping. Considered to be well suited for small growers.

4. PR 107

This is a primary clone developed in Indonesia, Sturdy, wind resistant and of average vigour. Shows good girth increment on tapping. The clone though a slow starter, shows rising trend. In India average yield over ten years under commercial planting is 1044 kg/ha/yr. Yield gets slightly depressed during wintering. Withstands higher intensities of tapping. Susceptible to Phytophthora. Tolerant to Powdery mildew.

5. TJIR 1

An Indonesian primary clone of good vigour, heavy crown liable to wind damage. Average commercial yield in India over 10 years is 930 kg/ha/yr. Highly susceptible to Phytophthora, Oidium and Pink diseases. Latex yellow.

6. GI 1

A Malaysian primary clone of below average vigour, healthy canopy with characteristic glossy bluish green leaves; wind resistant; quite high yielding in certain localities, susceptible to Brown bast and hence reduced tapping intensity is recommended. Observed to have some degree of drought tolerance. Performs better than other clones on lands with high water-table. The average commercial yield in India over 10 years is 1129 kg/ha yr.

7. PB 86

A Malaysian primary clone of slow growth, not liable to wind damage, suitable for planting in exposed areas, not tolerant to poor soils, yield high, latex white. Prolific seeder, highly susceptible to Abnormal leaf fall and Shoot rot. It performs well in Kanyakumari District where incidence of these diseases is very mild, Commercial yield in India over 10 years is 1129 kg/ha/yr.

8. PB 5/51

A promising clone evolved in Malaysia by crossing PB 56 and PB 24. Stem straight, and upright, branches, light and horizontal, regularly spread on the stem. Crown conical, light sparse foliage, small yellowish green leaves. Virgin bark thickness average, renewed bark below average. Vigour averaga before tapping and below average after opening.

Average yielding clone with average initial yield and subsequent yield· Commercial yield during 15 years of tapping is 1514kg/ha/yr in Malaysia. In India, it is 1261 kg/ha/yr during 10 years; summer yield high.

Highly resistant to wind damage, average tolerance to Phytophthora and below average tolerance to Brown bast and Pink· Highly susceptible to Powdery mildew.

9. PB 28/59

A Malaysian primary clone with average vigour and below average girth increment on tapping. Susceptible to Powdery mildew and Pink diseases, highly susceptible to Brown bast, high yield with, marked wintering depression. Commercial yield in India over 10 years is 1389 kg/ha/yr.

10. RRIM 605

Parents of this clone are PB86 and Pil B 84. Although reported to be a high yielding clone, its initial performance in the northern districts of Kerala is not encouraging. Growth average. Good performance reported in Punalur and Pathanamthitta areas. The average 10 years' commercial yield in India is 1203 kg/ha/yr.

11. RRIM 623

A secondary clone having PB 49 and Pil B 84 as parents. Vigorous with rising yield trend. Marked depression in yield during girth increment on tapping. Susceptible to Pink, Powdery mildew and wind damage. The average commercial yield over eight years in India is 1042 kg/ha/yr.

14. RRIM 703

The parents are RRIM 600 and RRIM 500. High yielding, with falling yield trend from the eighth year of tapping. Thick virgin and renewed bark shows some tolerence to Powdery mildew. Below average girthing rate on tapping. Susceptible to Brown bast and wind damage. In Malaysia, average commercial yield over 13 years is around 1725kg/ha/yr.

15. RRII 118

A vigorous clone evolved by the Rubber Research Institute of India. Parents are Mil 3/2 and tall, rather robust, Conopy well distributed and balanced. Above average vigour at opening. Virgin bark and renewed bark thickness above average.

Above average initial and subsequent yield. The mean estimated yield from the small scale trial during 14 years of tapping is 3100kg/ha/yr. Average tolerance to diseases. Estimated yield from large scale trial over four years is 1675kg/ha/yr.

17. RRII 208

A high yielding clone in the initial years of tapping. Parents are Mil 3/2 and AVROS 255. High susceptibility to Shoot rot. The average estimated yield from the small scale trial during 14 years of tapping is 3200 kg/ha/yr. Estimated yield from large scale trial over four years is 1685kg/ha/yr.

RUBBER PLANTING MATERIALS APPROVED FOR 1987

wintering. Susceptible to wind damage, Abnormal leaf fall and Pink disease. Bends at high level. May not be suitable for the northern districts of Kerala. The average commercial yield in India over 10 years is 1089 kg/ha/yr.

12. RRIM 628

Parents of this Clone are Tjir I and RRIM 527. Average vigour before tapping: poor after tapping, Average commercial yield obtained in India over nine years is 1051 kg/ha/yr. Poor summer yield, Average tolerance to Abnormal leaf fall and wind damage; highly susceptible to Brown bast.

13. RRIM 701

A fairly high yielding clone with steady yield trend. Parents are 44/553 and RRIM 501. High vigour in the early years. Average Hil 28, stem tall and stout. Prominent heavy branches, secondary branches long and slightly drooping in young stage. Several branches arise almost at the same level. Canopy dense, balanced crown. High vigour at opening. Virgin bark and renewed bark thickness average.

Above average initial yield, with rising yield, trend. The mean estimated yield from the small scale trial during four years of tapping is 1850 kg/ ha/yr. Encouraging trend is noticed in commercial plantings with an yield of 880 kg/ha/yr during first four years of tapping. Average tolerance to diseases.

16. RRII 203

A high yielding clone evolved by the Rubber Research Institute of India. Parents are PB 86 and Mil 3/2. Stem straight and

18. RRIC 36

A clone developed in Sri Lanka and reported to be high yielding, susceptible to bark diseases, unsuitable to areas with heavy rain.

19. RRIC 45

A Sri Lanka clone, reported to be high yielding. Tolerant to Abnormal leaf fall and panel diseases.

20. NAB 17

A Sri Lanka clone, reported to be vigorous with above average girthing. Moderately high yielding; low incidence of wind damage; susceptible to Brown bast.

21. WAGGA 6278

A Sri Lanka clone, fairly high yielding, sensitive to soil conditions, unsuitable for very steep areas. □

Rubber Cultivation in North Eastern Region

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The consumption of natural rubber in India has been increasing consistently during the last few years. The production in the year 1985/86 was 200,000 tonnes while the consumption was 235,000 tonnes. It is estimated that consumption of natural rubber would be to the tune of 500,000 tonnes by 2000 A. D. Expecting improvement in average productivity to 1250 kg/ha by then, a tappable area of 400,000 ha would be required to produce this quantity. Including immature areas, the total rubber area needed to bring about this output would be 500,000 ha. To meet this demand, the Rubber Board has taken up various steps to accelerate the production, both by maximising the output from the existing plantations and by introducing rubber to new areas. There is not much scope for expanding rubber cultivation in the traditional rubber growing tracts in Kerala and Tamil Nadu due to limitation of cultivable land and certain other socio-economic factors. Therefore attempts were made to explore the possibility of cultivating rubber outside the traditional belt. Experimental plantings were taken up in Karnataka, North Eastern Region, Konkan area of Maharashtra, Goa, Orissa, Andaman and Nicobar Islands, Jalpaiguri and Darjeeling districts of West Bengal etc.

The agro-climatic condition of North Eastern Region is suitable for raising rubber plantations even though the prolonged winter and summer retard the growth of the rubber plant to a little extent. The total area that can be straightaway planted with rubber in the North Eastern Region could be of the order of 100,000 hectares. Assam alone has prospects for a minimum 50,000 hectares. Tripura's share could be about 25,000 hectares and other States and Union Territories may contribute atleast 25,000 hectares. The figure could be even higher.

Geographical locations and agro-climatic conditions.

The North Eastern Region comprises of the five states of Tripura, Assam, Meghalaya, Manipur, Nagaland and two Union Territories of Arunachal Pradesh and Mizoram. Geographically the region lies between 22° and 28° in the north latitude and is far out side the normal rubber growing tracts of the World, which are confined to the tropical regions within 10° to 15° on either side of the equator. The temperature touches the lowest range in January, which coincides with the wintering in rubber trees. Hailstorms observed in this region occasionally cause injuries to foliage and bark of the trees. However, these factors are not likely to be adverse. The climatic conditions are nevertheless unique, in as much as near tropical features are obtained in most of the parts owing to low elevation, exposure to monsoons, protection of the hill ranges and other moderating influences.

Public Sector

Tripura: The climatic conditions in Tripura are better for rubber plantation than in other States and Union Territories of the North Eastern Region. The first rubber plantation was started in Tripura by the Forest Department in various localities such as Pathichari and Manu as early as 1963. Till 1976, the Forest Department raised 418.45 hectares with avilable improved seedling varieties. These plantations were eventually transferred to Tripura Forest Development and Plantation Corporation Limited (TFD& PC), established in 1976. The State Government took up large scale rubber plantation through TFD & PC. With the development of rubber plantations under TFDPC along with private rubber plantations, Tripura has by now emerged as the 4th largest rubber growing State in India, growing more than 60% of the rubber area so far developed in the North East. The Corporation has up till now planted rubber in an area of over 5000 hectares. There are at present 30 centres spread all over the State through its three divisions with 9 Centres in Bagafa, 11 Centres in Sadar and 10 Centres in Kumarghat. Implementation of the work is more or less according to schedule and the performance of the plantations is satisfactory. Owing to technical as well as managerial lapses, the plantings have suffered heavy casualities and the condition in a sizeable area is downright poor. The Centre-wise and division-wise achievements in development of rubber plantations are indicated in Table-1.

About one-third of the state population is tribal, who mostly inhabit the isolated inaccessible hilly areas. The benefits of development programme have not adequately percolated to these areas. Most of the people in these areas live below the poverty level. The tribal population practices shifting cultivation. Shifting cultivation which is locally known as "Jhuming" is a primitive form of agriculture, in the process of which the forest growth in the hills irrespective of the degree of slope is cut and burnt, to prepare the land to raise agricultural crops. In Tripura, the Jhum crop is raised only for one year and then a new forest area is selected in the next year. The process is repeated year after year. They shift from one place to other for jhuming. Shifting cultivation is a very destructive practice which causes considerable soil erosion, loss of fertility, siltation of river beds and reservoirs, sand casting on agricultural fields making them unfit for cultivation, natural havoc like flood and drought etc. With a view to rehabilitating the jhumias mainly through rubber cultivation, the State Government set up in 1983 another Corporation styled as Tripura Rehabilitation Plantation Corporation Limited. The Corporation operates a scheme to provide 1.50 hectares to each family for rubber plantation and I hectare for homestead cultivation. They plan to settle more than 1500 tribal families during the VII plan period. So far they have raised 238.5 hectares of rubber plantation. (Table. II)

Choice of Crop

Rubber has been selected as a main plantation crop to support the settlers because of the following advantageous factors.

a) The hilly and undulating areas are not suitable for conventional agriculture. Most of the project areas are lying unutilised. These were either jhumed or cleared for growing agricultural crops, but ultimately rendered unproductive. These areas are not suitable now either for jhuming or for permanent agriculture. But rubber plants will grow here well.

b) Rubber cultivation is labour intensive and can provide regular employment throughout its rotation period of 32 years, until it has stopped giving economic yields. It is estimated that every 1.6 hectares of plantation will provide regular employment to one person in Tripura.

c) Rubber Plantation is capital intensive. Major part of the expenditure for establishment of the plantation during the immaturity period of 7 years is spent as labour wages. This helps in increasing the purchasing power of the people, by circulation of money and improves the rural economy.

d) Rubber is a crop of good economic return. Of all the plantation and horticultural crops grown in the State rubber probably gives the highest net income regularly every year after it comes to production.

e) The tribal people are already accustomed to raising large scale rubber plantation in this State. Rubber can be grown easily by the jhumias under proper technical supervision and guidance.

Regional Office and Regional Research Centre

For the purpose of giving local publicity and technical assistance, the Board opened a Sub Office in Tripura in1967. The Officers have been ever since giving technical assistance to the State Governments, the Tripura Forest Development and the Plantation Corporation Ltd and also to private entrepreneurs, in all aspects of rubber cultivation and production. The office was upgraded into a Regional Office in 1980 for stepping up the activities and providing financial assistance for the expansion of cultivation. Apart from this, two Offices of Junior Field Officers were opened in 1983 at Udaipur and Kumarghat. A field office was opened at Aizwal, Mizoram in 1975 which had, however, to be closed down within a couple of years in view of the limited scope of work. A second Regional Office in the N. E. Region was established in 1980 at Gauhati in Assam. The technical officers of the Gauhati Office also give extension support and financial aids to the Assam Plantation Crops Development Corporation Ltd., Soil Conservation Departments of neighbouring States/Union Territories and a few private entrepreneurs who have taken rubber plantings recently.

In order to take care of the immediate research needs, the Rubber Research Institute of India established a Regional Research Centre at Taranagar in Tripura in the year 1979, to evolve suitable clones and for developing agro-management practices under the specific agro-ecological conditions of North Eastern Region. The various experiments are listed below:-

1. 15 clones of *Hevea* are being compared for their relative performance under the agro-ecological conditions.
2. To evolve optimum dose of fertilizers for rubber.
3. To compare suitability of different planting practices such as polybag and conventional budded stumps of various ages.
4. To compare the growth rate and yield potential of 12 clones under Tripura conditions against their performance in traditional rubber growing tracts.
5. To compare the suitability of various types of cover crops
6. To study the economics of growing various inter-crops in rubber plantations.

7. To arrive at the optimum density of rubber plants per unit area.
8. To improve the genetic stock of rubber by mutation breeding.
9. To find out the growth, yield etc of the polyclonal seedlings.
10. To find out the effect of stock plant on the growth of scion.
11. To find out the influence of environmental factors, physiological, parameters in *Hevea brasiliensis.*
12. For multidisciplinary evaluation of clones.

The Centre will also cater to the demand of this region in technical advice, improved planting materials training of personnel etc. The State Government allotted 66.40 hectares of land for the establishment of this Centre. Since most of the areas already allotted have been brought under rubber, action has been taken to procure additional 50 hectares of land for laying further trials. Bud mother plants of 22 improved high yielding clones exist in the budwood nursery at present. The centre also maintains a nursery for making available nucleus materials of modern high yielding rubber cultivars to the growers in the region. A soil and leaf testing laboratory was established in 1982 in Agartala for the benefit of rubber growers in this region. This laboratory helps the growers to adopt discriminatory fertilizer uses based on soil and leaf analysis, which is the most efficient and economic method of manuring rubber plants.

Assam

The introduction of rubber in the State by some individual growers and tea gardens dates back to the beginning of the 19th century. These plantations were subsequently abandoned as the species tried did not include *Hevea brasiliensis* and were found to be uneconomic.

Cultivation of rubber was also taken up by the Forest Department in association with other forest species as evidenced by the existence of a few rubber trees in Bilaipur areas of Cachar. This appeared to be at the local initiative rather than by virtue of any plantation policy. Systematic cultivation of rubber however dates back to the mid-fifties. This was adopted by the Forest Department as a solution to the ill effects of shifting cultivation extensively practised in the hill districts of Assam. On the basis of their performance, cultivation of rubber was continued and extended to different centres of both Karbi Anglong and N. C.Hills districts, with seeds brought from South Indian States. Departmental efforts were progressively increasing as the number of trial-cum-demonstration plots were continued. The tempo has been substantially cut down following the formation of the Assam Plantation Crops Development Corporation Limited which has been assigned the expansion programme in the hills on a large scale.

The Soil Conservation Department whose activities were initially confined to the Hills Districts alone, were finally extended to the plain districts since the year 1960. Accordingly, trial planting of rubber was started in the districts of Goalpara, Kamrup, Darrang, Lakhimpur, Dibrugarh and Cachar on a limited scale, An area of 336.27 hectares has been planted upto 1985 with clonal and unselected seedlings.

Production of rubber

Plantations raised in the earlier years in Tripura, Assam and Meghalaya are now under tapping. Better maintained and carefully tapped areas are yielding 800 kg of dry rubber per hectare a year in the plantations of Tripura Forest Development and Plantation Corporation. The production of rubber from the tapping blocks has increased from an average of 22.95 kg per block per month during 1982-83 to 32 kg per block per month during 1983-84. The year-wise production of dry sheet and scrap rubber in this Corporation from 1976 to 1985 is persented in Table IV. There are four small growers in Tripura whose areas have come into tapping. One small holder obtained 600 kg of dry rubber in the first year of tapping, 800 kg in the second year and 900 kg in the third year of tapping from one hectare of plantation. The planting material used was old clonal seedlings. This indicates that plantations raised with modern high yielding budded stumps may easily give an annual yield of 1000-1500 kg per hectare.

The Soil Conservation Department in Assam is producing a few tonnes of rubber from their trial plantations every year, though the trees are fully tapped.

Planting materials

All the States and Union Territories in the North Eastern Region are now poised for large scale expansion of rubber cultivation. To meet the demand of high yielding planting materials of the region, the North Eastern Council had financed establishment of two 10–hectare nurseries in 1979, one in Tripura and the other in Assam, and a 10-hectare nursery each in Tripura, Assam, Meghalaya, Manipur, Mizoram and Nagaland during 1981. These NEC-aided nurseries in Assam and Tripura, together with the nureries established by the public sector Plantation Corporations, have been able to produce enough high yielding budgrafts in the two states. The Tripura Forest Development and Plantation Corporation has also raised two NEC-aided nurseries during 1982–83. The public sector nurseries in Tripura are now in a position to produce 15 lakhs budded plants annually.

New Scheme Approved

In order to ensure comprehensive and organised rubber development, the Rubber Board has proposed a 16 year accelerated programme exclusively for the North Eastern Region in three phases. The first and second phases are of 3 year duration each. The first phase commenced in 1984. By 1989-90 the second a sizeable area is downright poor. The Centre-wise and division-wise achievements in development of rubber plantations are indicated in Table-1.

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Assam

The introduction of rubber in the State by some individual growers and tea gardens dates back to the beginning of the 19th century. These plantations were subsequently abandoned as the species tried did not include *Hevea brasiliensis* and were found to be uneconomic.

Cultivation of rubber was also taken up by the Forest Department in association with other forest species as evidenced by the existence of a few rubber trees in Bilaipur areas of Cachar. This appeared to be at the local initiative rather than by virtue of any plantation policy. Systematic cultivation of rubber however dates back to the mid-fifties. This was adopted by the Forest Department as a solution to the ill effects of shifting cultivation extensively practised in the hill districts of Assam. On the basis of their performance, cultivation of rubber was continued and extended to different centres of both Karbi Anglong and N. C.Hills districts, with seeds brought from South Indian States. Departmental efforts were progressively increasing as the number of trial-cum-demonstration plots were continued. The tempo has been substantially cut down following the formation of the Assam Plantation Crops Development Corporation Limited which has been assigned the expansion programme in the hills on a large scale.

The Soil Conservation Department whose activities were initially confined to the Hills Districts alone, were finally extended to the plain districts since the year 1960. Accordingly, trial planting of rubber was started in the districts of Goalpara, Kamrup, Darrang, Lakhimpur, Dibrugarh and Cachar on a limited scale, An area of 336.27 hectares has been planted upto 1985 with clonal and unselected seedlings.

Production of rubber

Plantations raised in the earlier years in Tripura, Assam and Meghalaya are now under tapping. Better maintained and carefully tapped areas are yielding 800 kg of dry rubber per hectare a year in the plantations of Tripura Forest Development and Plantation Corporation. The production of rubber from the tapping blocks has increased from an average of 22.95 kg per block per month during 1982-83 to 32 kg per block per month during 1983-84. The year-wise production of dry sheet and scrap rubber in this Corporation from 1976 to 1985 is persented in Table IV. There are four small growers in Tripura whose areas have come into tapping. One small holder obtained 600 kg of dry rubber in the first year of tapping, 800 kg in the second year and 900 kg in the third year of tapping from one hectare of plantation. The planting material used was old clonal seedlings. This indicates that plantations raised with modern high yielding budded stumps may easily give an annual yield of 1000-1500 kg per hectare.

The Soil Conservation Department in Assam is producing a few tonnes of rubber from their trial plantations every year, though the trees are fully tapped.

Planting materials

All the States and Union Territories in the North Eastern Region are now poised for large scale expansion of rubber cultivation. To meet the demand of high yielding planting materials of the region, the North Eastern Council had financed establishment of two 10–hectare nurseries in 1979, one in Tripura and the other in Assam, and a 10-hectare nursery each in Tripura, Assam, Meghalaya, Manipur, Mizoram and Nagaland during 1981. These NEC-aided nurseries in Assam and Tripura, together with the nureries established by the public sector Plantation Corporations, have been able to produce enough high yielding budgrafts in the two states. The Tripura Forest Development and Plantation Corporation has also raised two NEC-aided nurseries during 1982–83. The public sector nurseries in Tripura are now in a position to produce 15 lakhs budded plants annually.

New Scheme Approved

In order to ensure comprehensive and organised rubber development, the Rubber Board has proposed a 16 year accelerated programme exclusively for the North Eastern Region in three phases. The first and second phases are of 3 year duration each. The first phase commenced in 1984. By 1989-90 the second phase will also be over. The third phase is for a period of 10 years from 1990 to 2000 A. D. During the first two phases the target is to complete fresh plantings in 24,000 hectares. The 3rd phase will put up 70,000 hectares of new plantation in 10 years.

The first and second phases have been approved by the Government of India at an outlay of over Rs. 6 crores. To facilitate speedy implementation of the programme the following infrastructural facilities have been planned.

a) Strengthening the existing Regional Research Centre at Tripura and establishing new centres at Meghalaya, Asam, and Mizoram.

b) Establishing a Nucleus Rubber Estate-Cum-Training Centre at Tripura in 1,000 hectares which will be developed as a demonstration farm and training ground for the personnel of North Eastern Region.

c) Establishing a full-fledged and self contained Zonal Office of the Rubber Board at Gauhati with adequate power for sanctions of plantation subsidy and provision of technical and extension assistance to the whole North Eastern Region.

d) Opening a new Regional Office at Silchar, in addition to the ones existing in Tripura and Gauhati, besides starting several field extension Centres.

The respective Governments have allotted land for establishing research stations at Sonapur in Assam, Ganolgre and Darachigre in Meghalaya and Kolasib in Mizoram. Multidisciplinary evaluation of clones was started in these stations as in the existing centre at Tripura. The programmes initiated in 1986 include experiments on rubber based cropping systems, carpet area of intercrops and block planting of modern clones.

Suggestions for improvement of the Existing plantations

1) The benefits and economics of rubber cultivation and the assistance provided by the Rubber Board and credit facilities available from commercial banks should get widely propagated among the land owners. Widespread awareness campaigns have to be mounted throughout the length and breadth of the NE Region.

2) Considering the fact that most of the plantations are opened in virgin lands and the climatic conditions favour very dense weed growth mainly *Impreata Cylindrica* at least six rounds of weeding are required during the second year and five rounds in the third year of planting.

3) The efforts put in for the establishment of cover crops is meagre in most of the plantations. *Pueraria Phaseoloides* should be shown during the year of planting itself.

4) Discriminatory fertilizer usage based on soil and leaf analysis may be adopted in the existing plantations especially from the fifth year of planting onwards.

5) Tapping in most of the plantations in the North Eastern Region is done by unskilled labourers, who either under-exploit the trees or wound them seriously. It is necessary to make arrangements for training sufficient number of tappers on scientific methods of tapping.

6) Most of the plantations in this region have lot of vacancies. Care should be taken for filling up the vacancies as soon as noticed.

7) In some of the plantations there is dearth of competent staff to supervise tapping, collection and processing of latex etc. This can be solved by expert advice from the Rubber Board.

8) Apart from planting materials, many other materials like fertilizer mixtures, plant protection chemicals, sprayers and dusters, polythene tapes for budding, polythene bags for poly-bag plants, budding knives, tapping knives, spouts, collection cups, chemicals, sieves, bulking tanks, coagulating pans and rubber rollers (sheeting machines) are required in rubber plantations. Many of these materials are brought from Calcutta, and some like budding and tapping knives and rubber rollers are even now being brought all the way from Kerala. Apart from the high cost and long delay in the supply, equipments like rubber rollers often get damaged during transport from Kerala to this region. It is therefore, necessary to have a Regional Service Centre located either in Assam (Gauhati or Silchar) or in Tripura (Dharmanagar or Kumarghat) to manufacture and / or supply as many of these inputs as possible to the rubber growers in this region. Construction of smoke houses has also been found to be problematic.

9) Major diseases of rubber like abnormal leaf fall or pink disease are not observed in Tripura. However shoot rot incidence was found in Meghalaya in the Umling and other plantations. In the Kohra Plantations belonging to the Soil Conservation Department of Assam, bark diseases were noticed. Since the climatic conditions in Meghalaya and Assam appear to favour the incidence on diseases of rubber, Planters may take appropriate prophylactic measures in consultation with Rubber Board.

TABLE 1

The Centre-wise achievement in development of rubber plantations by T.F.D & P.C.*

Name of Centre	Rubber Plantations during						
	upto 1980	1981	1982	1983	1984	1985	Total
1	2	3	4	5	6	7	8
Sadar Division			(in hectares)				
Pathalia	93.40	50.50	15.5	–	–	–	159.40
Guliray	4.70	-	–	–	–	–	4.70
Warrangbari	183.00	1.86	–	–	–	–	184.86
Rupachera	267.48	–	-	–	–	–	267.48
Kalamchora	56.25	100.00	100.00	56.00	54.00	60.00	426.25
Karangichera	30.00	75.00	41.00	27.50	30.00	30.00	233.50
Padmanagar	-	-	71.00	25.00	–	–	96.50
Matinagar	-	–	–	20.00	56.00	70.00	145.00
Dhanpur	–	–	–	20.00	45.00	–	65.00
Kalkalia	–	-	30.50	20.00	–	–	50.50
Bankumari	30.00	6.00	19.00	20.00	–	–	75.00
Total	664.83	233.36	277.00	189.00	185.00	160.00	1,709.19
SOUTH DIVISION							
Pathichery	80.25	–	–	–	–	–	80.25
Kalshimukh	133.48	55.50	3.00	–	–	–	191.89
West Ludhua	189.80	47.00	38.00	–	–	20.00	294.80
Sachirambari	279.90	25.00	18.50	19.50	–	–	342.90
Takmachera	268.00	46.00	62.00	26.00	–	–	402.00
Abengchera	201.50	71.50	48.00	48.00	120.00	26.60	515.60
Paikhola	–	–	50.00	53.00	46.50	68.00	217.50
Gourifa	–	–	–	50.00	100.00	90.00	240.00
Ekinpur	–	–	–	–	–	15.00	15.03
TOTAL	*1152.95	245.00	219.50	196.50	266.50	219.60	2300.00
NORTH DIVISION							
Manu	2.80	-	–	–	–	–	2.80
Ratachera	241.50	22.00	1.50	–	-	-	265.00
Juri	371.00	40.00	9.40	-	-	–	420.40
N. C. Para	252.50	20.00	–	–	–	–	272.50
Panitilla	–	62.00	68.00	80.00	60.00	26.00	296.00
Nalkata	–	46.00	18.50	–	–	–	64.50
Saitenbari	–	67.00	61.00	–	–	–	128.00
Kanchanbari	–	–	38.00	60.00	64.00	100.00	262.00
Saiderpar	–	–	30.50	–	60.00	60.00	150.50
Rewa	–	–	–	–	–	35.00	35.00
TOTAL	867.80	257.00	226.90	140.00	184.00	221.00	1896.70

Source : Office of the Managing Director, TFD & PC

TABLE II

The District-wise achievement in raising rubber plantations by TRPC *

Name of Centre	Rubber Plantation during 1984	1985	Total plantation upto 1985
	(in hectares)		
SADAR DIST			
Promodnagar	75.00	30.00	105.00
SOUTH DIST.			
Karbook	–	45.00	45.00
NORTH DIST.			
Abhanga	–	34.50	34.50
Dulubari	–	54.00	54.00
TOTAL	75.00	165.00	238.50

* Source : Office of the Managing Director, TRPC.

TABLE III

Area under Rubber upto 1985 in Assam, Meghalaya, Mizoram, Manipur, Arunachal Pradesh and Nagaland. (in hectares)*

	Public Sector	Private Sector
Assam	1167.52	799.62
Meghalaya	1251.43	6.78
Mizoram	406.80	–
Arunachal Pradesh	30.75	–
Manipur	335.00	4.85
Nagaland	316.00	17.91

*From Zonal Office, Rubber Board, Guwahati and Regional Office, Agartala.

TABLE IV

Year-wise production of dry sheet rubber and scrap rubber (in kg.) under the TFD & PC*

Year	Sheet rubber	Scrap rubber	Total
1	2	3	4
1976-77	19,361.00	843.00	20,204.00
1977 78	26,775.00	1,408.00	28,183.00
1978-79	32,339.80	2,545.50	34,885.20
1979-80	36,087.82	3,044.87	39,132.69
1980-81	48,886.37	3,246.26	52,132.64
1981-82	73,515.52	10,964.18	84,479.71
1982-83	92,832.21	11,167.79	1,04,000.00
1983-84	1,16,383.50	16,163.82	1,32,547.32
1984-85	1,31,839.69	15,634.10	1,47,473.79

*Source : Office of the Managing Director, TFD & PC.

THE PLIGHT OF RUBBER BAND UNITS IN KERALA: AN OVERVIEW

Dr. K. THARIAN GEORGE

Introduction

In common parlance, the slow pace of industrialisation in Kerala and its divergence from the national pattern is generally attributed to weak inter-industry linkage of a lop-sided industrial structure. Alternatively, the "regional differentiation" process may be explained in terms of region-specific factors such as labour supply schedule, nature of entrepreneurship and availability of raw material etc. Although the State is enriched with the basic infrastructural facilities and skilled man power essential for a sustained industrial growth, its performance *is not impressive compared to many other States* and even in the case of raw materials like rubber on which the State has an absolute advantage, the picture is not encouraging. Though Kerala accounts for around 80 per cent of the total natural rubber (NR) production in the country, its proportionate share in NR *consumption is less than 15 per cent which shows the existence of a weak rubber based manufacturing sector in the State.* It is true that during the last one decade the proportionate share of rubber products has gone up in terms of the total value added in the 'Factory Sector' in Kerala. But the fragile base of the rubber manufacturing sector in the State becomes evident when compared to its share in national production.[1]

It is significant to note that according to the ASI data, it is only the 'Other Rubber Products' that has made a steady increase in its proportionate national share. This observation conforms to the existing structure of the rubber manufacturing sector in the State which is characterised by the dominance of latex based small scale rubber goods manufacturers in terms of their share in total number of rubber manufacturing units and the concentration in rubber consumption by a handful of tyre units and public sector undertakings[2]. Kerala tops also in the matter of the total number of rubber manufacturing units compared to other states. The mushroom growth of the small scale units in the State is mainly propelled by the relatively easy availability of the raw material though the type of products manufactured and the individual markets are wide and varied. Among these small scale units, *the rubber band manufacturing units occupy an important position in the state in terms of their total number, quantity of production and the labour employed.* Unfortunately many of these units are embedded with a multitude of problems arising mainly from the existing pattern of marketing arrangements and it is reported that *many of them are in the red.* This paper is an attempt to briefly analyse the major problems facing these units and to suggest a suitable framework for discussion and future course of action to overcome the major shortcomings in the existing arrangements.

1. Nature of the problem

An important characteristic of the rubber band units in Kerala is their multi product nature and the estimated average annual consumption ranges between 5–10 tonnes of rubber. Many of these units manufacture finger *tips, household gloves, and adhesives along with rubber* band. This multi product manufacturing system is facilitated by the relative flexibility in changing technical factors to fluctuating fortunes of the individual products. In other words, theoretically these small scale units have the advantage of adapting themselves to the changing market conditions of a concerned product. In practice, for many of the units, the advantages arising from the multi product manufacturing have been eroded by the existing marketing arrangements. In this connection, the case of rubber band units is illustrative.

1 The Price Factor

Among the estimated 180 licensed rubber band units in the State there is a wide disparity in the licenced capacity which reflects the existing inequalities in the

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[1] For instance see the Annual Survey of Industries (ASI), Government of India. During 1978–79 the folowing are the resective shares of various rubber products in Kerala as a proportion of total national production. Tyres and Tubes =3.92%, Rubber Footwear =2.17% other Rubber Products=22.63%.

[2] As on 1982-83 there are around 450 registered rubber manufacturing units in the state and the majority among them are the latex based small scale units. For the year 1985–86 the total number of licensed rubber goods units in the state is estimated to be more than 600. A cursory look into the pattern of rubber consumption in the state will reveal the fact that around 80 percent of the total consumption is accounted by three tyre units and two public sector undertakings.

production base. A corollary of the existing pattern of the production base is the difference in actual price realisation and the capacity to withstand unforseen circumstances among different units as reported during a pilot survey recently conducted by the Technical Consultancy Division of the Rubber Board. At present, the estimated average cost of production per kg of rubber band ranges between Rs. 25 to Rs. 26 and the average sale price revolves between Rs.28 to Rs. 30. It is interesting to note that during the last five years the sale price of the rubber bands was stagnating whereas the cost of production has gone up considerably due to rise in prices of raw materials such as preserved field latex (PFL), Chemicals, Acid and colour. Apparently the inability of the rubber band units to pass on the cost increase to the buyers suggests that there exists either a buyers' market or the prevalance of price cuts (cut-throat competition) among the producing units. In any case, a plausible conclusion in this regard requires an analysis of the structure of the rubber band market.

2 Structure of the Rubber Band Market

An important characteristic of the rubber band market is that the product is mainly sold outside the state either through selling agents/middlemen or directly. The units that have established own marketing outlets are only a few and as a result, majority of the units are dependent on the intermediaries. The extent of control exerted by the intermediaries is evident from the fact that many of the smaller units have to resort to price cuts to sell the product and consequently the sale price in monetary terms is stagnating. Paradoxically, the retail sale price at Bombay and other major consuming centres ranges between Rs.38 to Rs.40 per kg. This shows that on an average the disparity between producers price and the consumers' price is around Rs 10 per kg of rubber band which is pocketed by the middlemen.

An equally important problem facing the relatively smaller units is price discrimination by the intermediaries on the plea that there exists qualitative differences between the products of different size-groups. Interestingly, at present only visual grading is practiced and there exists no standard technical method to assess the quality. It is reported that many small units are forced to sell the product at a loss and in some cases the entire produce is sold to the larger units.

Finally, it is pointed out that on an average the duration of sales realisation is between 30-40 days and here again the intermediaries are the beneficiaries. For a majority of the units the capacity to hold the stock during a period of declining prices appears to be weak and very often they have to offer the produce on credit to the intermediaries.

3 Taxes

There is unanimity among all the units that the existing tax structure is not in tune with the changing conditions and it is irrational. It is pointed out that at present a rubber band unit has to pay at least four taxes to Central and State Governments. An important consequence of the present tax policy is that most of the units are forced to resort to unaccounted sales mainly due to the following reasons:

a) The buyers (intermediaries) prefer to lift the product without tax and the inability of the units to shift the burden of taxes to the buyers. Consequently, for all the accounted sales the units have to bear the burden of tax.

b) In the present circumstances, the rubber band units are not in a position to pay all the taxes due to the unattractive prices and therefore tax evasion has become a common practice.

The net result of the present tax system and the practices pursued by the units for tax evasion is that both Central and State Governments are deprived of their due tax revenues.

4 Price of the PFL

One of the advantages of the rubber band units in Kerala is the relatively easy availability of the raw material and many of them purchase it in the form of preserved field latex (PFL). The ruling market price of PFL is always higher than the lot sheet price and the margin fluctuates between Rs. 1.75 to Rs. 2.25 per kg of d.r.c. It is significant to mention that the increase in the price of PFL is not sufficiently compensated by an increase in the price of rubber bands during the last five years. Further, the rubber band units are not in a position to influence the price of PFL due to the peculiarities arising from the structure of latex processing industry in Kerala.

From the foregoing analysis, it becomes evident that the main factors behind the crisis facing the rubber band units in Kerala are the stagnant/unattractive prices, existing tax structure and the steadily increasing raw material prices. However, this is not to deny that on the technical side every thing is perfectly combined. Of course, the existing technical problems have to be identified and rectified so as to improve the quality of the product as reported by many units.

II. Conclusions and Recommendations

1. One of the important conclusions emerging from the present exercise is that the whole gamut of present marketing arrangements encircling the rubber band units have serious implications on the future growth of the industry, especially; the dominant role played by the middlemen who pockets the margin arising from the differences in producers' sale price and consumers' price. Moreover, the long duration for the realisation of sale proceeds is also to the advantage of the middlemen. Therefore, one plausible line of action is to form a co-ordinating body in the form of an industrial

co-operative society of the rubber band units which may be under an apex body like the Kerala State Co-operative Rubber Marketing Federation which has a wide network of marketing outlets in the major consuming centres of the country. In this connection, it has to be noted that the necessary initiative may be taken to get adequate financial assistance from funding agencies like NCDC to enable the apex body to procure adequate quantity of the product, to assure a reasonable price to the units and to edge out the strong lobby of middlemen from the picture.

2. It is also important to undertake a study on the implications of the existing tax structure and to examine whether there are possibilities of reducing the tax burden once the units are brought under an apex body and adapting the present tax policy to the changing circumstances. Once the units are brought under the co-operative umbrella, the exchequer also benefits since it assures prompt payment of taxes.

3. Arrangements can also be made to supply sufficient quantity of PFL to the rubber band units from the co-operative processing societies. With the establishment of the new Rubber Producers' Societies, the capacity of the co-operative processing societies to supply PFL will improve and this will become complementary as well as a mutually advantageous operation.

4. From the part of the apex body, it can make arrangements to supply chemicals and other ingredients to the units at reasonable rates through the newly formed rubber band co-operative society.

In conclusion, it has to be borne in mind that, this paper is only an attempt to provide a framework for discussion and future course of action. The initiative has to come from the affected units and adequate support for organisation and providing guidelines may be given by the Rubber Board and the Federation.

A COMPREHENSIVE STUDY ON INDIAN RUBBER INDUSTRY

Studies on the rubber industry in india so far are limited. Those available so far either concentrate on the plantation and marketing aspects of natural rubber or on a very generalistic view of the plantation-cun-manufacturing aspects. The structural aspects of the rubber processing and manufacturing industries have never become the compass of economic analysis.

The social and economic contribution of an industry can be best judged mainly from two aspects: 1) the capacity to create linkage effects in the economy, which in turn, influences income and employment generation; and 2) its impact on the distribution of income in society. These aspects have further been influenced by factors such as the economic environment in which the industrial sector as a whole operates and the characteristics of enterpreneurship. In a mixed economy where the private and public sectors cooperate in the industrialisation process, constant evaluation of the structure and direction of industrial growth and the social contribution of investment (both public and private) is important for purposes of fruitful planning. An empirical analysis of the nature of relationships between various forms of production, given the variety of modes of subordination between these various forms, thus become imperative.

The pioneering study in this area directed by prof. P. M. Mathew of the Centre for Social Studies, Surat, of fers such an analytical approach. This study, sponsored by Indian Council of Social Science Research (ICSSR) is aimed at seeking alternatives in industrial policy and theory. It has fortunately taken the rubber industry as a case, with special focus on the small scale sector, while at the same time linking it with the largescale sector.

Size of investment in plant and machinery and employment have often been used both by academicians and policy makers as the basis for industrial stratification. Such criteria have often bred misgivings between the large and small sectors. while the large sector disfavour a policy of discriminatory protection provided by the government to the small sector, the latter accuse the former for entering into their 'reserved area' in the form of bogus "small-scale" units. All this demands the introduction of better yardsticks for distinguishing between the two sectors. This should, again, be based on an understanding of the impact of past policies. Prof. Mathew tries to analyse all this, and the report is as well a study on industrial policy in general as it is on the rubber industry.

The study, started in August, 1984, is as well based on extensive field studies in Gujarat and Kerala. The report, limited copies of which may be available for sale, is likely to be finalised within a couple of months. Those interested may please contact 'Moti Niwas' B-5/III, Ambadi Road, Bassein (west), Bombay (Via).

A STUDY OF RUBBER WOOD MARKET

Dr. V. HARIDASAN

Introduction

Rubber is a perennial crop which provides a variety of materials to man. The original motivator for developing rubber plantations was the latex it produced. Later on it dawned on man that rubber wood too can be a useful addition to the variety of products that the rubber tree offered. With the depletion of forests and the growth of population, the need for using rubber wood has been felt in India. From a recent study using satellites, it has been found that the forest cover in India has been considerably lower than the 20 and odd percentage reported in official statistics. Therefore there has been an urgency to meet the growing wood requirements of the country from dependable sources and rubber wood can be one of them.

Until three decades ago, rubber wood was used only as firewood in India. In the sixtees it began to be used for manufacturing packing cases. With the rapid industrialisation of the country and the exhaustion of low-priced wood sources, more and more people turned to rubber wood for a number of uses. Packing case manufacturing industry however continues to be the most important consumer of rubber wood* in India and a paper on the subject has been published recently. The present study attempts to evaluate the use of rubber wood in other sectors of wood-based industry.

* 'Rubber wood-A study of supply and demand in India', by Haridasan V. and Sreenivasan K. C., Rubber Board Bulletin, Vol. 20 No. 4 April-June 1985, pp.19-21.

Materials and Methods

The data required for the study were collected by visiting the units consuming rubber wood. In the first stage the lists of factories producing plywood, veneera, splinters etc. were collected from the Industries Department of Kerala and the Kanyakumari District Industries Centre, Nagercoil. Making use of the lists, visits were made to the factories in 1985-86. A total of 273 units could be visited for this purpose. The data were collected by the author from the owner, manager, managing partner or managing director as the case my be, by direct interview.

Most of the factories in Kerala got some quantity of wood from the Forest Departments on the recommendation of the Industries Department. The two Departments maintained records relating to the units. The information obtained from the Departments was used for testing the veracity of the data given by individual units. The data related to the period 1984–85.

Results and Discussions

Table I shows the distribution of units in Kerala and Kanyakumari District of Tamil Nadu. The total quantity of rubber wood consumed by the 273 units was 3.27 million cft (92.7 thousand cmt.) in 1984–85. Of this quantity, 98.0 percent was accounted by the units in Kerala. The study covered the factories producing plywood, veneers and splinters for safety matches and other units producing accessories for textile industry and furniture.

Table II shows the units producing plywood and the quantity of rubber wood consumed by them. It will be seen that 37 percent of the total consumption of rubber wood in the plywood sector was in Calicut district. Some plywood units in the district also produced veneers and splinters as well. The largest number of units was also in the same district. There was no plywood unit in Kanyakumari district of Tamil Nadu.

Excepting five units, the plywood produced by all was mainly used for manufacturing teachest and naturally the size of the plywood was usually around 75 x 75cm with three plys of wood (around 3 mm thickness). Some units also produced plywood for seat and back of chairs. The plywood produced by the units also found use in the manufacture of suit cases. The five units were fairly large ones and they produced wood of different sizes and qualities. They were found using some form of chemical treatment for rubberwood. The five units used rubber wood for inside ply of commercial plywood when quality wood was in short supply. Three of the five units also occasionally used rubber wood as block-board for flush doors. No plywood factory was found using the chemical impregnation method for treating rubber wood. It may be mentioned that two large units operating in Kerala, reported that they were not using rubber wood and hence they are not included in the study.

Table III shows the units producing veneers and splinters for safety matches. Traditionally veneers and splinters have been produced from soft wood. Unfortunately soft wood is in short supply and the manufactures have to fall back upon the available substitutes. Although rubber wood is not the best substitute for veneers and splinters, in the absence of any suitable wood it is being used by the industry. Quilon district has the largest share of consumption in this sector followed by Palghat district.

Table IV shows the details of the rubber wood consumption in other spheres of the industry. There were only 16 units in this sector. The Table shows that these units are located in Trichur, Kottayam and Quilon districts of Kerala. The main items they produced were bobbins and shuttles for textile mills. In Kottayam district one unit produced door and window frames and shutters and also furniture after chemical impregnation treatment of rubber wood. In the same district another unit was producing penelling material after treating rubber wood. But the unit discontinued that line of of operation recently.

The clear felling of forest trees has been almost stopped in Kerala and the Kerala Government introduced the distribution of wood to registered SSI units a few years ago. The distribution is made by the Forest Department on the recommendation of the Industries Department of the State.

Table V shows the demand for wood as assessed by the Industries Department and the quantity of wood distributed to the different units in Kerala. The Table shows that only 14% of demand was met from the supply of wood from the Forest Department. It also shows that around 67 percent of the demand was met by rubber wood purchased from the open market.

An attempt has also been made to estimate the total quantity of rubber wood consumed by the packing case manufacturing industry and plywood, veneers and splinters and other sectors of the industry discussed in this paper. It would show that a total quantity of 16.9 million cft (0.49 million cmt) of rubber wood was consumed in Kerala and Kanyakumari district of Tamil Nadu in 1984-85 as per the two studies. The two studies show that the small scale wood based industry in Kerala and Kanyakumari district is sustained and supported mainly by the rubber wood.

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TABLE I

District wise Classification of Rubber wood Consumption (1984-1985)

District	No.of Units	Quantity(CMT)	%
Alleppey	16	909	1
Kottayam	27	9598	10
Ernakulam	18	5701	6
Trichur	41	12400	13
Palghat	18	4605	5
Malappuram	5	1515	2
Calicut	69	20102	21
Cannanore	11	12772	14
Quilon	42	21581	23
Pathanamthitta	4	1416	2
Idukky	5	731	1
Total Kerala	256	91330	98
Kanyakumari Dist.	17	1342	2
G. T.	273	92672 (3.27 million cft)	100

A STUDY OF RUBBER WOOD MARKET

Dr. V. HARIDASAN

Introduction

Rubber is a perennial crop which provides a variety of materials to man. The original motivator for developing rubber plantations was the latex it produced. Later on it dawned on man that rubber wood too can be a useful addition to the variety of products that the rubber tree offered. With the depletion of forests and the growth of population, the need for using rubber wood has been felt in India. From a recent study using satellites, it has been found that the forest cover in India has been considerably lower than the 20 and odd percentage reported in official statistics. Therefore there has been an urgency to meet the growing wood requirements of the country from dependable sources and rubber wood can be one of them.

Until three decades ago, rubber wood was used only as firewood in India. In the sixtees it began to be used for manufacturing packing cases. With the rapid industrialisation of the country and the exhaustion of low-priced wood sources, more and more people turned to rubber wood for a number of uses. Packing case manufacturing industry however continues to be the most important consumer of rubber wood* in India and a paper on the subject has been published recently. The present study attempts to evaluate the use of rubber wood in other sectors of wood-based industry.

* 'Rubber wood-A study of supply and demand in India', by Haridasan V. and Sreenivasan K. C., Rubber Board Bulletin, Vol. 20 No. 4 April-June 1985, pp.19-21.

Materials and Methods

The data required for the study were collected by visiting the units consuming rubber wood. In the first stage the lists of factories producing plywood, veneera, splinters etc. were collected from the Industries Department of Kerala and the Kanyakumari District Industries Centre, Nagercoil. Making use of the lists, visits were made to the factories in 1985-86. A total of 273 units could be visited for this purpose. The data were collected by the author from the owner, manager, managing partner or managing director as the case my be, by direct interview.

Most of the factories in Kerala got some quantity of wood from the Forest Departments on the recommendation of the Industries Department. The two Departments maintained records relating to the units. The information obtained from the Departments was used for testing the veracity of the data given by individual units. The data related to the period 1984–85.

Results and Discussions

Table I shows the distribution of units in Kerala and Kanyakumari District of Tamil Nadu. The total quantity of rubber wood consumed by the 273 units was 3.27 million cft (92.7 thousand cmt.) in 1984–85. Of this quantity, 98.0 percent was accounted by the units in Kerala. The study covered the factories producing plywood, veneers and splinters for safety matches and other units producing accessories for textile industry and furniture.

Table II shows the units producing plywood and the quantity of rubber wood consumed by them. It will be seen that 37 percent of the total consumption of rubber wood in the plywood sector was in Calicut district. Some plywood units in the district also produced veneers and splinters as well. The largest number of units was also in the same district. There was no plywood unit in Kanyakumari district of Tamil Nadu.

Excepting five units, the plywood produced by all was mainly used for manufacturing teachest and naturally the size of the plywood was usually around75 x 75cm with three plys of wood (around 3 mm thickness). Some units also produced plywood for seat and back of chairs. The plywood produced by the units also found use in the manufacture of suit cases. The five units were fairly large ones and they produced wood of different sizes and qualities. They were found using some form of chemical treatment for rubberwood. The five units used rubber wood for inside ply of commercial plywood when quality wood was in short supply. Three of the five units also occasionally used rubber wood as block-board for flush doors. No plywood factory was found using the chemical impregnation method for treating rubber wood. It may be mentioned that two large units operating in Kerala, reported that they were not using rubber wood and hence they are not included in the study.

Table III shows the units producing veneers and splinters for safety matches. Traditionally veneers and splinters have been produced from soft wood. Unfortunately soft wood is in short supply and the manufactures have to fall back upon the available substitutes. Although rubber wood is not the best substitute for veneers and splinters, in the absence of any suitable wood it is being used by the industry. Quilon district has the largest share of consumption in this sector followed by Palghat district.

Table IV shows the details of the rubber wood consumption in other spheres of the industry. There were only 16 units in this sector. The Table shows that these units are located in Trichur, Kottayam and Quilon districts of Kerala. The main items they produced were bobbins and shuttles for textile mills. In Kottayam district one unit produced door and window frames and shutters and also furniture after chemical impregnation treatment of rubber wood. In the same district another unit was producing penelling material after treating rubber wood. But the unit discontinued that line of of operation recently.

The clear felling of forest trees has been almost stopped in Kerala and the Kerala Government introduced the distribution of wood to registered SSI units a few years ago. The distribution is made by the Forest Department on the recommendation of the Industries Department of the State.

Table V shows the demand for wood as assessed by the Industries Department and the quantity of wood distributed to the different units in Kerala. The Table shows that only 14% of demand was met from the supply of wood from the Forest Department. It also shows that around 67 percent of the demand was met by rubber wood purchased from the open market.

An attempt has also been made to estimate the total quantity of rubber wood consumed by the packing case manufacturing industry and plywood, veneers and splinters and other sectors of the industry discussed in this paper. It would show that a total quantity of 16.9 million cft (0.49 million cmt) of rubber wood was consumed in Kerala and Kanyakumari district of Tamil Nadu in 1984-85 as per the two studies. The two studies show that the small scale wood based industry in Kerala and Kanyakumari district is sustained and supported mainly by the rubber wood.

Acknowledgement

I am grateful to Dr. M. R. Sethuraj, Director and Shri. P. N. Radhakrishna Pillai Joint Director for their valuable suggestions. I also record my gratitude to Shri. P. Mukundan Menon RPC, and Shri. M. G. Jagadish Das Join RPC for their advice. The help rendered by Shri. K. G. Sreenivasan and shri. V. Purushothaman is acknowledged.

TABLE I

District wise Classification of Rubber wood Consumption (1984-1985)

District	No.of Units	Quantity(CMT)	%
Alleppey	16	909	1
Kottayam	27	9598	10
Ernakulam	18	5701	6
Trichur	41	12400	13
Palghat	18	4605	5
Malappuram	5	1515	2
Calicut	69	20102	21
Cannanore	11	12772	14
Quilon	42	21581	23
Pathanamthitta	4	1416	2
Idukky	5	731	1
Total Kerala	256	91330	98
Kanyakumari Dist.	17	1342	2
G. T.	273	92672 (3.27 million cft)	100

TABLE II

District wise Consumption of Rubber wood in Plywood factories (1984-1985)

District	No.of Units	Quantity (CMT)	%
Alleppey	2	179	–
Kottayam	7	5392	11
Ernakulam	9	4384	9
Trichur	16	6737	14
Palghat	1	285	–
Malappuram	2	552	1
Calicut	54	18190	37
Cannanore	6	11781	23
Quilon	12	1008	2
Pathanamthitta	2	1360	3
Total Kerala	111	49868	100
Kanyakumari Dist.	—	—	–
G. T.	111	49868 (1.76 million cft)	100

TABLE III

District wise Consumption of Rubber wood in veneers & splinters manufacturing Units (1984–85)

District	No.of Units	Quantity (CMT)	%
Alleppey	14	731	2
Kottayam	18	3798	10
Ernakulam	9	1317	3
Trichur	14	4171	11
Palghat	16	4237	11
Malappuram	3	963	2
Calicut	15	1911	5
Cannanore	5	991	2
Quilon	28	19441	49
Pathanamthitta	2	57	—
Idukky	5	831	2
Total Kerala	129	38448	97
Kanyakumari Dist.	17	1342	3
G. T.	146	39790 (1.40 million cft)	100

TABLE IV

District wise Consumption of Rubber wood in units other than Plywood, veneers & splinters (1984–85)

District	No.of Units	Quantity (CMT)	%
Alleppey	–	–	–
Kottayam	2	408	14
Ernakulam	–	–	–
Trichur	11	1491	49
Palghat	1	85	3
Malappuram	–	–	–
Calicut	–	–	–
Cannanore	–	–	–
Quilon	2	1030	34
Pathanamthitta	–	–	–
Idukky	–	–	–
Total Kerala	16	3014	100
Kanyakumari Dist.	–	–	–
G. T.	16	3014 (0.11 million cft.)	100

TABLE V

Wood Requirement, Quantity Alloted and Quantity of Rubber wood Consumed (1984–85) (256 Units – Kerala)

Quantity (CMT)

	Plywood	Splinters & Veneers	Others	Total
Demand for wood as assessed by the Industries Department	60000	53000	23000	136000
Forest Dept. (Quantity allotted)	9000 (15% of requirement)	5600 (11%)	4200 (18%)	18800 (14%)
Other sources	1132 (2%)	8952 (16%)	15786 (69%)	25870 (19%)
Rubber wood consumption according to the study	49868 (83%)	38448 (73%)	3014 (13%)	91330 (67%)

Causes and Remedies for Sickness of Small Scale Units Producing Rubber Products in Kerala

C M GEORGE

Introduction

There is general agreement that the problems of sickness in industrial units, like those of human illness, are diverse in their manifestation and hence call for different diagnosis and different treatments. Like human sickness again, there are sicknesses for industrial units, which are temporary in nature and which can leave the patient sometimes strong and sometimes dead. But there was a tendency in the past to pronounce bad management as the main source of industrial sickness and to look for magical cures in one single direction–that is good management. Time has proved that it is not fully correct and that the basic causes and roots of industrial sickness may be too complex. Therefore, it has to be concluded that the term industrial sickness, covering a vast variety of ailments, needs different remedies, stretching over different periods. In Kerala, today, there are over 550 units producing rubber products which includes only half a dozen large, few medium and the remaining small scale units. The annual consumption of NR in the State is estimated to be only 10% of the total production of this commodity in the State. Therefore, rapid rubber based industrialisation of Kerala, is the foremost need of the day. But it is disappointing to note that the industrial sickness is a very common thing among the rubber goods manufacturing units in the [illegible] the same is the main cause restricting the development of rubber based industrialisation in the State. This has necessitated to sort out the causes for the sickness and make recommendations.

Present status in Kerala

At present there are about 550 small scale rubber goods manufacturing units in Kerala. A perusal of the State wise distribution of the small scale rubber industrial units, shows that Kerala shares with Maharashtra, West Bengal, Delhi, Punjab and Haryana, a very prominent position in the matter of small scale rubber based industrialisation. However, from the rubber consumption figures available, it appears that Kerala occupies only an insignificant position in the matter of rubber based industrialisation, eventhough the total number of units in the State is pretty high. It is rather difficult to reconcile this situation, with the fact that the State produces over 90% of the total NR produced in the country and have plentiful supply of water, comparatively cheap hydroelectric power and abundant skilled and unskilled workers, which are the essential requirements for the development of rubber based industries. However, it is a common knowledge that too much incidence of ailments to the small scale rubber units already established and premature mortality in the case of newly started rubber based units are the reasons for the

The basic causes of sickness

The basic problem leading to sickness in the case of most of the small scale rubber goods manufacturing units in the State is that these units have not been able to attain the optimum rate of growth. Therefore, identification of the causes for the sub–optimal growth of the small scale units, will throw light on the common causes for ailments/sickness of the small scale rubber goods manufacturing units. The main cause for the sub-optimal growth of the small scale rubber goods manufacturing units are likely to be the following.

1) Lack of modern industrial management and marketing knowhow of the entreprenuers.
2) Marketing problems, leading to financial problems and under utilization of installed capacities.
3) Prevalence of non–conducive industrial climate and poor labour productivity.
4) Use of low cost and outdated equipments and machinery.
5) Lack of quality control facilities
6) Inability to keep abreast of modern trends in product design, machinery and technological practice.
7) Non-availability of the right type and grade of NR at steady prices, around the yea[r]

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4) Use of low cost and outdated equipments and machinery.

5) Lack of quality control facilities

6) Inability to keep abreast of modern trends in product design, machinery and technological practice.

7) Non-availability of the right type and grade of NR at steady prices, around the year and consequent high cost of production.

It is wellknown that the socio-economic and historical factors had never been favourable in Kerala for the smooth development of entreprenuership. Also, it is a fact that most of the people who started small scale rubber goods manufacturing units in the State had no exposure to industrial management and to modern concepts in marketing to begin with. In the absence of co-ordinated extension and training efforts, most of the rubber based industrialists in the State are still in the dark in respect of modern concepts in industrial management and marketing. As a result, they often fail to manage their factories efficiently and economically thereby making them sick.

Problems

Problems in marketing are the most important ones which cause sickness of small scale rubber proudcts manufacturing units. It appears that a number of factories soon after their establishment used to get sick and even die out in some cases due to difficulties in marketing. Besides the failure in adopting modern marketing methods, the periodic changes in the supply-demand balance in respect of individual rubber products, is the most important factor contributing to marketing problems leading to sickness of the concerned industrial units. Local demand for most of the products have not been rising steadily due to various reasons, to ensure full utilization of the capacities already established, thereby keeping the cost of production under control. In some cases, part of the incremental demand is deing satisfied through untimely imports which at times lead to force the small scale units to accumulate unwanted inventories sometimes even with a lower level of production. Also the demand for some of the rubber items has also been affected by imports from countries with low levels of indirect taxation. Another factor that has contributed to sickness due to marketing problems, is the seasonal decline in demand due to price hikes of the products necessitated by steep increase in the price of the raw materials.

The industrial climate in Kerala has never been conducive to avoid sickness of industrial units in the State, eventhough the political parties in Kerala have greatly contributed in creating greater awareness among the people regarding their rights and duties. The proliferation of political parties and trade unions in the state were always resulting in frequent strikes and layouts in industrial units. This, lack of industrial peace, has been found to cause sickness in the case of number of units.

Wages

The labour wages in Kerala have been rising progressively since independence mainly through the activities of trade unions. In fact, the minimum wages fixed in Kerala are comparatively higher than that prevailing in the neighbouring States. Through this trend is justifiable, the fact that labour productivity has not been improved, is an important factor contributing to high cost of production and consequently many of the small units are found loosing cost advantage to outside manufacturers, thereby facing marketing problems and getting sick.

Studies conducted in several small scale rubber goods manufacturing units have shown that they are using equipments and machinery which are outdated, considering their cheapness. No efforts are being made by such units to modernise their equipments and machinery and as a consequence they fail not only to achieve the optimum quality but also to ensure avoidance of wastage of materials and workman's time. Due to wastage leading to high cost of the products, coupled with the poor quality of the products, profitable marketing in such cases becomes difficult. In such cases sickness develop very easily.

As a general rule, the small scale rubber goods manufacturing units in the State are found not to bother much about the quality of the products they are manufacturing, probably because the urge for quality control, arising from competition was non-existant. Also in spite of the fact that the Indian Standards Institution has already formulated national standards for most of the rubber products, they have not bothered much about quality control and standardisation of the products. As such, most of the units have not established any facilities for quality control and have not developed any proper inhouse specification for ensuring the quality of their products. This lack of quality mindedness among the small scale rubber goods manufacturing units is yet another major cause for development of sickness of atleast some units.

Modern trends

The technology of rubber products manufacture is a rapidly changing one. Therefore, unless the entreprenuers keep abrest of the modern trends in product design, machinery and technological practice, it will be difficult to become competitive. Once the products produced in a unit, find it difficult to compete in the market, profitable marketing will become difficult and under such circumstances chances for development of sickness will become more. Most of the rubber product manufacturing units in the State are using Natural Rubber as the main raw meterial. Due to seasonal variation in production, there will be much variations in the supply-demand of the different types and grades of NR. Usually the supply position of some of the premium grades of dry NR and latex concentrates are found to be erratic and price fluctuations of such grades are also found to be fantastic. Such situations of nonavailability of the right type and grades of NR at steady prices round the year and the consequent high cost of production leading to poor chances for profitable marketing, are also found to cause sickness of some units.

Remedies for the sickness

Having identified some of the major causes of sickness among the small scale rubber goods manufacturing units in the state, it is imperative to suggest appropriate remedies which would cure the sickness. But in this context, it is important to mention that sometimes it will be better to allow sick units which are beyond redemption, to close instead of sinking large amounts, in reviving them. In place of such sick units, modern units can be substituted. In the case of other such units, the most important remedies that can be considered for curing the sickness in small scale rubber goods manufacturing units are the following:

1) Stimulation of growth
2) Improvement of management
3) Modernisation
4) Improvement of the industrial climate and labour productivity;
5) Improvement of marketing and adoption of the concept of Quality Marketing; and
6) Making available all the different types and grades of NR and compounding ingredients at reasonable and steady prices.

For better growth

The merger of sick units into viable ones, as well as expansion and diversification of some of the sick units, can result in the stimulation of growth and once it is possible to ensure the unhindered growth of the units concerned, the industries concerned will become healthy. Improvement of the management of the unit concerned can also act as a magical cure sometimes. In this connection, it is pertinent to remember that there was no good unit which bad management could take into liquidation and in reverse, there was no bad unit which good management could not transform into a healthy unit. In fact, there are striking cases where good management has brought about a virtual U-turn in the viability and profitability of small scale units. Therefore, the agencies responsible for development of rubber based industries in the state will have to make it a point to ensure that the right managerial talents are made available to the sick units.

Modernisation

Modernisation can be well recognized as a cure for the sickness of some units where use of outdated equipments and machinery and technology are practised. Since modernisation can result in the production of quality goods and avoidance of wastage, the competitive position of the products in the market can be enhanced. Therefore, modernisation is a move in the right direction. But at times, implementation of modernisation programmes though can result in remarkable gains in certain areas, social environments will make it often quite difficult to obtain maximum gains from such programmes. When sick units are modernised, the entreprenuers will hesitate to rationalise the labour so that the productivity per worker can be genuinely increased to pay for the increased burden of depreciation and interest charges that must be borne consequent to the installation of the latest capital equipments and facilities. If the unit being modernised fails to establish substantial expansion of its capacity required for mitigating the necessity of etrenching the excess work force, the full gains cannot be srecured through modernisation.

The importance of maintaining industrial peace in the State, for curing the sickness of some units cannot be underestimated. If the State Government can ensure industrial peace by taking appropriate policy decisions from time to time, it will be possible to avoid sickness in many cases. Also constant vigil on labour productivity is required with a view to ensuring optimum results. It will be worthwhile in this context to mention that production linked wage system may prove to be rewarding for achieving optimum labour productivity. Properly devised incentive schemes and other measures can help improve discipline in organisation. It would be necessary in this connection to reconsider some of the labour laws which at present mitigate against higher productivity. These steps would go a long way in preventing sickness of units.

Poor Marketing

The most important cause for the sickness of small scale rubber products manufacturing units in the State is the poor marketing arrangements made and available. It appears that a number of factories soon after their establishment used to get sick due to difficulties in marketing. This clearly indicates the substantial ground to be covered in the improvement of marketing for curing sickness. Slow growth in domestic demand for som products has been a critica factor in some cases and in such cases it is important to institute steps which would bring greater consumer dynamism. These can include rationalisation of the excise duty structures and more concerted efforts for controlling the cost of production. Lower duties and cost of production will help narrow the present gap between domestic and international prices and thus improve exportability. The resultant increased production and sales will compensate the Government for any loss in revenue arising from reduced duties. Marketing products with specification can also prove to be useful in developing a growing demand, thereby avoiding marketing problems and consequent sickness. The role of exports of rubber products in improving marketing and ensuring better capacity utilization can not be under-estimated. In this context, the products which have export potential need to be identified and such potentials should be exploited. This would be feasible if proper encouragements are given. Provision of assistances for quality control and marketing by concerned agencies which should include market research, testing and certification, organised marketing and export, also will be helpful in avoiding marketing problems and consequent sickness of units. Also by making available all the different types and grades of NR and the important compounding ingredients, at reasonable and steady prices, the

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Having identified some of the major causes of sickness among the small scale rubber goods manufacturing units in the state, it is imperative to suggest appropriate remedies which would cure the sickness. But in this context, it is important to mention that sometimes it will be better to allow sick units which are beyond redemption, to close instead of sinking large amounts, in reviving them. In place of such sick units, modern units can be substituted. In the case of other such units, the most important remedies that can be considered for curing the sickness in small scale rubber goods manufacturing units are the following:

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Modernisation can be well recognized as a cure for the sickness of some units where use of outdated equipments and machinery and technology are practised. Since modernisation can result in the production of quality goods and avoidance of wastage, the competitive position of the products in the market can be enhanced. Therefore, modernisation is a move in the right direction. But at times, implementation of modernisation programmes though can result in remarkable gains in certain areas, social environments will make it often quite difficult to obtain maximum gains from such programmes. When sick units are modernised, the entreprenuers will hesitate to rationalise the labour so that the productivity per worker can be genuinely increased to pay for the increased burden of depreciation and interest charges that must be borne consequent to the installation of the latest capital equipments and facilities. If the unit being modernised fails to establish substantial expansion of its capacity required for mitigating the necessity of etrenching the excess work force, the full gains cannot be srecured through modernisation.

The importance of maintaining industrial peace in the State, for curing the sickness of some units cannot be underestimated. If the State Government can ensure industrial peace by taking appropriate policy decisions from time to time, it will be possible to avoid sickness in many cases. Also constant vigil on labour productivity is required with a view to ensuring optimum results. It will be worthwhile in this context to mention that production linked wage system may prove to be rewarding for achieving optimum labour productivity. Properly devised incentive schemes and other measures can help improve discipline in organisation. It would be necessary in this connection to reconsider some of the labour laws which at present mitigate against higher productivity. These steps would go a long way in preventing sickness of units.

Poor Marketing

The most important cause for the sickness of small scale rubber products manufacturing units in the State is the poor marketing arrangements made and available. It appears that a number of factories soon after their establishment used to get sick due to difficulties in marketing. This clearly indicates the substantial ground to be covered in the improvement of marketing for curing sickness. Slow growth in domestic demand for som products has been a critica factor in some cases and in such cases it is important to institute steps which would bring greater consumer dynamism. These can include rationalisation of the excise duty structures and more concerted efforts for controlling the cost of production. Lower duties and cost of production will help narrow the present gap between domestic and international prices and thus improve exportability. The resultant increased production and sales will compensate the Government for any loss in revenue arising from reduced duties. Marketing products with specification can also prove to be useful in developing a growing demand, thereby avoiding marketing problems and consequent sickness. The role of exports of rubber products in improving marketing and ensuring better capacity utilization can not be under-estimated. In this context, the products which have export potential need to be identified and such potentials should be exploited. This would be feasible if proper encouragements are given. Provision of assistances for quality control and marketing by concerned agencies which should include market research, testing and certification, organised marketing and export, also will be helpful in avoiding marketing problems and consequent sickness of units. Also by making available all the different types and grades of NR and the important compounding ingredients, at reasonable and steady prices, the problem of getting sick by many small scale units can be remedied.

Though the above referred remedies for curing scikness in the case of rubber goods manufacturing units may prove to be useful, it is important to state that prevention is better than cure. An attempt has therefore been made to list out ten commandments which if adhered to, can prevent sickness in small scale rubber goods manufacturing units. They are the following:

1. Recognize the need for continuous improvement of the units already established and make concerted efforts to innovate in all areas.
2. Make available the raw material requirements of small scale units at reasonable and steady prices through the minimum number of reputed suppliers who can provide after sales service.
3. Ensure quality of the products produced by resorting to preventive action.
4. Encourage all personnel connected with the operation and management of the unit to identify and resolve problems.
5. Identify sources of wastage and wasteful procedures and cure at source.
6. Ensure that the organisational and management systems followed support innovation and continuous improvement.
7. Provide supervision for problem identification and problem solution.
8. Make advance marketing arrangements and ensure regular cash flow.
9. Maintain good labour relations and ensure optimum labour productivity through motivation.
10. Maintain a vigorous and innovative training programme covering all areas of product development, manufacturing and market development. Institute training on the job for all employees.

Conclusion

Sickness of a good percentage of small scale rubber based industrial units, is one of the main reasons for the poor development of rubber based industrialisation in Kerala. The main causes of sickness among the small scale rubber goods manufacturing units in the State and the remedies suggested need careful consideration by all concerned. Steps to ensure that the rubber based industrial units in the State adhere to the ten commandments given, need be taken by the concerned agencies to prevent sickness among small scale rubber based industries in the State with a view to achieving rapid NR based industrialisation.

Acknowledgement

The author wishes to express his thanks to Shri. P C Cyriac, I. A. S., Chairman, Rubber Board, for giving permission to prepare and present this paper.

ORGANIC COMPOUNDS FOR SOLAR HEAT STORAGE

Organic compounds that accumulate solar energy, which can be tapped later, have been developed at the Institute of Chemistry at a branch of the USSR Academy of Sciences. Products of petro-chemical synthesis form the basis of these substances. Under the influence of sunlight, chemical transformations take place in them resulting in a new product which can store the accumulated heat.
One of the scientists of the project said that one kilogram of the product can accumulate 300 kilo-calories, sufficient to heat a few dozen litres of water to boiling point. The substances can be carried even in a suitcase. In order to release thermal energy, it is necessary to add a special catalyst. If needed the substance-accumulator can be charged from solar rays practically any number of times. For charging, the new compounds are put into a solution poured into a transparent vessel, like one of quartz, and placed in the sun. A few hours later, the liquid can be used. The charged substance can be kept in the form of crystals.

THE WRITE-TYPER

"Personal Writer", the process developed by a French Company, allows the transformation of hand-written texts to typed ones on the screen of a personal computer without the help of a key board.

The system comprises a special tablet, holding a sheet of paper, an electronic pen for writing and handwriting-recognition software. Personal Writer, which now works on Apple Macintosh, can memorise the style of handwriting with a relatively high degree of tolerance in drawing. This has never been achieved in a satisfactory manner before in PCS. The recognition of handwritten script from a binary coding tablet necessitated writing in capital letters as the cursive letters used to be ill-assimilated by the pattern recognition softwares.

The software also contains a dictionary of 200,000 words for an automatic correction of spelling mistakes.

— Scientific and Technical News from France

SHOULD WE GROW RUBBER IN THE NORTH-EAST?

PC CYRIAC IAS CHAIRMAN RUBBER BOARD

About 96% of India's rubber is grown in the narrow belt on the south-western coast in Kerala and the Kanyakumari District of Tamilnadu. This year, the production is expected to be 2,20,000 tonnes and the consumption about 2,55,000 tonnes. What about the future?

The demand for rubber originates from the production of various rubber goods. Thousands of products are manufactured using rubber. The present pattern of use of rubber is as follows:–

Auto tyres and tubes	52%
Cycle tyres and tubes	12%
Tread rubber	5%
Foot wear	11%
Belts & hoses	6%
Latex Foam	4%
Others	10%
	100%

The consumption of rubber in the country is increasing rapidly and steadily. At the time of independence, the synthetic and natural rubber consumption together was 17,000 tonnes. By 1969–70 it went up to 1,17,000 tonnes and by 1979–80 it touched 2,08,000 tonnes. The average annual compound growth rate during the decade was 6%. During the eighties, the growth rate so far has been 6.6%. Please see the table below:-

Year	Natural Rubber consumed	Synthetic Rubber consumed
1947	17,000	Nil
1970–71	87,237	33,160
1980–81	173,630	47,057
1981–82	188,420	52,650
1982–83	195,545	55,250
1983–84	209,480	62,300
1984–85	217,510	65,400
1985–86	235 440	70,035
1986–87	255,000*	72,000*

(*Estimates)

Projections of demand for rubber have been made in the recent past by several agencies - the Sub-Group on Rubber of the Working Group on Plantation Crops of the Planning Commission, the Sub-Group on Plastics, Elastomers and Engineering Plastics, the National Council of Applied Economic Research, the Rubber Board, the various Associations of Rubber Growers and the Associations of the tyre and non-tyre manufacturing industries. After studying the latest data and after re-assessing the assumptions made by all of them, I feel that it would be realistic to project the demand in the next few years as given below:

Year	Natural Rubber	Synthetic Rubber
1986–87	255,000	72,000
1987–88	273,000	75,000
1988–89	293,000	77,000
1989–90	315,000	80,000
1994–95	420,000	100,000
1999–2000	560,000	120,000

We can look at the demand projections from another angle. The per capita consumption of rubber in India today is 0.4 kg. per year, while the same is 12kg. per capita per year in U. S. A. and Japan, and 5 to 10 kg. in other developed countries. With the steady improvements in living standards in our country, it would be very reasonable to expect this figure to reach at least 0.5 kg. per capita per year by the turn of the century. For the then expected population of 100 crores, the rubber consumption would work out to at least 500,000 tonnes, by 2000 AD. This figure would reach 600,000 tonnes, if per capita consumption of rubber becomes 0.6 kg. per year.

Production prospects

For projecting the production, the tappable rubber area in each year has to be worked out, based on the year of planting. This area has to be distributed amon the different age/yield groups as the yield of the rubber tree increases gradually from the 1st year of tapping to the 5th to 7th year of tapping, then remains more or less steady upto the 17 to 20th year of tapping and thereafter starts declining. Production is then computed by multiplying the tappable area in the different groups by the cor sponding yield per hectare. T loss of production due to repl tation and the increase in prod ction as the new planted and replanted areas reach tappab age, are also taken into acco It is assumed that replanting will be at the rate of 4000 ha. per year during the 7th Plan period and 7000 ha. per year during the 8th Plan. The anticipated rate of new-planting in the traditional rubber growing area would be only 3000 ha. per year during the 7th Plan and about 600 ha. per year during the 8th plan period. As the use of advanced planting materials like polybagged plants would be more common in the nineties, area planted until 1994, may be considered for evaluating the yield at the turn of the century. There is a possibility to increase the productivity in the traditional rubber area as a result of the popularity of the new high yielding clones like RRII 105, widespread use of fertilisers based on soil and leaf analysis, use of yield stimulants and rain guarding, reduction of immaturity period by irrigation and use of polybagged planting material, adoption of correct tapping and processing procedures and use of fungicides.

Production Projections

The production projections obtained after taking into account all these factors are given below:-

1986-87	–	220,000 tonnes
1987-88	–	240,000 ,,
1988-89	–	260,000 ,,
1989-90	–	280,000 ,,
1994-95	–	390,000 ,,
1999-2000	–	490,000 ,,

Thus a gap of about 70,000 tonnes of Natural Rubber will be there in 2000 AD, necessitating import of NR, losing foreign exchange. If we want to avoid this drain of foreign exchange, we have two alternatives:

(i) Producing an additional quality of 70,000 tonnes of Synthetic Rubber (SR)

(ii) Producing an additional quantity of 70,000 tonnes of Natural Rubber (NR) by taking up rubber cultivation in non-traditional areas.

There is no problem in manufacturing synthetic rubber but the following factors have to be borne in mind:-

(i) The high initial cost. The synthetic rubber plant is a more capital intensive unit than the rubber plantation. Investment required per unit of rubber produced is three times more in the case of SR. A sizeable portion of this investment will have to be in foreign exchange.

(ii) SR plant generates much less employment opportunities than what an equal amount invested in plantations can generate. One unskilled worker per ha. is the job potential in a rubber plantation.

(iii) SR production requires costly energy inputs, while the rubber plant produces natural rubber as a result of photosynthetic action without any energy inputs.

(iv) While the SR plant produces effluents which call for costly treatment procedures to avoid environmental pollution, the rubber tree purifies the air and the environment by releasing oxygen into the atmosphere.

(v) The rubber plantations which are generally raised along slopes with contour bunds and grown in association with a leguminous cover crop providing a ground cover, prevents soil erosion, regenerates soil and improves the micro climate of the area substantially.

(vi) Most of the areas considered fit for rubber cultivation in the North East and other new regions, are already badly denuded as a result of indiscriminate jhuming (shifting cultivation) By growing rubber in such lands they can be regenerated, the economically backward tribals and others got fixed on to the land and their entire pattern of life will undergo a big change. They will start working hard once they find the latex oozing out of the bark of the tree. Steady employment and steady income will change their outlook completely. This will usher in a big social revolution in these backward regions.

Future Plans

Thus, if we want to close the gap by producing more NR, we have to plan very much in advance as the rubber tree will start yielding the commodity only after 7 years of planting. The new area expected to be brought under rubber in the traditional rubber growing region during the 5 years of 7 th Plan may not be more than 15,000 ha. and that during the 8 th Plan may not exceed 3,000 ha. This is because of several [factors including the limited availability of suitable land in Kerala and Kanyakumari District and the recent fall in rubber prices, making them lower than the 1983, 1984 and 1985 prices, though the costs have been steadily going up. This means that we have got to turn to non-traditional regions like the North-East, Andamans, Orissa, Bastar District of Madhya Pradesh, Goa, Karnataka and Southern Maharashtra. It is in these circumstances, that the Government has asked the Rubber Board to launch a campaign for propagating rubber in the new areas. The Board's plan is to plant about 25,000 ha. to 30,000 ha. in these non-traditional areas during the 7th Plan period. The rubber from these new areas will start reaching the market around 1995 and by 2000 AD, the production from this area will reach a level of at least 30,000 tonnes per year. Since all these new plantations would be of high yielding varieties alone, an average production of about 1200 kg. per hectare can easily be achieved from there by then. Taking into account the growth of consumption beyond 2000 AD, we have to aim at a new planting rate of at least 8000 ha. every year in these non traditional regions from the beginning of the 8th Plan and stepping it upto a level of about 10,000 ha. per year from 1995.

But, will the rubber plant grow well and yield rubber in the non-traditional areas, which do not have the round the year warmth and sunshine and the copious rainfall enjoyed by Kerala or Kanyakumari District? Here, we need not have to live on hopes alone. The first few rubber plantations raised in Assam, Tripura, Andamans and Goa a few years ago have already started yielding by now. The total area planted is 1425 ha. in Assam, 8200 ha. in Tripura, 850 ha. in Andamans and 720 ha. in Meghalaya and 700 ha. in Goa. Out of this, tapping has begun in 436 ha. in Tripura, 136 ha. in Assam, 64 ha. in Meghalaya, 125 ha. in Goa and 600 ha. in Andamans. Considering the poor quality of the planting and maintenance in most of these early planted areas, the yield being obtained now is very encouraging and the productivity will be not very much below the levels obtained in Kerala.

Though rubber traditionally grows well in the regions between 0 to 10 degrees of latitude on either side of the equator, it is a tough and hardy plant and it can thrive in less congenial climates as well. The Rubber Board has started recommending the raising of rubber plantations in non-traditional regions referred to above if the annual rainfall is at least 1200 mm. and if the temperature does not go beyond 10°C and 38°C. During the first three years of the plant's growth, it may have to be given at least one wetting in a week during the rainless months.

Viable Projects

But, what will be the cost of raising the plantation in the non-traditional areas? What is the point in producing the rubber in the non-traditional area, if the cost of production becomes very high? Is it worthwhile to invest in such a venture our scarce resources? These are all genuine questions which call for explanations.

Let us examine the various cost components. Wages form about 57% of the total annual expenditure in maintaining a plantation and about 70% in the cost of establishment of it. It is in this element of cost that the non-traditional areas score over the Kerala-Kanyakumari belt where the wages are very high, in fact 100% higher. Costs of fertilizers, fungicides and planting materials are almost the same. The cost of land also is very low in the non-traditional regions. While the total cost of raising a of rubber plantation and m. taining it for the 7 year immat. period is about Rs. 28,000/- in Kerala, the same is only Rs. 19,000/- in Orissa. The wage levels and therefore the cost are more or less at the Orissa rate in the other new areas as well. The only additional item of expenditure to be added in the non-traditional areas is the cost of irrigation. Since the irrigation required for the young rubber plant is only one wetting a week and that too during the summer months alone (10 litres per plant per week in association with mulching) heavy expenditure will not be incurred on that. We have already seen that the productivity of the rubber plantation in non-traditional areas will not be very much below the levels attained in Kerala. But, then the cost also is less than the cost of cultivation in Kerala. Thus, it is clear that the rubber plantations in the North-East and other new regions will be eminently viable projects.

Considering all these factors, it is obvious that we should take full advantage of the abundance of sunshine and other favourable conditions in our country and try to grow natural rubber to the maximum possible extent.

FUNGUS ROOTS FOR PLANT NOURISHMENT

Researchers at the Centro Internacional Agricultural Tropical (CIAT), Colombia have worked out a simple method of producing mycorrhizae inoculum, so that the small farmers can introduce them into their fields themselves. The scientists suggest that small areas of 25 sq. metres should be sterilised, and they should then be infected with a starter inoculum specially selected for its adaptation to specific soils and crops. A fast-growing host plant (legumes) can be grown in the fields using minimum quantities of agrochemicals, according to them.

Farmers trained in this method can produce about five tonnes of infested soil at a time—enough to inoculate a hectare of land in four to six months, without using large-scale sterilisation. The farmers should be supplied only a minimum package of 2.5 kg of inoculum and small amounts of fumigant, say the researchers.

Mycorrhizae are microscopic soil fungi, which have mutually beneficial association with the plants whose roots they inhabit. Literally meaning 'fungus-roots', mycorrhizae tap their host plant's ability to photosynthesise, absorbing between 10 and 40 per cent of the carbohydrates and other nutritive substances it produces. In exchange, the fungi helps in effective expansion of the root system, and provides the plants with elements such as nitrogen, phosphorus, copper and zinc that are vital for growth.

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Technical Points to be Considered by Manufacturers of Rubber Products from Dry Forms of Raw Rubber

Dr. E V THOMAS

Rubber industry is a composite industry. For making rubber products a number of ingredients other than rubber are required. The rubber used by manufacturers may be natural rubber, synthetic rubber or combinations of the two. There are manufacturers who use rubber in combination with plastics in the manufacture of some products. One of the essential requirements in trouble free manufacture of rubber products is the quality control of raw materials.

Equally important is the control of steps in rubber product manufacture. The important steps in rubber product manufacture are mixing, shaping and vulcanisation. Processing operations in a factory should be carried out under standardised conditions to ensure trouble free working.

Service requirements of the products and the conformity standards by the products manufactured are to be ensured by product manufacturers. Proper testing facilities are necessary for this. Intensive testing for a product is essential for an industrialist to know his product and to improve it. Some of the defects cannot be detected by visual observation.

In this paper it is proposed to discuss briefly the above aspects with some illustrations.

Raw material selection and quality control.

The important raw materials used in rubber industry can be classified under one or the other groups given in the table below:

	Group		Examples
1.	Rubber	–	(Natural, synthetic or reclaim)
2.	Plasticisers	–	(Mineral rubber, ester plasticiser pinetar, mineral oil)
3.	Peptisers	–	(Penta chloro thio phenol type)
4.	Activators	–	(Zinc oxide/Stearic acid)
5.	Fillers-Reinforcing	–	(Carbon black-silica)
	Non-reinforcing	–	(Clay, whitting)
6.	Accelerators	–	(Sulphenamides, thiazoles thio carbamates)
7.	Curing agent	–	(Sulphur, peroxide, resins)
8.	Antioxidant/Anti ozonant	–	(PBN, DPPD)
9.	Special additives	–	(Blowing agent, Retarders, abrasives, colour etc).

In many small rubber industrial units facilities for quality checking of raw materials are absent. Instance has come to the notice of this author where in one unit ZDC was used in place of Zinc Oxide. Both are white coloured meterials. One is an ultra accelerator, the other is an activator. The whole mix will be scrapped by such a mistake. In another instance a manufacturer has used China clay in place of zinc oxide. The product will not readily undergo vulcanisation in thise case. These defects are occuring because of lack of quality assessment of raw materials.

Poor quality

Instances have also come to the notice of the author where the poor quality of raw rubber used has affected adversely the service life of end products. A particular manufacturer who was using Estate Brown Crepe rubber in his product mix had to face complaints from consumers on poor service life of the tyres they produced. On analysis of the samples of EBC used by this manufacturer in detail it was observed that the ash content in EBC was 20% in some cases. This was willful contamination of the raw rubber by supplier. There were also instances in which Estate Brown crepe were adulterated with skim rubber. When such low grade rubber is used, the oxidation resistance of the whole mix will be decreased and the service life of the product will come down.

Problems of this nature can be overcome only if the manufacturers do regular quality checking of the raw meterials. For raw rubber there is ISI specification. It is only a matter of curiosity for you to examine whether the raw rubber you procure conforms to ISI specification. The IS No. prescribing raw rubber specification is IS 4588. The properties specified are given in table I. It is preferable to standardise the rubber that you get from regular sources and to assess the variation in its properties.

Synthetic rubber is also used by some of the manufacturers. Many small industrialists have no idea about the quantity of synthetic rubber to be used along with natural rubber for the manufacture of different products. This author had occasion to examine a typical formula for tread manufacture used by a small industrialist. The polymer content of the formula was as shown below.

Natural rubber sheets (RMA)	11.0
Poly Buta diene	8.0
Reclaim rubber	1.0

Even in a good quality tread the base polymer composition need only be in the following proportion

Natural rubber	75.00
Poly Buta diene	20.00
Reclaim WTR	10.00
Total rubber	100.00

The per kilogram cost of formula with higher amount of Poly buta diene will be around one rupee higher in polymer side alone. It need not be emphasised that such a high cost of polymer used in formula will lead to substantial erosion in the margin of profit of a tread unit. Another interesting thing seen in some formulation of retreaders is the excessive use of antioxidants in production of treads. It may be a matter of interest to you to know that the life of a tread used in truck or bus tyre is only 3-4 months. No oxidation will be there for the tread in this short period even if it is prepared without incorporation of antioxidants. In a formula weight of 160, sometimes 1-2 kilo of antioxidants are used. Judging from the cost of these materials to-day it is possible to say that one can easily save 50 to 60 Ps. per kilo production cost by dispensing with these materials or at least by substantially reducing their quantity. Some work in this line was done by this author and the results indicate that the treads without anti-oxidants gave some tread life as those with antioxidants.

Properties and conformity to standards of each compounding ingredient should be assessed by every manufacturer. There are ISI standards for the HAF black, the CBS, S, Zinc oxide, Stearic acid and every such chemical used in industry. It is good to test and assess the quality of these costly materials which is bought and used in large quantity. Table II of this paper gives the IS No. for various raw materials used in rubber industry. The Consultancy Division of the Rubber Board can help a lot in standardising the quality of the raw materials used in the factories of small industrialists. The inter-changeability of the chemicals used in manufacture is another important point to be considered by the small industrialists. When a particular accelerator is absent some times manufacturers stop production. There was shortage of an accelerator vulcacit DZ in the market sometime back. Many have stopped production of tread. It is possible to use a combination of delayed action accelerator and a retarder to get the same effect as that of vulcacit DZ. Some manufacturers who came to the Rubber Board with this problem were given this suggestion and they could continue their production without increasing the cost. Similarly it it is possible for a manufacturer of tread to use secondary accelerator systems in his tread in combination with retarders especially for the tread to be used by local retreaders. Information on this is available at the Consultancy Division.

Processing Operations

In the manufacture of rubber products from dry rubber there are three important steps, viz. mixing, shaping and vulcanisation. Mixing of rubber and ingredients are done by small manufacturers in mixing mills and large units in internal mixers. The energy consumption of rubber mixing is a matter to be considered seriously by all manufacturers. The use of raw materials and the procedure selected should be such that the mixing time and energy consumption should be lowest. In many manufacturing operations use of peptisers, oil extended natural rubber or constant viscosity rubber will prove to be helpful in reducing power consumption.

Temperature of mixing

When compounding is done temperature of mixing has to be controlled dpending on the nature of the ingredients used. Peptisers will give proper action only at temparatures above 70°C. At temperatures above 110°C insoluable sulphur will loose its insoluable nature. If mixing is done at higher temperature in a mix containing insoluable sulphur there will be tendency for blooming in the mix during storage. If synthetic rubbers or plastics are to be mixed with rubber it is necessary to do mixing at higher temperatures to ensure proper myscibility. In the case of synthetic rubber/natural rubber blending, it is necessary to do the pre-mastication of the rubber which has higher viscosity.

Extrusion/Calendering

In calendering and extrusion an important point to be remembered is the dimensional stability of the shaped products. Compounds with excessive mill shrinkage will have poor dimension stability after extrusion or calendering. Suitable compounds should be designed to over come this problem. It has been proved that use of SP rubber in compound preparation is helpful in manufacture of extruded products with good dimensional stability. Porosity observed in extruded products is mainly due to presence of moisture in compounding ingredients. Fillers, rubber etc used in compounding should be perfectly dry. There is also tendency for compounds to undergo scorch during extrusion. This can be overcome by properly controlling the barrel and head temperature and also using accelerators with good orch safety.

loulding

ome of the defects observed in oulded rubber products and e causes for these are given elow in tabulated form.

ature of defect	Reasons
Pock Marks, surface blemish with sharp edges	Low viscosity of the compound. Excessive softening of compound on hot mould before pressure application.
Entrapped air	Poor mould design. Improper blank shape, Low viscosity or softening of stock on hot mould.
Excessive flash	Improper bumping. Excessive mould loading, improper mould closing, low moulding pressure, high viscosity of stock. Improper mould design.
Poor knitting	a) Incorrect size of the blank, incorrect location. b) Low moulding pressure c) High viscosity of stock (incipient scorch) d) Inadequate mould flow time e) Bloom or dust on stock.
Blister Tearing	Air in blank Improper mould design. Inadequate hot tear strength, excessive high curing temperature, over cure, fouled moulds and sticking of moulding. Inadequate application of mould lubricant. Improper shape of blank and poor knitting. Under cure.
oblems of Kattai sheet	
proper finish of the product	Soiled mould under cure. Use of high loading of mineral fillers in the formulation. Inadequate use of mould lubricants.
oblems of straps Bloom	Sulphur bloom-under cure. *Zinc-stearate*-This can occur only in the surface of the strap, if excessive amount of stearicacid is used especially with loading of activated calcium carbonate. With activated calcium carbonate use of stearic acid can be avoided from the fomulation.

Defects in micro cellular soling sheet production. Holes and pin holes in the bubled sheet

This defect can occur due to (a) entrapped air in the blank or (b) undispersed grit in the compound or (c) undispersed blowing agent.

Sheets with cracked edges

This is due to a formula defect. Change in formula is required.

Many defects observed in moulded products are due to non uniformity of press platen temperature, unsatisfactory design of the mould, excessive application of mould lubricants or due to unclean moulds. Sometimes defects occur due to incorrect use of compounding ingredients. Individual cases have to be studied in detail for giving proper corrective measures.

Common defects observed in moulded goods manufacture, foot wear, cycle tube/tyre manufacturing etc. are given in the annexure to this paper.

Quality control of finished products·

Testing of finished products and assessing their conformity to standards fixed by national standard body is important. It may be difficult for every small industrialist to set up testing facilities. The centres established for testing of products can be utilised for this purpose. The small industries service institute had set up a testing centre at Changanacherry mainly for catering to the needs of Small Scale Industries. The Consultancy Wing of the Rubber Board has also facilities for testing a range of rubber products in accordance with the standards fixed by the Indian Standards Institution.

In all factories making good quality products, quality checking of end products is one of their essential operations. Defective materials when marketed will spoil the reputation of the supplier. It is desirable if manufacturers make attempts to market their products with ISI Mark. Any body who is interested in marketing the produce with ISI mark can also get full guidance on this from the consultancy division of the Rubber Board.

TABLE – I

IS: 4588 – 1977

Indian Standard

SPECIFICATION FOR RUBBER – RAW NATURAL

(Second Revision)

1. Chemical Requirements for Natural Rubber (Clauses 3 & 4.2)

Sl. No.	Characteristic	Requirement for ISNR 5 Special	ISNR 5	ISNR 10	ISNR 20	ISNR 50	Method of Test Ref: to
1.	Dirt Content, percent by mass, Max	0.05	0.05	0.10	0.20	0.50	NR : 1 of IS : 3660 (Part 1) -1968*
2.	Volatile matter, percent by mass, Max	1.0	1.0	1.0	1.0	1.0	NR : 2 of IS : 3660 (Part 1) -1966*
3.	Ash, percent by mass, Max	0.6	0.6	0.75	1.0	1.5	NR : 3 of IS : 3660 (Part 1) -1966*
4.	Nitrogen, percent by mass, Max	0.7	0.7	0.7	0.7	0.7	NR : 11 of IS : 3660 (Part III) : 1968**
5.	Initial plasticity, Min	30	30	30	30	30	NR 12 of IS : 3660 (Part III)- 1971***
6.	Plasticity retention Index (PRI) Min	80	60	50	40	30	NR : 13 of IS : 3660 (Part III) – 1971***

* Methods of test for natural rubber, Part I

** Methods of test for natural rubber, Part II

*** Methods of test for natural rubber, Part III

TABLE – II

IS STANDARDS FOR RUBBER AND RUBBER CHEMICALS

60% HA-Latex	IS : 5430–1981
-do- Methods of test	IS : 3708 (I&II) – 1966
Raw Natural Rubber	IS : 4588–1977
-do- Methods of test	IS : 3660 (I) – 1966 &
	IS : 3660 (III) – 1971
Sulphur	IS : 8851–1978
Carbon Blacks:	
FEF	IS : 8135–1976
GPF	IS : 10357–1982
HAF	IS : 7497–1974
ISAF	IS : 8134–1976
SRF	IS : 10387–1982
SAF	IS : 10358-1982
C-black, sampling & Tests	IS : 7498-1974
Styrenated phenol	IS : 7351–1974
Stearic Acid	IS : 1675–1971
Mercaptobenzthiazole	IS : 6918–1972
Zno	IS : 3399-1973
Diphenyl Amine	IS : 8278-1976
Diethyl, P-phenylene diamine (N, N)	IS : 10246-1982
Diethylene slycol	IS : 7918-1975
Tetramethyl thiuram disulphide	IS : 8979-1978
Na-Carboxy methyl cellulose	IS : 9830-1981
Barytes	IS : 1683-1973
Benzothiazyl-2-cyclo hexyl-sulphenamide	IS : 7069-1973
Casein	IS : 399–1967

Problems in Moulding

1.	Surface shyness (seen at an angle)	–	Undercure
2.	Pockmarks Surface blemish with sharp edges	–	Low viscosity Excessive softening of stock on hot mould before pressure application.
3.	Entrapped air Shiny concave surface	–	a) Poor Mould design. b) Improper blank shape c) Low viscosity or softening of stock on hot mould. d) Improper bumping.
4.	Excessive flash	–	Excessive mould loading Improper mould closing. Low moulding pressure High viscosity of stock. Improper mould design (wide land/width)
5.	Poor knitting	–	a) Incorrect size of blank. Incorrect location. b) Low moulding pressure c) High viscosity of stock (incipient scorch) d) Inadequate mould flow time (scorching) e) Bloom, dust on stock f) Excessive lubricant on mould
6.	Blister	–	Air in blank
7.	Pebbling Hard speck on stretching	–	Improper dispersion of curatives
8.	Sticking	–	Undercure Fouled mould. Inadequate mould lubricant.
9.	Bloom	–	If sulphur Undercure Low press temperature. Uneven platen temperatures. Cold mould/core Incorrect compounding.
10.	Loss of gloss Action of ozone in humid weather		
11.	Tearing	–	a) Improper mould design b) Inadequate hot tear strength (excessive high curing temperature) c) Overcure d) Fouled moulds and sticking of moulding. e) Inadequate application of mould lubricant f) Improper shape of blank and poor knitting. g) Uudercure h) Incorrect formulation/mixing.
12.	Curling and distortion (rough surface of moulding)	–	a) Use of scorched blank b) Stock with with too low mould flow time or excessive delay in closing after insertion of stock.
	(polished surface of moulding)	–	a) Undercure and distortion while removing.

13. Bulging of article. Porosity in centre — a) Undercure.
b) Bad mixing.
c) Insufficient pressure
d) Insufficient stock.
e) Improper shape of blank, stock flowing outside the cavity rather than into the cavity.

Problems-Kattai sheets.

1. Improper finish of the product — a) Soiled mould.
b) Undercure.
c) Use of high loading of mineral fillers in the formulation.
d) Inadequate use of mould lubricants.

2. Depressions on the surface due to air entrapment — a) Improper blank especially high roughness on the blank sheets can give rise to air entrapment.
b) Improper size of blank.
c) Improper design or mould especially if from the two cavity on both sides of the mirror finished stainless steel sheet.

3. Tearing — Sticking in the mould due to undercure or soiled mould.

Problems in M C straps

1. Air bubbles in the straps — a) Low compound viscosity, low moulding pressure.

2. Blooming
i) Sulphur bloom-Undercure
ii) Zinc stearate-This can occur only on the surface of the starp if excessive amount of St. Acid is used especially with loading of activated calcium carbonate, With activated calcium carbonate, St. Acid can beomitted from the formulations.

3. Ageing or poor storage stability of straps. — a) Undercure
b) Overcure
c) Colours used should be free from Ionic opper impurities.
d) Inadequate dosage of Antioxidant.

4. Tearing — a) During production
i) Soiled mould
ii) High loading of mineral filler
b) During service
i) Improper cutting of the flash.

Trouble shooting in micro cellular soling sheet production:

1. Inconsistent production (varying sheet size and hardness). The reason is the uneven degree of precure which may be due to (a) uneven curing characteristics of the batches. (b) varying temperatures in the platens and (c) varying precure time given in the production.

a) To maintain the curing characteristics at equal level, the batches are blended. The batches are made with curatives and blowing agent and then stored for around 24 hours. On the next day, sheets from different batches are picked up for warming and the blanks are made. In this way the curing characteristics of the batches can be evened out to certain extent.

b) The temperature variation in the platens of a multiday light press can be due to faulty steam connections or waterlogging in a steamheated press or due to faulty working of temperature controllers on an electrically heated press.

c) If the press opening on a hydraulic press can be automatically controlled by a timer variations in the precure time can be avoided. On a hand press due to the difficulty of opening the press, the degree of precure cannot be accurately controlled and one has to live up with the variation in size and hardness of the product.

2. Non-uniform sheet (Edges nonparallel)

This defect results if (a) there is a loss of gas/compound from one side of the mould or (b) the degree of precure varies over the sheet.

a) If the mould is warped or improperly designed and the seal along the edge is not perfect, when the internal pressure in the compound shoots up after the decomposition of the blowing agent, oozing of the compound starts. The sheet has lower expansion in the region where the loss of gas has occured. If the mould loading is too high the flash that develops at the sides is too thick. A thick flash may not set up before the internal pressure builds up. When the blowing agent decomposes and the internal pressure builds up the thick unvulcanized flash will be pushed out and the compound leakage can start.

On a hand press the closing pressures are not of high order. With higher mould loadings thick flash is inevitable. Even with correct mould loadings on a hand press, the mould may not get properly closed along all sides and again compound leakage may start.

b) Sometimes on a steam heated platen the temperatures over the whole platen area may not be constant due to water logging towards the steam exit end. The resultant uneven degree of precure results in uneven expansion. On an electrically heated platen with multiple heaters the temperature can be varied over the platen surface.

Measures should be taken to avoid this temperature difference over the surface.

3) Curved sheets.

This defect can arise when (a) the bottom and top platens around the mould have unequal temperature or (b) the blank is composed of sheets from batches with uneven curing characteristics/uneven content of blowing agent or (c) mould loadings are high leading to thicker flash formation.

a) If the platen temperatures are different (which can easily happen on a multiday light steam heated press with platens joined in series) the side in contact with hot platen gets a higher degree of precure and hence expands less. The sheet on removal from the mould bents with the side in contact with hot platen on the inside.

b) When multicoloured sheets are to be manufactured the base composition (without colours) should be identical for the different coloured batches to ensure identical precuring characteristics and identical expansion characteristic. Any deviation in this respect will lead to production of curved sheets.

c) Any excess compound squeezed out of the mould on closure should be immediately wiped out. The thin flash on the sides of MC soling sheets is always curved to a greater extent and hence has less tendency to expand. When the sheets come out from the moulds, the flash should be immediately trimmed off. The hot sheets should be stacked one above others with a heavy weight on top to flatten the sheets.

4. Warped or weavy sheets. This defect is due to the fact that on release of pressure the sheet is unable to pop out of the mould immediately. This may happen if (a) the opening of the press is not quick enough or (b) the sheet is wedged in the mould because of wedging of the flash in between the mould plates.

5. Bulging in the sheets.

i) The cutsection shows torn rough edged walls on the bubble. This is a case of undercure or too low degree of precure. The precure time should be lengthened.

ii) The cutsection shows smooth walls on the bubble. This is a case of air entrapment in between the layers of the blank. When the blank is built up of layers it is preferable to keep the preforms stacked up and stored for few hours so that the air in between the layers diffuses out and the layers fuse together.

6. Hoses and pinholes in the finished sheet.

This defect can arise due to (a) entrapped air in the blank or (b) undispersed grit in the compound and (c) undispersed blowing agent particle.

a) If thick blanks are sheeted out directly from the mill it is very likely that the blank will contain air bubbles which enlarge on expansion of the sheet. In this case, it is advisable to allow the compound to run on the roll for sometime and then cut out the sheet.

b) Any filler/sand or grit particle will not expand alongwith the sheet and will form a pinhole in the sheet. On examination of the pinhole by a magnifying glass the filler particle can be seen and its nature can be sometimes judged by its appearance.

c) The problem can arise with improper types of DNPT type blowing agents. If the batches after mixing the blowing agent are stored for about 24 hours and then rewarmed this type of defect is mostly overcome. If the problem persists with the DNPT type of blowing agent, either the supply of blowing agent should be changed or else addition of the blowing agent little earlier in the mixing cycle can be considered.

7. Sheets with cracked edges If the compound is highly loaded with inert mineral fillers especially in case of the compounds based on high quantity of emulsion SBR and reclaim the hot tear strength of the vulcanizate is quite low. On release of

the moulding pressure the sheet expands, the thin flash tears out at places and sometimes the tear propagates to the sheet proper. Sometimes the sheet immediately on removal is perfect but in a few minutes starts cracking and results in a scrap product. The remedy lies in changing the compound formulation. Part replacement of SR by natural rubber, reduction in the inert filler level along with the replacement of the level of by reinforcing fillers, increase in the levels of plasticisers and resins help to overcome the problem.

8. Bubbles on the sheet during postcure

This is due to incomplete decomposition of the blowing agent during precure. The precure time can be increased (after reduction in accelerator dosage to keep the degree of precure at the same level). The decomposition of the blowing agent can be activated further by use of acidic substances e. g. Benzoic Acid GK.

9. High shrinkage during postcure/stabilization step
The degree of precure can be reduced by (a) lowering the accelerator dosage of (b) lowering the precuring temperature.

For production of consistently good quality of microcellular soling it is not necessary to have elaborate production machinery and extensive laboratory facilities to keep control at every stage of production. By taking into consideration the basics of microcellular production and taking reasonable care at various stages of production even a small scale manufacturer will be in a position to manufacture consistently good quality product.

Problems - Cycle tubes

1. Improper finish of the tube – a) Soiled mandrels.
   b) Air entrapment between mandrel and the tube.
   All air between the tube and mandrel should be removed by drawing rubber piece with hole over the tube on the mandrel.

2. Bulging of tube while testing – a) Uneven speed of the conveyor in front of the extruder
   b) Ballooning of tubes in the vulcaniser due to air entrapment between tube and mandrel.
   c) Undercure - One of the reasons might also be due to non-removal of air from the vulcaniser. It is preferable to have an air vent over the vulcaniser.

3. Extrusion defects
   a) Scorching in the extruder – If whole tube is coming very rough and enlarge then this is due to
   i) Low scorch safety of the compounds
   ii) Improper cool extruder
   iii) High clearance between screw and barrel.

   b) Scorched particles – If scorched particles are coming over the tube, the defect is due to faulty design of the die assembly. Compound is getting scorched at the dead spots in the assembly.

4. Tearing of tubes while removing – a) High loading of mineral fillers especially china clay in the tube.
   b) Use of high quantities of synthetic rubbers like SBR, BR in the formulation.
   c) Soiled mandrels

5. Lines on the surface of the tube – This is due to clogging of the die due to:
   a) foreign particles coming either from the polymer or from the mineral fillers used.
   It is preferable to strain cycle tube compounds containing all ingredients except sulphur. The masterbatch should be added to the masterbatch before use.

GUIDELINES TO OVERCOME SOME OF THE PROBLEMS ENCOUNTERED IN THE PRODUCTION OF CYCLE TYRES

DEFECT	CAUSE	CORRECTIVE ACTION
1. Air marks (deep and with sharp edge) on the side wall or short mounding or tread design.	1. Too low compound viscosity 2. Thermoplasticity due to long exposure of green tyre to high temperature	Reduce time of mastication of natural rubber. Reduce level of oil; use high viscosity SBR. Try to reduce loading/ unloading time. Replace natural rubber partly with SBR.
2. Unglazed marks (Bareness on side walls)	Setting up on the compounds due to long exposure to the cure temperature	If the downtime of the press cannot be reduced, increase the processing safety of the compound by using safer sulfenamide accelerators or by reducing the level of booster accelerators.
3. Knitting cracks apparent especially near the bead wire region	1. As in (2) 2. Delay in application of full air pressure after closing of the press 3. Excessive use of mould lubricant. 4. Dust on the green tread 5. Dry compound with low green tack 6. Uneven thickness of air bag.	As in (2) Check air lines Dilute the mould lubricant. Use sparingly. Clean the green tread before loading. Use some tackifier in the compound. Check the air bag, by feel, for soft spots. Reject such bags.
4. Porosity in tread design or surface shyness on the sidewalls.	Undercure	Check for water loading in the mould. Increase cure time.
5. Air bubbles in between plies or between ply/tread	1. Air entrapment during building up operation 2. Traces of solvent or rubber solution being used during building up operations.	Proper rolling during building up operation. Increase the green tyre storage time before moulding.
6. Air bubbles in tread	Air bubbles in the green tread.	Extrusion of tread is to be preferred. If extrusion is not possible use 3 or 4 roll calender, change the method of feeding on the two roll calender. Increase viscosity of the compound. Reduce the amount of reused scrap.
7. Porosity at one sport especially near the bead wire region.	1. Leaky air bag.	Change the air bag.

DEFECT	CAUSE	CORRECTIVE ACTION
8. Sticking of the tyre in the mould.	1. Insufficient use of mould lubricant.	If this problem is arising in one or two moulds only, the reason is water logging in the mould. It is preferable to have separate steam trap for each mould.
9. Sticking of air bag to the cured tyre	1. Too old cracked airbag. 2. Undercured new airbag. 3. No mould lubricant on airbag. 4. Undercured fabric impregnation compound.	It is preferable to use a hot air bag for bagging the green tyre. Increase the level of the booster accelerators in the impregnation compound.
10. Ply separation	1. Fabric impregnation compound set up.	
	2. Dust on the fabric	
	3. Solvent traces on the fabric.	
	4. Undercure	In this case the separation is observed below the thick tread part only. Increase the level of booster accelerator.
11. Low ply adhesion	1. Insufficient rubber compound on the fabric.	
	2. Residual safety in the rubber compound used for impregnation at the time of moulding low and too fast compound.	Reduce the level of booster accelerator, Increase the dosage of stearic acid with Vulkacit F.
	3. Too long storage of fabric and blooming of sulphur on the surface.	
	4. Dust on the fabric.	Keep fabric-cutting and building up sections of the factory free of talcum; check the fabric liners before use.

Financial Assistance for purchase of Rubber Rollers

Rubber Board has decided to grant 50% of the cost as subsidy for the purchase of hand operated rubber sheeting rollers to small rubber growers. Under the scheme, small rubber growers owning rubber plantations not exceeding 20.23 hectares in extent having mature rubber area will be eligible to receive the financial assistance. The subsidy is limited to 50% of the actual price paid or Rs. 3500.00 whichever is less. The grower shall purchase the machine direct from suppliers paying the full cost and thereafter apply for subsidy in the prescribed form. The applications for grant of subsidy shall be submitted to the Dy. Development Officer of the concerned Regional Office of the Rubber Board. The details of the scheme can be had from the office of the Rubber Production Commissioner, Sastri Road, Kottayam or the various Regional Offices and Field Offices of the Rubber Board.

PROCEDURE MODIFIED

As per the existing procedure one of the prerequisites for issue of new manufacturer's licence is that the applicant should produce DGTD/SSI registration certificate or licence issued by the Panchayat / Municipal / Corporation Authorities to start the industry at the proposed premises.

Now the above condition has been further relaxed to the extent that if the applicant holds salestax registration certificate, such cases can also be considered. Accordingly, all the Liaison Officers/Excise Duty Officers/ Assistant Excise Duty Officers/ Excise Duty Inspectors are instructed that where the applicant holds salestax registration certificate, those cases may also be recommended for issue of new manufacturer's licence even if they do not hold DGTD/SSI registration certificate/licence issued by Panchayat/Municipality/Corporation Authorities.

AID TO RUBBER GROWERS

The Malaysian government has approved an allocation of £ 15 million per year until 1990 to assist rubber smallholders in replanting their old trees. Normally a fund contributed by a 'replanting cess' levied on natural rubber exports finances all replanting activities in the country. This fund is managed by a government agency called the Rubber Industry Smallholders Development Authority. In recent years, however, a decline in rubber exports (and therefore, lower cess collection) plus the increasing cost of replanting has rendered the cess fund inadequate to meet its commitments. The additional funds should alleviate some of RISDA's replanting problems. Malaysia, the world's leading producer of natural rubber has 1.7 million hactares of rubber trees. More than two -thirds of these are owned by about 500,000 smallholders scattered all over the country. About 32,000 hectares need replanting annually

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Annual Publication - Price	.. Rs.	50.00
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vi. Directory of Estates and Holdings in India	.. Rs.	238.00
(5 volumes)		
vii. Handbook of Natural Rubber Production in India	.. Rs.	175.00
(Available with the Director, Rubber Research Institute of India, Kottayam 686 009)		
Postage	.. Rs.	20.00
viii. Rubber and its Cultivation	.. Rs.	2.00
Price		

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RUBBER BOARD BULLETIN

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RUBBER BOARD BULLETIN

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THE QUARTER

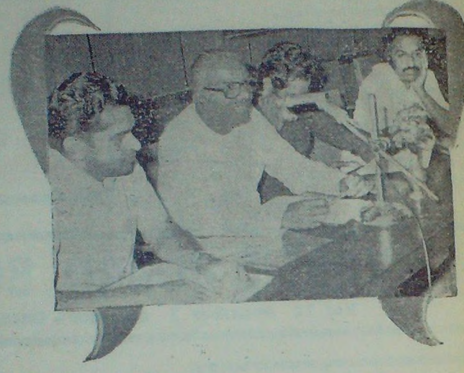
Old, uneconomic and low yielding rubber trees are retained by small holders in over 50000 hectares in the traditional rubber growing regions of Kerala State and Kanyakumari District of Tamil Nadu, which require immediate replanting. These units are a liability to the holders and the state's economy as they tend to depress the figures of production and productivity of natural rubber. In order to persuade the small growers to fell their old trees and take up replanting using high yielding materials, the Rubber Board proposes to launch an intensive drive by convening group meetings in over 300 centres.

Handsome subsidies and loans are available under the Rubber Plantation Development Scheme of the Rubber Board for replanting which are adequate to cover the entire cost of cultivation. Incentives under this scheme include a cash subsidy of Rs 5000/- per hectare, long term Bank loan at reduced rate of interest, 3% rebate on the interest accrued, Rs. 2700/—as subsidy for procuring 450 polybagged plants @ Rs. 6/-per plant and free technical advice.

In view of these attractive incentives it is hoped that the small holders would pay heed to the call of the Rubber Board to replant their old trees.

MINISTERS IN RUBBER BOARD

Union Commerce Minister Shri P. Shivasanker and the State Minister for Commerce Shri Priya-ranjan Das Munshi visited the Rubber Research Institute of India on 20th and 23rd December 1986 respectively.

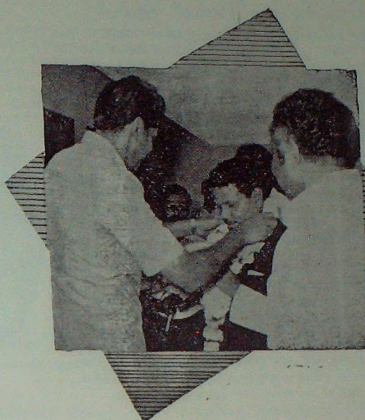


On his arrival at the Rubber Research Institute of India, Shri P Sivasanker was warmly received by Shri PC Cyriac IAS, Chairman, Rubber Board. Shri George Joseph Mundackal MP and Shri Omman Chandy were also present. Members of the Rubber Board, Senior Officers, Representatives of UPASI, APK and leading Planters were present on the occasion. Representatives of the Service Organisations of the Board garlanded the Minister on his arrival at the Guest House in the RRII, Campus. The Minister inaugurated the Central Testing Laboratory and the Guest House and they visited the various research divisions. At the Tissue Culture Laboratory he was shown the test tube rubber plants with well developed root and shoot systems.

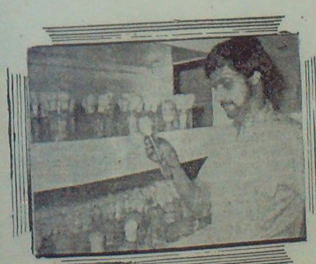
The method of tapping rubber tree and the process of making rubber sheets were shown to him. The Minister also saw the method of making industrial gloves in the cottage sector.

Later the Minister met the representatives of various rubber growers' organisations, rubber dealers' organisations and representatives of plantation labour They raised problems pertaining to their respective areas. They have unanimously demanded the need of a clear decision to prevent the State Trading Corportaion from arbitratily releasing imported rubber. The Minister replied suitably to the points raised by the various representatives. He also formally announced the significant break through in tissue culture propagation of rubber achieved at the Rubber Research Institute of India by Dr. MP Asokan, Dy. Director. (Report on Tissue Culture elsewhere)

Shri Priyaranjan Das Munshi arrived at the RRII on 23rd December 1986. He was accompanied by Prof. P J Kurian MP, Shri Ommen Chandy MLA and Shri Joseph Monipally. Shri PC Cyriac, Chairman, Rubber Board, Members of the Rubber Board, Representatives of rubber growers, traders and Staff Organisations of the Rubber Board received him. He visited various research divisions. Minister also visited the Tissue Culture Laboratory and afterwards addressed a meeting of Members of the Board, Planters and Representatives of Growers' Associations and Staff Organisations in the Rubber Board. □



THE TEST-TUBE RUBBER PLANTS: INDIA'S NEW ACHIEVEMENT



A significant break through in tissue culture propagation of Rubber has been achieved at the Rubber Research Institute of India, Kottayam by Dr. M. P. Asokan, Deputy Director and his associates Smt. P. Sobhana, Assistant Plant Physiologist and Miss. S. Sobha, Scientific Assistant. They have produced tissue cultured plants with tap roots ready for transplanting in the soil. Normally rubber has been propagated by grafting of desired clonal buds on open-pollinated seedlings. However, trees derived from such practice have few drawbacks. One such drawback is the rootstock-scion interaction causing highly variabl rubber yield levels in plantations. Moreover, grafted trees have leaner tree trunks compared to trees grown from seeds. The growth behaviour of tissue culture generated plants may be similar to seedling plants. Tissue cultured plants do not need grafting, thus circumventing stock-scion interaction. Besides, millions of plants can be produced within a limited time using very little plant material and space.

Another significant difference is the increased girth of tissue culture derived trees when compared to traditionally propagated trees. Increase in trunk girth can result in increase in latex yield. Since the girth and the growth rate of such trees are higher, early tapping also may be possible. In all rubber producing countries, rubber tissue culture procedures are kept very secret due to the critical commercial value of the crop and the trade competition between such countries. Many rubber producing countries have been trying for the last several years to produce tissue cultured rubber plants, but so far very little success has been reported. And hence, for India, this is a very significant step. Biotechnological techniques offer new vistas for plant and plant cell manipulation leading to crop improvement. New selection systems can be developed *in vitro* where selections for disease resistance, cold resistance, drought resistance, etc. can be done in a flask full of thousands of 'baby' plants, circumventing elaborate and expensive field screening for such conditions. Hybridization between two cells originating from two widely different parents are possible where conventional breeding is not possible. Cellular manipulation for gene alteration, plant regeneration from single cells, introduction of cell organelles from one species to the next are some of the new techniques being tried on several crops. Hence Biotechnology research appears to have lots of promise for crop improvement. □

NEW ACHIEVEMENT FOR CROP IMPROVEMENT

LATEX FOAM

NC SAMAJDAR
Technical Services
IEL Ltd
West Bengal

Technical Seminar

A technical seminar on latex jointly sponsored by the Kerala Sub Branch of the Plastics & Rubber Institute and IEL Limited, Rishra, West Bengal was held on 22nd February 1987 at Hotel Aida, Kottayam. Shri Dilip Sreevasthava, Sales Manager, IEL, Calcutta inaugurated the seminar. Dr. EV Thomas, the Chairman of the Kerala Sub Branch and Dy. Director, Technical Consultancy Division of the Rubber Board welcomed the participants of the technical seminar. Dr. KA Jose, Additional Director of Industries and Commerce delivered the felicitation address. He exhorted the industrialists and the entrepreneurs to start new latex based industries instead of depending on items manufactured in large numbers. He quoted the examples of rubber gloves, bands etc. Shri N. C. Samajdar presented a paper on 'Latex Foam'. Dr. M. K. Mukherjee Prof. Francis and the Technical Officers of the Rubber Board participated in the discussions that followed. Dr. E. V. Thomas summarised the recommendations of the seminar. The Hon. Secretary of the Kerala Sub Branch, the Plastic and Rubber Institute Shri P. K. Mohamed proposed a vote of thanks. Shri K. R. Krishnan, IEL Ltd, Cochin is the Hon. Treasurer of the Kerala Sub Branch.

Following is the paper presented by Shri N. C. Samajdar. He is the Section Manager, Technical Services (Rubber Chemicals), IEL limited, West Bengal.

The production of latex foam is the most important of all latex processes, as it is the bulk consumer of latex used directly in rubber industry. The process essentially consists of expanding (foaming) a suitably compounded latex to a desired volume, setting (gelling) the rubber particles and then vulcanising the product.

In the Dunlop process sodium silicofluoride is used as the gelling agent. The latex compound is mechanically beaten up to a foam and then the requisite amount of a dispersion of sodium silicofluoride is added, which, in presence of zinc oxide, will set the foam to a 'gel' within a few minutes. The 'gelled' product is then vulcanised in steam.

A typical formulation for latex foam is given below:

	Parts by weight
60% NR Latex	167.0
20% Potassium oleate soap solution	5.0
50% Sulphur dispersion	4.0
50% Accicure ZDC dispersion	2.0
50% Accicure ZMBT dispersion	2.0
20% Accinox B dispersion	2.5
50% Accinox SP emulsion	2.0
50% China clay slurry	0-30.0
Fast colour	as required
40% Zinc Oxide dispersion	10.0
Secondary gelling agent	0.5-1.0
20% Sodium silicofluoride dispersion	5.0-7.5 or as required

The function of secondary gelling agent is to reduce the gelling time so that no premature foam collapse may occur. Premature foam collapse is a common phenomenon specially with those latices which show a low gelling pH. Among the secondary gelling agents, commonly used, may be mentioned cationic soaps, triamine base and guanidines. Vulcastab EFA which is a triamine base is available as a viscous dark brown liquid miscible with water in all proportions. A 50% solution in water is generally used and is incorporated just prior to the addition of the main gelling agent, viz. sodium silicofluoride.

In addition to its function in preventing the premature foam collapse, Vulcastab EFA also imparts a higher modulus to the foam product and thus gives a worth-while saving in cost. It has been found that as much as 10% of latex can be saved by the use of Vulcastab EFA. Compression set of the foam is also improved.

DPG, can also be used as a secondary gelling agent. It is generally used as a 20% aqueous dispersion or as a composite dispersion with zinc oxide.

Process

The process of foam production can be divided into the following steps:

1) Compounding and maturing
2) Foaming and gelling
3) Vulcanisation
4) Washing and drying

1) Compounding and Maturing

The high ammonia content (0.7%) in ammonia preserved centrifuged latex is objectionable, as it may cause gelling problem and poor foam structure. The ammonia content is brought down to 0.1 to 0.15% by the addition of formaldehyde or by blowing moist air across the surface of the latex while stirring it.

Experience has shown that 'maturing' the latex compound before foaming considerably improves the quality of the foam. Maturation can take place simultaneously with the deammoniation process. Part or whole of the sulphur and accelerator are added to the latex which is kept stirred under a current of air (to remove ammonia) and is maintained at a controlled temperature slightly above room temperature. After maturation is complete (12–24 hours are generally required), the latex is commonly stored at a low temperature and heated to the room temperature before use. One aspect of maturation is partial vulcanisation of the latex. Principal function of 'maturation' is to assist in the control of hardness and shrinkage. The modulus is also improved and the final product is more lively with a better recovery.

The next step is to mix the remainder of sulphur and accelerator and the other ingredients (excepting zinc oxide and gelling agents) and subject the compound to foaming.

2) Foaming and Gelling

The foaming may be done either by a batch or a continuous process. In the batch process a simple equipment like 'Hobart' mixer is used. The mixer is provided with a wire cage which rotates in a planetary motion with about 225 r.p.m., whipping the compounded latex into a foam. The formation of the foam is also assisted by blowing air below the surface of the latex. The exact beating time required should be determined by experiment. In normal cases, it varies between 15 and 20 minutes and the volume increase of the compounded latex is generally from 4 to 6 times for cushions up to about 14 times for very soft, low density sponge. After the desired volume increase has taken place zinc oxide with the secondary gelling agent, if required, is added followed by the gelling agent. The speed of beating is usually reduced at this stage in order to 'refine' the foam i e. to reduce the bubble size and this beating is continued till the chemicals finally added are uniformly distributed. This foam is then poured into the mould and the lid placed in position. In the batch process gelling, is allowed to take place within 6 to 10 minutes. By this time, however, the mould will be in the vulcanisation chamber.

The most popular frothing machine used in the continuous process is that known as the Oakes mixer. The mixing head of the Oakes machine consists essentially of a rotor which is totally enclosed within two stator members. Both the rotor and stator halves carry teeth enmeshing with each other. Latex compound and air are metered accurately in the right proportion to this head and broken into a fine foam. In a second mixing chamber, the zinc oxide, foam stabiliser and silicofluoride are metered in and mixed into the foam. The complete foam then passes through a polyethylene hose to a moving line of moulds which are closed automatically when full. During the progress of the moulds on the conveyor belt, the foam gels and the moulds then enter the vulcanising chamber.

In this process the time required for the foam to enter into the moulds after introduction of the gelling agent is quite short and hence very fast gelling times, e. g. of the order of two minutes are possible.

Construction of the moulds: The moulds for foam rubber are usually made from aluminium because of the lightness, durability and good heat conductivity of the metal. Stainless steel may also be used. Freedom from copper and manganese must be ensured.

When cushions and mattresses are made cylindrical cores are attached to the lids which give the underside of the moulded foam the characteristic "honey comb" apperance. The crores are generally of such size that at no point the actual wall thickness of the product exceeds three-quarters to one inch. The main object of this type of construction is to ensure adequate vulcanisation in the centre of the foam. There is a great saving of material because of the hollow spaces which also cut down and distribute shrinkage which would otherwise distort the product. Closed moulds are normally used, but the lid should be provided with small holes to allow escape of air from the cavities during the closure of the mould. When designing the mould, allowance should be made for shrinkage of the sponge or drying, which usually amounts to some 10-20% by volume.

Some sort of stripping aid (mould lubricant) should be applied to the mould for easy removal of the product. Silicones and solutions of polyethylence glycol (e. g. Vulcastab PG) have proved to be very effective mould lubricants. A 5% solution of Icipol RD prepared by dissolving in warm water can also be used.

3) Vulcanisation

The foam gel is a poor conductor of heat and for this reason vulcanisation in hot air rarely effective. Steam at atmospheric pressure is normally used for curing moulded foam products. The aim should be to secure adequate vulcanisation of the interior of the foam within a reasonable time and without overcure of the surface, and hence the vulcanisation time required will depend on the thickness of the product. In normal cases a period of 30–45 minutes would be adequate.

Thin layers of foam, e. g. as used in carpet backing, can be suitably cured by hot air.

4) Washing and Drying

After vulcanisation, the foam product is stripped from the mould and trimmed to remove any flash. It is then thoroughly washed in water to remove the salts and soaps and eliminate odoriferous residues. Washing is generally carried out by passing the product between rollers under the surface of a water bath. With properly cured products, there will be no collapse during the operation.

The excess water after washing is removed by squeezing the foam between rollers or by centrifuging. The product is then dried in hot air oven at 60°-80°c. There must be a good circulation of air which should be constantly changed.

Common defects in foam making

The following are the common defects encountered during foam manufacture:

1. Shrinkage
2. Foam collapse
3. Settling
4. Complete distortion of the foam

1. Shrinkage

Under normal working condition, there is about 10-20% shrinkage of latex foam on drying and allowance for this should be made while designing the moulds. It has been experienced that maturing the latex compound before use considerably improves the shrinkage. If an excessive dose of the gelling agent is used very quick setting may take place leading to enormous shrinkage. The dosage of the gelling agent should therefore be correctly adjusted by preliminary trials. Often suitable modification of the gelling agent, e. g. adjusting the PH to 7.0 or adding a potassium salt which reduces the rate of hydrolytic decomposition of sodium silicofluoride helps considerably in controlling the gelling rate and the consequent shrinkage.

2 Foam collapse

In certain cases, specially with those latices which show too low a gelling pH, gelling may take too long a time so that the dispersed air system may be largely destroyed before the latex gel is properly formed. The result is a collapse of the foam structure Various secondary gelling agents e. g. Vulcastab TM, Vulcastab EFA, and Vulcafor DPG have been recommended to 'sensitize' the gel formation so that the rubber particles are destabilised before the dispersed air system is affected. All these secondary gelling agents cut down the gelling time by raising the gelling pH.

3. Settling

If the dose of the gelling agent is not sufficient to gel the latex in the desired time there may be settling of the gelling agent resulting in a non-uniform density of the foam.

4 Complete Distortion of the foam

Complete distortion of the latex foam may take place either by foam callapse or by incomplete vulcanisation. The dosages of the gelling and curing agents should therefore be properly adjusted and adequate curing time in open steam should be given.

Synthetic latices in foam Industry

Of the common synthetic latices, SBR and polychloroprene latex have found wide application in foam making, the former mainly as partial replacement of natural latex and the latter for special applications.

SBR Latex

Compared with natural latex SBR latex yields a foam of lower tensile strength and elongation at break. The hot tear strength is also poor, making the removal of the cured foam from the mould difficult. Because of these limitations, SBR latex is rarely used alone but in more usually used is admixtuje with natural latex. A typical foam formulation based on a blend of 50/50 natural and SBR latices is given below:

	PARTS BY WEIGHT WET	DRY
60% Natural latex (0.1% NH3)	83	50
69% SBR latex (Intex 100)	73	50
20% Potassium oleate solution	1.25	0.25
50% Sulphur dispersion	4	2
50% Accicure ZDC dispersion	2	1
50% Accicure ZMBT dispersion	2	1
50% Accinox SP emulsion	2	1
Foamed and then added		
50% Vulcastab EFA solution	1.5	0.75
50% Zinc oxide dispersion	8	4
20% Sodium silicofluoride	9	1.8

Cure: 45 mins, at 100°C in water or steam

Polychloroprene Latex

Polychloroprene latex foams possess superior flame, oil, chemical, and ageing resistance. The principal uses of these foams include, among others,shipboard mattresses journal box lubricators and hospital mattresses.

A typical foam formulation based on Neoprene Latex 601A is given below:

	PARTS BY WT (DRY)
Neoprene 60 IA	100
40% Petroleum emulsion	3
33% Permanax WSP dispersion	2
50% Sulphur dispersion	2
50% Accicure ZDC dispersion	2
Foam and then add:	
15% Vulcastab LS solution	0.01 or as required
50% Accicure TC dispersion	2
50% Zinc oxide dispersion	7.5
20% Sodium silicofluoride dispersion (or preferably equal proportions of the sodium and potassium salts)	2

Cure: Initial 30' at 120°C in steam, postcure (drying) 16 hrs, at 80°C

NATURAL RUBBER PRODUCTION AND DEMAND

The paper was presented at the two-day National Seminar on 'Rubber Industry by 2000 AD-A perspective Plan' organised by the All India Rubber Industries Association in New Delhi on 4 and 5, February 1987. Shri M. Arunachalam, Union Minister of State for Industrial Development inaugurated the seminar. The deliberations of the seminar highlighted various problems of the Association and it streamlined various measures for planning and decision making for the better development of the Rubber Industry.

In his paper presented there, Shri PC Cyriac IAS, Chairman, Rubber Board discussed in detail significant progress made by rubber producing sector and rubber using sector. The paper reveals that India has become the 10th largest consumer of rubber in the World. By the end of the century it may even attain the 7th position. Regarding the consumption, the Chairman said India's progress is linked with fast growth rate between now to 2000 AD according to the International Rubber study Group. Shri George Jacob Dy. Director (Marketing) who attended the seminar along with the Chairman gave a brief talk on the role of technically specified and speciality rubbers in the days to come.

Following is the paper presented by Shri P.C. Cyriac.

PC CYRIAC IAS

Introduction

The Rubber Industry which comprises mainly of the rubber producing sector and the rubber using sector has recorded commendable progress during the last 25 years. The production of natural rubber which in 1960-61 was 25,697 tonnes has increased to 200,465 tonnes in 1985-86. Estimated production during 1986-87 is 220,000 tonnes. The area under rubber has increased from 130,000 hectares in 1960-61 to 362,000 hectares in 1985–86. Productivity measured in terms of yield per hectare during the period has gone up from 365 kg. to 898 kg. Rubber plantation industry in India has been well recognised for its outstanding performance viz-a-viz other agricultural industries.

Production of synthetic rubber was started in 1963. At present two factories are producing synthetic rubber with a total capacity of 52,000 tonnes. The total output of synthetic rubber in 1985–86 was of the order of 35,000 tonnes.

Consumption of rubber (Natural and Synthetic) which is considered as the index of performance for the rubber goods manufacturing sector, has gone up from 55,545 tonnes in 1960-61 to 305,475 tonnes in 1985-86. During 1986–87 consumption is estimated to touch 326,000 tonnes. The average annual compound growth rate in consumption during the 1970's was 6.0% During 1980's it has beNn 6.6% so far. As a result of the tremendous progress, India has become the 10th largest consumer of rubber in the world and by the close of the current century the country could rise to the 7th place according to the demand forecast of the International Rubber Study Group (IRSG). India is ranked as one among the four countries which are expected to have the fastest growth rate in rubber consumption between now to 2000 according to the IRSG.

Demand potential

Demand for rubber depends on the production of various rubber goods. India is claimed to be producing 35,000 different manufactured rubber products. The present pattern of use of rubber is as shown below:-

Automobile tyres & tubes	- 52%
Cycle tyres & tubes	- 12%
Tread rubber	- 5%
Footwear	- 11%
Belts & hoses	- 6%
Latex foam	- 4%
Others	- 10%
Total	-100%

From the above it is evident that tyres are by far the biggest single outlet for rubber. Therefore, economic, environmental or technological changes which influence the design, performance or output of tyres will have important effects on the demand for rubber.

The major economic and technological changes in the Indian tyre industry in recent times have been the following:-

1. Replacement of cross ply construction of tyres by radial ply construction can have a negative effect on rubber consumption. A reduction in the rubber consumption to the level of 50% in car tyres and 55% in truck tyres per running km is possible due to the change over. During 1984, 42% of the world production of truck tyres was of the radial ply category. By 1995 the proportion is estimated to go upto 90%. In the case of car tyres the proportion is estimated to change from 72% to 95%. Almost the entire production of tyres in India is in cross ply category. However, a small beginning has been made in the production of radial tyres for passenger cars by a few manufacturers. Many of the tyre companies have been planning to switch over to radial tyres. The Satyapal Committee on tyres and tubes recommended that "early measures should be taken to speed up the pace of introduction of radial tyres within the country on account of the significant advantages from this improved variety of tyres to the economy".

2. Introduction of the cold cure technology for retreading of tyres in a massive way can result in the extension of the life of the tyres by about 50% or more.

3. Continuous improvement in the casing design of tyres favouring remoulding will have a dampening effect on replacement demand for new tyres.

4. Downsizing of both automobiles and automobile tyres is yet another factor that will have a negative effect on the use of rubber. In this context the introduction of a number of Japanese vehicles in the country need noticing.

As a result of the above developments in the tyre manufacturing sector, consumption of rubber in future may not increase as it did hitherto. Liquid injection moulded tyre (LIM) developed by Polyair Maschinenbau GmbH is also worth mentioning in this context. While this is a potentially significant development and is likely to be the forerunner of similar developments, it is unlikely to effect any impact in rubber demand during the next few years. Development of thermoplastic natural rubber on the other hand opens up new exciting vistas including recovery of ground already lost to plastics. Application of rubber in new areas is also being explored.

Considering all these developments and also taking into account the good potential in non-tyre sector, the demand for natural and synthetic rubber is estimated to go up to 395,000 tonnes by 1989-90 and to 650,000 tonnes by 2000 A.D. This closely agrees with the projection of the IRSG which is 648,000 tonnes for the year 2000.

of rubber cultivation up to the year 2000 is estimated as 300,000 hectares, the break-up of which is as follows:-

Kerala, Karnataka and Tamil Nadu	- 85,000 ha.
Assam & Meghalaya	- 50,000 ,,
Tripura	- 30,000 ,,
Orissa	- 50,000 ,,
Andamans & Nicobar Islands	- 20,000 ,,
Goa & Maharashtra	- 30,000 ,,
Other States/ Territories	- 35,000 ,,
Total	- 300,000 ,,

Development of rubber plantations in all these lands, particularly in non-traditional areas would no doubt require immense efforts. Progress in non-traditional areas will be weighed down heavily by various constraining factors. Considering the need for fast development and the importance assigned to non-traditional areas in future expansion of the programmes, the Government of India had approved a project for accelerated development of rubber plantations in North Eastern Region. It is under

CONSUMPTION OF RUBBER

(Qnty. in tonnes)

Year	Natural	Synthetic	Total
1960–61	48,148	7,397	55,545
1965–66	63,765	21,553	85,318
1970–71	87,237	33,160	120,397
1975–76	125,692	32,452	158,144
1980–81	173,690	47,050	220,680
1985–86	235,440	70,035	305,475
1989–90 (Projection)	315,000	80,000	395,000
2000 (-do-)	520,000	130,000	650,000

Production potential

The main factors of production are:-

1. Area under rubber
2. New planting and re-planting
3. Planting materials
4. Cultural practice and tapping system
5. Price

New planting and re-planting

According to the present assessment, area available for expansion

implementation from 1984. The project envisages providing necessary infrastructure for the development of rubber plantations in the region, including establishment of a Research Complex and a large Training and Demonstration farm. Similarly projects for other parts of the country are being prepared for the approval of the Government of India. A Rubber Plantation Development Scheme is under implementation from 1980-81 onwards for encouraging extensive newplanting and replanting and by granting financial and technical assistance.

The extent likely to be brought under rubber during the 7th Plan period is estimated as 55,000ha. as against 52,000 ha. achieved during the 6th Plan period. During the 8th Plan period expansion of rubber area is contemplated in an extent of 75,000 ha. Plantations raised after 1994 will not be mature for tapping till the year 2000 and they are not taken into consideration in this paper.

Plantations raised upto 1970-71 will outlive their economic life period by the turn of the century and will require systematic rehabilitation. The present aim is to replant 25,000 ha. during the 7th Plan period as against 18,000 ha. achieved during the previous Plan period. Further programme is to raise the replanting rate to 50,000 ha. each during the 8th and 9th Plan periods so as to complete the entire area requiring replantation.

Productivity

There is possibility to step up productivity substantially as a result of the popular use of high yielding varieties, widespread use of fertilisers based on soil and leaf analysis, application of yield stimulants and rainguarding, reduction of immaturity period by adopting modern planting techniques and better exploitation and processing practices. The yield potential of newer clones developed and released by the Rubber Research Institute of India (RRII) and now in large scale use is 2,000 to 2,500 kg. per ha. as against the materials with yield range of 1,000 to 1,500 kg. per ha. used during the 1960s and 1970s. By 1989-90 the average productivity in rubber plantations is estimated to reach 1000kg. mark from 900 kg. during 1985-86. By the turn of the current century productivity could be further increased to 1400 kg.

Price

A steady and remunerative price is essential for the sustained growth of the rubber plantation industry. Small holders who account for about 77 per cent of the total rubber area react very quickly to price changes. A good degree of price stability had been achieved during 1985 and early 1986 with the periodical monitoring of supply, demand and price trends and release of imported rubber at a fixed price by adjusting suitably the import duty. The trend in market price during the last four years was as shown below:-

Average price of RMA-4 in Kottayam market (Rs/quintal).

1983	1672
1984	1689
1985	1694
1986	1670

Of course there has been short term fluctuations during the last few years. In February 1986, Government had approved a bufferstocking scheme with a view to maintaining a stable price for rubber which is remunerative to the rubber growers and fair to the manufacturers. For giving necessary guidance to the State Trading Corporation, which is operating the scheme, the Government have recently constituted a small committee consisting of a representative each of the Ministry of Commerce, Ministry of Industry, the RubberBoard and the STC.

The plantation industry in India has been often dubbed as a high cost producer of rubber. It is true that the cost of production in India is to an extent higher than that of Malaysia, Indonesia, Thailand and Sri Lanka. However, it is less than that of countries like China, Brazil, and Nigeria. There are various reasons for this. It is relevant to mention the most important ones:

The geographical handicaps,

Rubber tree flourishes and yields best in warm, equable and tropical climate. Such conditions are normally obtained at low elevations in certain regions of the world lying within 10° latitude on either side of the equator. In India, Kanyakumari District of Tamil Nadu and Nicobar Group of Islands are the only regions falling within this geographical limits. Areas lying outside this belt experience pronounced seasonal variations in climate such as excessive rainfall, extended drought, cold winter etc., which are all factors affecting growth and yield of rubber to varying extents depending upon the severity of the incidence of each or all these climatic variations. Most of the rubber growing areas in India lie in marginal and submarginal locations and suffer from high incidence of diseases necessitating expensive control measures, rain interference of tapping which calls for rainguarding, loss of tapping days which reduces yield and lengthening of immaturity period which results in increase in capital investment. Rubber plantations in India also exist mostly on slopy lands where the relative absence of easy workability and the need to have effective soil conservation measures become responsible for higher costs and reduced labour output.

- High cost of such essential inputs as fertilisers, weedicides, plant protection chemicals, coagulating acid, petroleum fuels and fuel wood.
- Low productivity of tapping labour. While in Malaysia, for instance, the daily tapping task for a worker is 500 to 600 trees, it is only 250 to 300 in India.

There is also a wrong impression that the abnormally low prices which prevail in South East Asian markets during the last few years represent a fair level of world price. Actually even for the higher productivity obtained under the favourable climatic conditions of Malaysia, the price realised by the Malaysian farmer is not considered fairby him and naturally he is not working hard to improve the production and productivity. No wonder, the Malaysian rubber production and productivity are not going up. The Government has appreciated this situation and have decided to make available a steady and stable price which is remunerative to the growers and reasonable and affordable for the manufacturing industry. From the point of view of the manufacturing industry also, price stability at a reasonable level and the ready availability of rubber of the appropriate quality are the important considerations.

Coming back to the production figures, for projecting the production, the tappable rubber area in each year has to be worked out, based on the year of planting. This area has to be distributed among the different age/yield groups as the yield of the rubber tree increases gradually from the 1st year of tapping to the 5th to 7th year of tapping, then remains more or less steady upto the 17th to 20th year of tapping and thereafter starts declining. Production is then computed by multiplying the tappable area in the different groups by the corresponding yield per hectare. The loss of production due to replantation and the increase in production as the newplanted and replanted areas reach tappable age, are also taken into account. Based on these parameters, the production of natural rubber upto 2000 A.D. has been estimated as follows:

Year	Total Area ('000 ha.)	Tappable Area ('000 ha.)	Yield per ha. (kg.)	Production ('000 tonnes)
1985-86	365	223	898	200
1989-90	405	280	1000	280
1999-2000	570	410	1400	575

I can see two doubts in your minds. One, will the rubber plant grow well and yield rubber at a reasonable cost, in the non-traditional areas which do have many adverse climatic factors?

Here, we do not have to live on hopes alone. Rubber tapping has already begun in about 430 ha. in Tripura and 130 ha. in Assam. Considering the poor quality of the early planting in Tripura the yield obtained now is very encouraging and the Assam plantations which were of high yielding varieties though maintained in an unsatisfactory manner, have been giving yields of around 1000 kg. per ha., which is better than today's average production even in Kerala. Research facilities have also been set up in the North East to find solutions to the local problems and improve productivity.

The second question which is relevant is concerning synthetic rubber. Should not we also try to emulate the rest of the world and increase synthetic rubber consumption or should we pursue the present policy itself? The following points are relevant.

i) The high initial cost. The synthetic rubber plant is a more capital intensive unit than the rubber plantation. Investment required per unit of rubber produced is three times more in the case of SR. A sizeable portion of this investment will have to be in foreign exchange.

ii) SR plant generates much less employment opportunities than what an equal amount invested in plantations can generate. One unskilled worker per ha. is the job potential in a rubber plantation.

iii) SR production requires costly energy inputs, while the rubber plant produces natural rubber as a result of photosynthetic action without any energy inputs.

iv) While the SR plant produces effluents which call for costly treatment procedures to avoid environmental pollution, the rubber tree purifies the air and the environment by releasing oxygen into the atmosphere.

v) The rubber plantations which are generally raised along slopes with contour bunds and grown in association with a leguminous cover crop providing a ground cover, prevents soil erosion, regenerates soil and improves the micro climate of the area substantially.

vi) Most of the areas considered fit for rubber cultivation in the North East and other new regions, are already badly denuded as a result of indiscriminate jhuming (shifting cultivation). By growing rubber in such lands they can be regenerated, the economically backward tribals and others got fixed on to the land and their entire pattern of life will undergo a big change. They will start working hard once they find the latex flowing out of the bark of the tree. Steady employment and steady income will change their outlook completely. This will usher in a big social revolution in these backward regions.

In view of all these reasons, we should not fail to take advantage of the full production potential of natural rubber before exploring other avenues to meet our polymer requirements. □

Rubber Plantations - An Effective Economic Activity to Generate Employment Among Women*

PK NARAYANAN

Rubber is a perennial crop which has an economic life span of 30 to 35 years. It combines several advantageous features such as prevalence of remunerative price for the produce, round the year return from the trees and attractive incentives for planting, processing and marketing. These factors have resulted in widespread adoption of this crop elevating it to the third biggest position in the State after rice and coconut. As on date there are over 3 lakhs hectares under rubber in the State; which accounts for 90% of the area and production of natural rubber in the country.

Labour intensive enterprise

Rubber planting is one of the most labour-intensive agricultural enterprises. One hectare of plantation has been found to provide direct employment to one person (0.7 person per hectare to be exact) and indirect employment to a small family. The Rubber Plantation Development Scheme of the Rubber Board being implemented since 1979, provides to meet the entire cost of cultivation besides extending free extension and advisory services, which is hailed as the most imaginative agrarian development programme ever fielded in the farm sector. This is probably the largest single factor that has accelerated the adoption of rubber cultivation in the State.

Economic unit

With the advent of yielding rubber clones like RRII 105 the concept of 'economic unit' of rubber plantation has been redefined. 10 trees of this clone is capable of yielding up to 1 kg of dry rubber per tap. With the price of a kg of dry rubber ruling between Rs. 16 and 17, even 50 trees can maintain a family ie. under the alternate system of tapping, out of 50 trees only 25 trees will be tapped a day which will yield about 2½ kg of dry rubber. This can be sold for about Rs.40/-.

This points to the possibility of raising rubber as a backyard crop in homesteads. One cent of land can accommodate 2 rubber trees. Therefore for planting 50 trees the area required is only 25 cents. This can be fully attended to by women. In fact many households in Kerala are practicing it.

Avenues for employment

Almost all the operations in a rubber plantation can be undertaken by women, leaving probably such operations like cutting down the trees, preparing the land, digging pits and planting.

Tapping

The most important item of work which could be gainfully performed by women in rubber plantation is tapping. In fact a large number of women are now employed as tappers in proprietory rubber estates. In owner operated small holdings also mostly women are tapping the rubber trees.

Tapping is a skilled job. Wages of tappers also are remunerative. The recent notification of Government has revised this to Rs. 22.78 per day for a task of 300 trees. Though this is meant to be enforced strictly in units covered by Plantation Labour Act, many a small holder also abide by this.

Rubber Tapping is an avenue, where women workers could seek employment on a large scale. In order to impart theoretical and practical training to those who aspire to take up tapping, the RubberBoard is running a few Tappers' Training Schools in different parts of the State, where the trainees are given free tuition, boarding and lodging. Though hundreds of trainees have taken advantage of this programme, it is strange that only a handful of women workers availed of this opportunity to acquire this unique skill. It would be worthwhile to train women in these schools, which could be taken up with the Rubber Board by the appropriate agencies.

Other items of work

Maintenance of nurseries, weeding, manuring after care of young plants like white washing, mulching providing supports etc. are certain other items now attended to by women. Processing of the latex including transporting latex to processing sheds, straining, coagulation, sheeting, smoking etc. could also be handled by women.

Benefits of planting rubber

Rubber is emerging as a new 'Kalpavrikha' for Keralites. Every part of this tree is usable to man. It yields precious timber, which is considered good as a building material for houses and other structures, if it is subjected to proper treatments. Rubber logs have several other uses also, such as fabrication of packing cases, TV and Radio cabinets and other precision components.

Rubber seed is a rich source of the oil, used in soap industry. Rubber seed oil cake is a good cattle feed and organic manure. Besides all these the rubber tree exudes honey which fetches a reasonable income. Bee keeping is a feasible economic activity which could be undertaken in rubber plantations.
It is reported that 60% of the honey produced last year in Kerala was from rubber plantations. This is yet another activity which could be taken up by women on a large scale.
The Khadi and Village Industries Commission is imparting training and extending a variety of incentives to those who are willing to choose Bee keeping as a vocation.

For women

Rubber Plantation Industry thus offers a vast avenue for employment opportunities for women. But it depends how best these are made use of. It is up to the Rural Development Units, voluntary agencies, Women's organisations and concerned Departments of Governments to initiate action to ensure participation of women in various operations in rubber plantations. As a lucrative economic activity which generates employment opportunities for rural women rubber plantation could go a long way in resolving the already grave malady of job-less-ness among women.

* Paper presented at the national seminar on 'Women and Rural Development' held at the College of agriculture Vellayani in Jan-1987 organised by the College of Rural Home Science, under the Kerala Agricultural University.

□

EXTRA-FLORAL NECTARIES IN *HEVEA BRASILIENSIS*

L. THANKAMMA and K. V. GEORGE

Eventhough the source of honey in most other plant species is the flower, in the case of rubber tree, it is the leaf. Bee keeping in rubber plantations is getting acceptance now a days. As early also as in 1968, work was conducted on the extra floral nectaries of rubber and a paper was published describing three types of nectaries. Of these, one was an original finding by the author Smt. L. Thankamma, now working as Mycologist in the Rubber Research Institute of India. Though some articles are written and published in journals on the topic, most of the rubber planters are still unaware of the source of honey in rubber. There is also a feeling among so many that rubber honey is produced in the flowers. We are now reproducing the paper published in the Rubber Board Bulletin Vol. 9 No. 4 (1968). ~~The late~~ K. V. George, the co-author of the paper was Deputy Director in the Rubber Research Institute of India in 1968 and later became the Director of Cardamom Development, Cardamom Board, Ernakulam.

Hevea brasiliensis is monoecious with diclinous flowers arranged in panicles. According to Dijkman (1951), the plants are typically entomophillous cross pollinators. The studies of Mass (1919), Morris (1929), Seibert (1947), Muzik (1948), Warmke (1951, Sripathi Rao (1961) and Jayarathnam (1965) also show that insects play an important role in the pollination of *Hevea brasiliensis*. Various characters of the flower, viz, colour, fragrance, sticky nature of the pollen and stigmatic surface, further point to insects as the most favourable pollinating agents. Considering that *Hevea brasiliensis* is predominantly adapted for insect pollination, that various insects including honey bees have been observed to be active and numerous during *Hevea* flowering season and that bee hives kept in rubber gardens during flowering season, yield plenty of honey, it is to be expected that nectar is secreted by some part of the plant.

While no floral nectaries have been observed in *Hevea brasiliensis*, two types of extra-floral nectaries have been reported. Martius (1873) in his "Flora of Brazil." and Delpino (1887) in his studies on extra-floral nectaries, mention about the presence of nectaries, on the poliage leaves viz. the petiolar nectaries. The structural details of these petiolar nectaries are described by Daguillan and Coupin (1903). Parkin (1904) in his paper, "The extra-floral nectaries of *Hevea brasiliensis*," reports the occurrence of nectariferous bud scales, in addition to the petiolar nectaries and gives an account of their structure possible evolution and functions. Bobilioff (1923) in his "Anatomy of *Hevea braiiliensis*," while describing the structure of the petiole, mentions about the presence of a small disc with several glands on the petiole at the point of insertion of the leaflets and these are reported to function only in the young stage, when they give off excretory products. He also reports presence of special openings, viz., hydathodes, seen as pin holes, on the lower surface of the leaves and states that these are of assistance in getting rid of excess water, in a liquid form, at times when the stomata fail to function.

In the present paper, the authors have attempted to give a detailed account of the extra-floral nectaries already reported by earlier workers, viz., petiolar nectaries and nectariferous bud scales. Further, occurrence of another nectariferous structure is also reported. These are the glands on the lower surface of the leaves and wrongly defined by Bobilioff (1923) as hydathodes.

Observations

Three different glandular structures, all foliar in origin, were observed to secrete a colourless, sticky and sugary iiquid, viz., nectar. These are the nectariferous bud scales, nectariferous glands on the petiole tips and the nectariferous glands on the lower surface of the leaf lamina. The morphology, anatomy and functions of these glandular tissues, observe to secrete nectar, are described.

Nectariferous bud scales

In young shoots of *Hevea*, a varying number of small, green, fleshy scales are seen developing on the stem, towards the terminal bud, below the whorl of tender flush (Fig. 1). Normally, these scales subtend an axillary vegetative bud, but during flowering season, the top most scales may subtend inflorescences. In young actively growing shoot, the transition from these fleshy scales to normal leaves can be clearly seen (Fig. II). The lower most scales are short, roundish, gradually tapering to a pointed tip and highly curved outwards. The outer convex surface is slightly raised, pale, yellow, made of glandular tissue and with a longitudinal median groove. At the pointed tip a number of trichomes are present. Towards the terminal bud, the scales gradually become more elongated and straightened. The glandular portion shows gradual reduction in size and gets confined to the middle region of the outer convex surface. Simultaneously, the longitudinal groove gets less prominent and in the top most scales they are not visible. Along with the elongation of the scales and simultaneous reduction in the glandular tissue, three abortive leaflets appear at the tip of the scale as thin bristles. The upper most scales are devoid of the glandular tisue and they carry at their tips three leaflets which resemble the normal leaflets in shape and structure, but much reduced in size (Fig. II,7-8). Few such scales resembling typical leaves except for their reduced size, may be seen just below the whorl of true leaves. These as well as the glandular scales below are shed as the true leaves mature.

The glandular tissue on the lower fleshy scales secrete nectar profusely, during flowering season. The nectar secreted collects into small droplets which often coalesce and trickle down. The drops of nectar are large in the morning hours, slowly drying up in the sun.

A microscopic study of longitudinal sections of the glandular scales showed that they are fleshy structures, composed mostly of parenchymatous tissue and poorly developed vascular elements bounded by cuticularised epidermal layer. The scale is bounded on all sides by normal epidermal cells, excepting the outer convex surface where the epidermal cells get modified into a glandular tissue, covered on the outside by thick cuticle. The glandular tissue is made up of thin-walled columnar or pappilose (shaped) cells and characterised by dense cytoplasm Many of these cells are divided by tangential walls into two or sometimes three daughter cells. Due to pressure of nectar secreted by these glandular cells, the cuticle bursts. Just below the glandular tissue, a layer of compact isodiametric parenchymatous cells is noticed, beneath which normal parenchyma is seen. In the parenchymatous tissue, vascular traces are seen small branches of which end below the glandular region (Fig. III).

Apart from the nectariferous bud scales, a few basal scales, which are small, thin and non-nectariferous are also observed (Fig. I-1). These basal scales protect the dormant bud and as soon as the bud sprouts, they shrivel, dry up and fall off.

Nectariferous glands on petiole tips

At the distal end of the petiole, in the region of insertion of the leaflets, a varying number of glands one to seven—usually three—are noticed. These glands are circular to oval or even irregular in shape, with slightly raised margins. Quite often, two or more of these glands are observed to unite attaining irregular shapes (Fig. IV). The glandular area is paler than the surrounding area.

In surface peelings, they appear as groups of small, nonchlorophyllated cells. In longitudinal section, the gland is seen to be made up of a group of thin-walled columnar cells, nonchlorophyllated, rich in cytoplasmic contents, as seen in the case of the glandular portion of the nectariferous scales. A cross-section of the petiole tip where the glands are situated, shows that the upper and lower epidermis are normal, except at the region of the glands, where the epidermal cells are modified to form the thin walled columnar cells. Many of these cells are divided by tangential walls forming two or three daughter cells. Beneath this epithelial layer, a single layer of isodiametric, nonchlorophyllated, parenchymatous cells is noticed, beneath which normal parenchymatous tissue is observed. Small branches of vascular traces arising from the central vascular tissue are seen ending below the glandular layer (Fig. V). The individual glands are observed to secrete small drops of nectar which often run together forming bigger drops. These glands do not function during the early stages of leaf formation or long after the leaves have attained full maturity. The secretory function is predominant following refoliation when the leaves have turned green, fully expanded and no more flaccid. Once the leaves are fully matured, the glands become functionless, the tissues shrivel and get discoloured.

Nectariferous glands on the lower surface of the leaf

These glands are seen as minute yellowish spots, numerous and irregularly distributed on the lower surface of the leaf. On microscopic examination, in surface view, these are seen to be more or less circular in outline and slightly raised above the surrounding surface, the glandular area being composed of small cells and delimited by a ring of highly lignified cells (Fig. VI). At the region of the gland, the leaf is slightly thick. The upper epidermis is normal. The depth of the palisade tissue is considerably reduced. Below this is seen a vascular trace, the end of which is towards the lower glandular portion. The region below is composed of compact parenchymatous cells, many of which are devoid of chloroplasts, in place of the normal chlorophyllated and loose spongy parenchyma. Below this, a compact layer of isodiametric cells, without chloroplasts is seen. Immediately beneath this, is seen the glandular layer, composed of thin walled columnar cells, (devoid of chloroplasts) and rich in cytoplasmic contents.

Some of these cells are divided by tangential walls into two cells. The lower surface of these cells is rounded and covered with a thick layer of cuticle (Fig. VII). The nectar secreted is seen as small droplets, suspended from the lower surface of the leaf, at the regions of the glands. A close similarity in the anatomy and functions of the three nectariferous glands described above is noticed. In all cases, the secretory epithelium consists of modified epidermal tissue in the form of thin walled, nonchlorophyllated and columnar cells, which by later tangential wall formation, forms two or three daughter cells in some cases. The glandular region is well supplied with vascular elements. Further, secretion of nectar has been observed in all the three cases.

In mature plants, these nectariferous glands normally function only for a short period, confined to the refoliation time, which significantly coincides with flowering. In *Hevea brasiliensis* refoliation and the more or less concurrent occurrence of the main flowering, normally occurs in this country, during January-March period and it is during this period, that these glandular tissues have been observed to be actively functioning, secreting nectar. In young rubber plants where several flushes of growth are produced in an year unlike the mature trees, functional nectariferous bud scales and nectariferous petiolar glands are noticed with each new flush of growth, which after a certain period become functionless. It was however observed that the nectar secreted was considerably low compared to the quantities secreted by the nectariferous glands in mature trees during flowering season.

Discussion

Earlier workers have reported the occurrence of two kinds of extra-floral nectaries, viz, the nectariferous bud scales and the petiolar nectaries, in *Hevea brasiliensis*. In addition to giving a detailed account of the structure and functions, of these two kinds of extra-floral nectaries the authors report the occurrence of a third kind of extra-floral nectary, viz, the nectariferous glands found on the lower surface of the leaves. Describing the occurrence of hydathodes in *Hevea brasiliensis*, Bobilioff (1923) states:

"On the lower side of leaves, besides the stomata, special openings are found whose function is analogous to that of the stomata. They may be seen as pinpoints on the lower side of the leaves. They arise as raised regions of the epidermis in which finally an intercellular opening is formed. The opening in the centre arises through the separation of cells and increases in size with the age of the leaf. Through this opening, the water exudes when transpiration through stomata does not take place" From the above description, it is clear that what Bobilioff has referred as hydathodes are the nectariferous foliar glands reported in this paper. Presence of one or more permanent openings is a characteristic of a hydathode. Though Bobilioff has reported the presence of such an opening arising by the separation of the cells, the authors could not observe any such opening in these foliar glands, even though leaves at varying stages of maturity were examined. Further, the secretion from these glands is a sweet and sticky liquid-nectar and not water as reported by Bobilioff. The absence of any opening, the presence of a secretory epithelium consisting of modified epidermal cells, similar to those noticed in the nectariferous bud scales and petiolar nectaries, the compact parenchyma below the secretory epithelium and the sugary nature of the secretion, are all clear indications that what Bobilioff described as hydathodes are really not hydathodes but nectariferous foliar glands.

Referring to the petiolar nectaries, Bobilioff (1923) states: "These glands apparently function in the young stage of the leaves. The openings arise through the splitting of the epidermal cells of the petiole." Contrary to the above observation, the authors could not find any openings in these petiolar glands, though several such glands at various stages of growth were examined. Further, these glands were not osberved to function till the leaves were fully expanded and mature.

Parkin (1904) reports that the nectaries of the foliage leaf are not prominent structures and that they do not differ as a rule in colour from the surrounding surface. The present observations differ from the above in that the petiolar glands are yellowish-green in colour in contrast to the green colour of the surrounding surface. The light colour of the glandular surface is due to the secretory epithelial layer.

Many entomophillous plants produce nectar, which attracts insects. Nectar is secreted by specialised cells either on the floral parts or on other structures outside the flower. Definite and elaborate structures adapted to secretion of nectar, occur in certain families e.g. Euphorbiaceae. In *Hevea brasiliensis*, a plant typically adapted for insect pollination, the occurrence of the three kinds of extra-floral nectaries described in the paper, could be considered as a feature providing attraction to insects. Parkin (1904) while describing the nectaiiferous bud scales and its functions, states: "The bud scale glands may be looked up-on as attracting ants to keep off insects injurious to the developing foliage. As soon as the foliage leaves mature, their own nectaries become functional and the scale ones being no longer required, wither and drop off." Different types of ants have been observed by th[e] authors feeding on the nectar from the bud scales of young plants. These may be keepin[g] off insects injurious to the deve[loping] foliage. However, in the case of mature plants whe[re] refoliation and flowering are more or less simultaneous, it

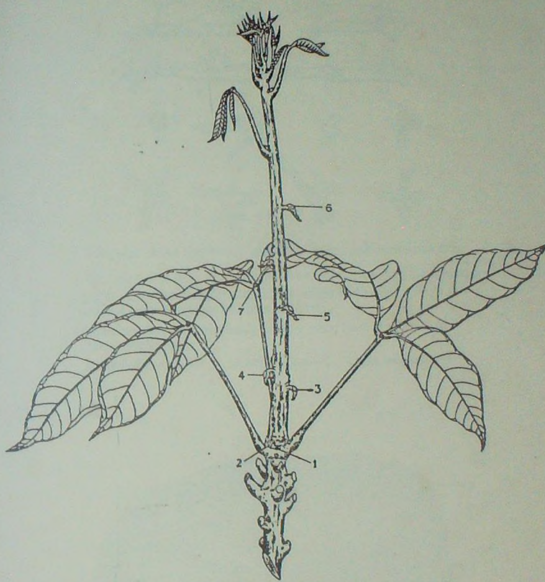


Fig - 1

Young shoot of *Hevea brasiliensis* showing glandular bud scales

1. Scar left by non-nectariferous bud scales.

2–6. Nectariferous bud scales. 7. Petiolar nectary.

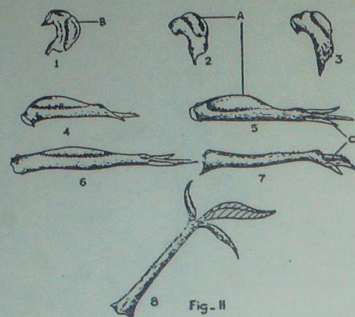


Fig. II

Nectariferous bud scales showing transition to foliage leaf

1-3. Highly curved lower bud scales.

4, 5, 6. Upper bud scales which are straightening out showing glandular area and highly reduced leaflets.

7 & 8. Upper most scales without glandular area and the leaflets more pronounced.

A—glandular area. B—median groove. C—reduced leaflets.

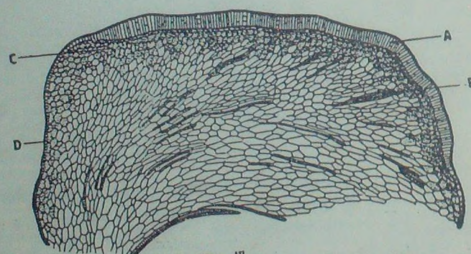


Fig. III

L. S. of nectariferous bud scale

A. Secretory epithelium consisting of modified epidermal cells.

B. Vascular trace. C. Chlorophyllated parenchyma.

D. Normal epidermis.

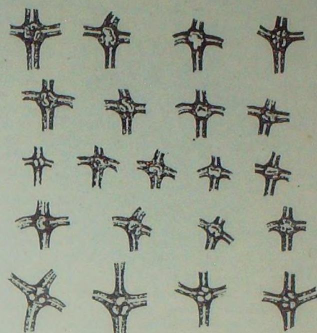


Fig - IV

Petiolar nectaries showing variation in size, shape and number

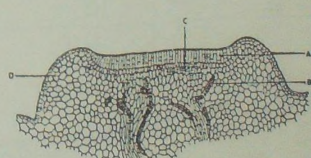


Fig. V

T. S. of petiole at the region of the nectary

A. Secretory epithelium. B. Vascular trace.
C. Chlorophyllated parenchyma. D. Normal epidermis.

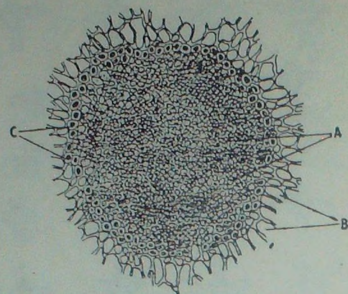


Fig-VI

Surface view of a nectariferous foliar gland.

A. Glandular cells. B. Normal epidermal cells.
C. Lignified cells delimitting the glandular portion.

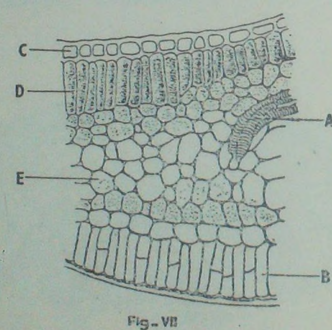


Fig-VII

T. S. of leaf through a nectariferous foliar gland

A. Normal upper epidermis. B. Vascular trace.
C. Secretory epithelium consisting of modified lower epidermal cells.
D. Palisade layer. E. Compact parenchyma.

would appear that the extra-floral nectaries serve mainly a function of attracting insects, some of which at least aid in pollination. It has been observed that all the three kinds of nectaries function simultaneously during *Hevea* flowering season. The bud scale glands have been observed to continue secretion of nectar even when the petiolar glands have developed and are functioning. It has also been observed that the quantity of nectar secreted by all the three kinds of nectaries are considerably more during the flowering season compared to other seasons. Further, Jayaratnam (1965) observed Indian honey bees feeding on the secretion from the petiolar nectaries and *Calliphorids* were found to perch on the ventral side of the leaves, when not visiting flowers and they were also found to feed on the nectar.

Summary

A short review of two kinds of extra floral nectaries of *Hevea brasiliensis*, reported by earlier workers is given. In addition to giving a detailed account of the structure and functions of the two kinds of extra-floral nectaries already reported, occurrence of a third kind of extra-floral nectary viz, toe nectariferous glands on the lower surface of the leaf, is also reported. Nectariferous bud scales are a characteristic feature of the young expanding shoots and they are present on both young as well as mature plants. There is close similarity in the structure of the three kinds of nectaries. Eech has a well defined secretory epithelium with a thick cuticle above. The secretory epithelium consists of modified epidermal cells, some of which may be two or three layered. In young plants, these extra-floral nectaries could be looked upon as attracting ants to ward off insects injurious to the developing foliage, but those on mature trees, during flowering season, could be considered as providing attraction for insects for aiding in pollination.

Acknowledgment

The authors wish to express their gratefulness to Dr. K.T. Jacob, Director, Rubber Research Institute of India, for the kind encouragement given during the investigations.

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RUBBER CONSUMPTION INCREASED

World rubber consumption increased in 1986 with United States showing a 1 per cent rise in demand. According to a report published by International Rubber Study Group, the world demand went up to 1.2 per cent in 1986 with Asia accounting for more than half of the increase. So also the synthetic rubber use rose by 1.5 per cent to 9.19 million tons and natural rubber demand went up 0.5 per cent to 4.38 million tons. Asian nations showed increase in rubber use. Demand went up 14% in South Korea, 10% in Taiwan, 6% in India, 5% in China and 4% in Malaysia.

CORPORATE IMAGE AND MEDIA MANAGEMENT

A one day programme on 'Corporate Image and Media Management' was organised at the International Hotel, Ernakulam on 7.3.1987 by the Kerala Chapter of the Public Relations Society of India. Shri P C Cyriac, Chairman Rubber Board inaugurated the morning session. Shri MD Nalapat, Editor, Mathrubhumi delivered the key note address. Shri PVK Namboodiri talked on corporate views.

Image building

Shri P C Cyriac in his inaugural address examined the factors influencing the image of an institution. The dedicated and disciplined employees or labourers contribute to the reputation of the Institutions to which they are attached. He cited the example of KSRTC the image of which is at the low ebb due to the misbehaviour of conductors or drivers to the public. On the other hand, the TVS has an excellent image among the public mainly due to its devoted employees. He said that the image is the sum total of the functioning of an Organisation. How image is brought out? It is only due to the successive efforts that a good image is built up. Larsen & Toubro, DCM TATA etc are some of the reputed names holding a good amount of credibility.

How to get out of the poor image? The only way out is simple and sheer hardwork, he said. There is no short cut to attain the objective. The employees must be prepared to work hard and earn the good-will of the people. According to the theory expounded by Geibels, if the lie is repeated hundred times, it becomes truth. But in the present day context, it never becomes true, he said. To make the organisation achieve its goals, solid work has to be carried out. Result oriented works will only expose dynamism and devotion to duty. Here, the relevance of Public Relations is increasingly felt. The good work done could be projected through the media. Good work is always to be made known. He said that Public Sector should come out with facts which should reflect its proper functioning. In conclusion he emphasised the need for the greater role the media has to play in fostering the image of the Corporate Sector.

Traditional Values.

Shri MD Nalapat, Editor, Mathrubhumi who delivered the key note address exhorted the media men to inculcate the traditional values. Based on a principle of correct assessment, newspapers also should be prepared to induct what is required taking into consideration the postures and positive responses of the changing times.

Had the Prime Minister opted some other day to visit Kerala except 7th, the day of the seminar, Shri Nalapat said that he would have spent more time with the delegates for a full day interaction with them.

Shri Namboothiri who offered his views on Corporate Sector advocated a smooth flow of information mainly through a two way track which will facilitate the functioning of the Public Sector. He also presented the erring views of both the Media and Corporate Sectors. Shri Namboodiri also explained in detail the problems confronted by the Public Sector. Earlier Shri PK Narayanan, Dy. Director (P&PR) of Rubber Board and Chapter Chairman PRSI Kerala welcomed the chief guests and delegates. Shri GPC Nayar, Secretary Kerala Chapter of PRSI proposed a vote of thanks.

Need for liaison

Media & Corporate Sector was the theme of the session that followed which was presided over by Shri N C George, Director, Institute of Management Training and Consultancy. Dr. P A Ramaswamy, Managing Director KTCO Ltd elucidated the corporate views of the Media. Shri P Rajan, News Editor, Mathrubhumi who spoke of the Media response, discussed at length his own personal experiences as a journalist and explained his views on Media activities and Corporate Sector. He categorically denied the indulgence of Media Men in corporate functioning. In fact, Newspapers have been instrumental to its growth and development, he said. Quoting examples he highlighted the need for a liaison between the two. Regarding the criticism of the Chairman and Managing Director, KSRTC for playing up the news of accidents and death toll forgetting other factors, Shri Rajan replied that the news of accidents and the resultant death toll is as important as any other important item to the Editor at the desk. Analysing the preindependent period Shri Rajan narrated the primary role of the Mathrubhumi in the struggle. Even after the independence, the paper made conscious attempts for social changes. He also identified the areas of cooperation between the two sides to foster better functioning in the respective areas of operation.

Professional Ethics

Shri B Unnikrishnan, Asst. P R Manager, FACT Ltd presented his thoughts on P R Response. He dwelt at length the principles for which a P R Professional stands. Demarcating the boundaries of professional ethics, he impressed upon the participants the importance of the public relations to the working of Corporate Sector. The delegates evinced keen interest in the discussions that followed.

At the second session on 'Public Relations - A Corporate Responsibility', Shri K R Hattangadi, Manager, Corporate P R, Union Carbide India Ltd made his opening remarks. Shri K B Nair, Managing Director, Kerala Soaps and Oils Ltd chaired the session. Shri P Aravindakshan Correspondent, The Week, offered his views on Media in a prepared speech read out on the occasion.

Role of Corporate Sector

Shri Hattangadi briefed the background of the big tragedy of Union Carbide by which about 2000 people lost their lives. Eventually, the Company lost faith and its image got tarnished. The senior executives of the company were arrested and put behind bars and constantly subjected to questioning by the authorities concerned. Regaining of the lost image would be practicable only by an ongoing process of building up the trust reposed on them by the public. He however, said the Corporate Sector plays a dominant role in the economy of the Nation and a true perspective of its functioning needs due coverage by the Media.

PR-truth alone

Shri P K Narayanan, Chapter Chairman repudiated the ethos of the convictions spread over a period which depended purely on conventional definitions. The negative thoughts are still nurturing most of the minds. There are people who still believe that Public Relations is white washing or liaison. Arranging accomodation or reserving Railway tickets are not PR functions! He strongly criticised the biased feelings being grown in the minds of certain persons. What is required is a change in the outlook and attitude. He defined Public Relations as truth and truth alone. It is a highly skilled job, he said. No other parameters could be attributed to the vision. The foremost quality of a P R man is his primary commitment to the profession. If it is lacking, one cannot do justice to his profession with the result he fails to discharge his functions properly.

During the course of his evaluation of the PR views, he pointed out the instances when the ethics of the profession is endangered in the hands of incompetent persons. This leads to severe consequences often. Turning to the Institutions and Corporate bodies, he said that if the Institution lacks credibility it cannot stand on its own legs. Having narrated his own personal experiences spread over a period of over two and a half decades, he outlined the true perspectives of PR Profession.

Concluding Session

The subject of the valedictory session concentrated on the "Changing Corporate Environment". Shri O P Joseph, Past President of the PRSI presided. Shri N K Gopalakrishnan, Managing Director, Plantation Corporation of Kerala Ltd explained his views on the role of Corporate Sector. Shri K P Joseph, Chief Manager (MS) Cochin Shipyard Ltd and K M M Ashraf, Manager SIDCO Ltd spoke on PR and Citizens and Role of PRrespectively. Delegates actively took part in the discussions that followed. Shri G P C Nayar proposed a vote of thanks.

About 40 delegates and 16 Student delegates participated in the seminar.

— **ARAVINDAN**
Publicity Officer

NEW RUBBER ACCORD

A new International Natural Rubber Agreement is in the offing Both the producers and consumers of natural rubber have ironed out the major points of discord that have hampered negotiations in the past. The break through in the latest rubber talks was made possible as the producers scaled down considerably some of their demands and there was greater flexibility on the part of the consumers on some of the key points.

Some of the fundamental aspects of the new accord are : regular price review every 15 months instead of every 12 months as advocated by consumers and 18 months under the present accord; automatic 5 per cent price revision if the market price exceeded INRO price during the 6 months preceding a regular review plus contingency stock of 150,000 to be brought at 152 Malaysian/Singapore cents a kilo of buffer stock purchases reach 400,000 tonnes; the flcor price of 150 Malaysian/Singapore cents is unchanged and also the currency combination in which INRO prices are quoted; current market intervention levels are also to remain the same. The new Agreement will come into force in October 1987 when the old Agreement expires. Experts feel that the main incentive for reaching an agreement was to avoid the disposal of 360,000 tonnes held in buffer stocks that might have become necessary if the talks had failed.

Use of Filler in Rubber Products Manufacture

Dr. B. BANERJEE *

The use of filler in rubber compounding is almost as old as practice as the use of rubber itself. Fillers used by the rubber industry can be classified broadly into two groups; namely reinforcing and non-reinforcing or inert filler. Inert fillers are generally used to reduce the compound cost. They hardly contribute the compound properties. Various inorganic fillers used by the rubber industry are clay (hard and soft), whiting, calcium carbonate, activated calcium carbonate, barytes, litherge, magnesium oxide, etc. I shall make brief menti on of application of some of these inorganic fillers:-

Soft clay

These are off white powder (particle size greater than 2mm) are used at high loading for low cost off coloured mechanical goods. They impart more hardness than whiting or calcium carbonate but lower resilience.

Hard clay

These are generally whiter than soft clays, hard clays impart more hardness and tensile strength than soft clays. Hard clays are used in high loading (to cut down compound cost) in mechanical goods, hose, flooring, shoe soling, etc.

Whiting, precipitated calcium carbonate and activated calcium carbonate

Whiting (mineral calcium carbonate) is used in high loading in low cost compound. Generally whiting and calcium carbonate hardens the compound to much lesser degree than clays (at the same loading). Thus for achieving the same hardness whiting or calcium carbonate can be loaded at higher degree than clay thereby reducing the cost of compound. However with calcium carbonate or whiting, the compound has poor tensile and tear properties than clays. Precipitated calcium carbonate is used in mechanical goods and proofing and offer better product appearance than the ground mineral. Activated calcium carbonate finds applications in softer compounds requiring smooth surface finish such as hot water bottle.

Barytes–It has a very high sp. gravity (4.5). It is used as an inert filler particularly in chemical and acid (sulphuric) resistant tank lining.

Lithophone

A mixture of zinc sulphide and barium sulphate (precipited) is used mainly as whitening agent in cheaper compounds.

Titanium dioxide

Anatase grade is used as a whitening agent. Rutile grade offers rather creamier colour but more stable at high temperature.

Silicates and silicas

Hydrated (precipitated) aluminium silicate and calcium silicate find application as a semi-reinforcing filler in non black compounds such as shoe soles and in mechanical goods. Both these silicates have some retarding effect which can be countered by using diethylene glycol or triethanol amines in the mix.

Precipitated silicas

Hydrated precipitated silicas are known to possess the highest reinforcing properties among the inorganic fillers. They generally have about 8 to 10% bound moisture and their particle size varies from 10–40 mm. Silica filler inherently retards the cure which can be compensated using DEG or TEA or higher levels of accelerator.

They also improve bonding between rubber and fabric particularly in the direct bonding system. However, silica filled mixes are generally hard and dry.

Carbon black

Carbon black continues to be the most versatile reinforcing filler available to the rubber industry and are available in tailor–made grades to suit compounder's specific needs. Generally speaking, finer the particle better the reinforcement (in terms of abrasion, tear, hardness, modulus, etc.) and higher the hysterisis loss, (hence higher the heat development in mixing and higher the heat generation in dynamic application) lower the yield and higher the cost. Generally there are four important properties to characterize a black; namely particle size, surface area, structure and surface chemistry.

* Manager (P & D) Carbon & Chemicals Ltd.

Effect of increasing particle size and increasing structure of black on processing and vulcanizate properties is given in Table–1. Struceure is important from the point of view of processing giving better dispersion and improved carbon black extrusion characteristics. Higher the structure, lower the extrusion shrinkage. Modulus and abrasion resistance increase with increasing structure, however, cut growth resistance is affected with increasing structure. With increasing surface area tensile strength and abrasion resistance increase resilience decrease and hence heat build up in dynamic application increase. The typical properties of some of the commercial black are given in Table–2.

The effect of carbon black loading on different physical properties of rubber vulcanizate is shown in fig. 1-8. It may be noted that with all black tensile strength increase with increased loading (extent of increase is more with finer blacks) attain a maximum followed by a decrease. Modulus and hardness increase with loading while elongation generally decreases with increasing loading. It may be noted that abrasion resistance increases sharply with increasing loading followed by a sharp decline. Therefore, a compounder should know the correct level of black required to attain optimum abrasion resistance. Resilience drops with increasing loading - the drop is more sharp in case of finer blacks hence consequently heat build up increases with increased loading. Thus it may be noted that quite often one property is achieved at the expense of the other.

Generally finer blacks are used for application which demand high reinforcement (high tensile strength and modulus, high abrasion resistance and fatigue resistance) such as tyre tread, shoe soles, outer cover of conveyor belting, hose, etc. While coarse blacks are used for application where comparatively softer compounds are to be designed such as carcass of tyre, cycle tube, tyre tube, etc. The choice of black for a particular end use application depends on the properties demanded by the service condition of the goods, compound cost, and last but not the least the philosophy of the compounder. Quite often for the same application, different blacks are used by different compounders, often combination of 2 or more blacks are used in the same compound. The quantity of blacks to be used in a particular compound should be such that optimum properties (as demanded by the service condition of the rubber goods) is achieved. Quite often a compound is designed to attain a particular degree of hardness. The amount of hardness imparted by different blacks in different rubber can be apparent from Table-3. Choice of types of different blacks for different application is given in Table-4.

State of carbon black in the rubber mix

When carbon black is mixed into rubber the first step is the penetration of rubber into the void space. This occurs before the black is randomly dispersed. If at this stage considerable rubber black interaction occurs subsequent dispersion is rendered more difficult since bound rubber cements many primary aggregates together. For this reason low structure, high surface area blacks are difficult to disperse-their small void space and dense packing leads to high local black concentration and their large surface provide ample opportunity for early interaction with polymer. At the same time such blacks are quite rapidly incorporated. It is only their subsequent dispersion into individual structure aggregates that is rendered difficult. High structure blacks are more slowly incorporated but more easily attain a satisfactory degree of dispersion eventually. Even in perfectly random dispersion of filler in rubber there exists many interaggregate physical contacts.

Reinforcement of elastomber blends by fillers

Reinforcement of blends generally follow the same pattern as the individual polymer. Generally polymer blends consist of micro dispersion of one polymer into the other or of intermingled micro-regions of both - when a filler is incorporated into such a blend a situation may arise that the filler may not get evenly distributed. The behaviour is common when the viscosity of two dispersed polymers vary widely.

During the mixing of filler into the preblend the soft polymer will penetrate the void space of black particles first so that there will pe a higher concentration of black in the softer region. This uptake of filler will thus increase the viscosity of the softer polymer and bring it on par with the other polymer when probably both will take the black in. If the blend is of two polymers, one of which is self reinforcing like natural rubber - better properties of the blends are obtained if the other polymer contains more black. There may also be an effect of rate of cure - one polymer may cure faster (and becomes more hard) than the other.

Carbon black v/s· non black reinforcing fillers

Volume of specific surface area of various filler (in m^2/cm^3) is given in fig. 4. It may be noted that these are not specific surface area (m^2/gm) as is conventionally used – hence the specific gravity of the filler also is to be taken into account if these are to be compared as specific surface area in m^2/gm. The precipitated silicates and silica covers the reinforcing and semi-reinforcing range of blacks. The talc and clay are in semi or non-reinforcing range.

Tensile strength is considered to be an important criteria for reinforcement which often is dependant on particle size. In amorphous rubbers the tensile

TABLE - 1

CARBON BLACK FOR COMPOUND PERFORMANCE

Effect of Changes in Surface Area and Structure on Rubber Properties

Properties/Process Characteristic	Increasing Surface Area	Increasing Structure.
Loading capacity	Decreases	Decreases
Incorporation time	Increases	Increases
Oil extension potential	Little	Increasse
Dispersibility	Decreases	Increases
Mill bagging	Increases	Increases
Viscosity	Increases	Increases
Scorch time	Decreases	Decreases
Extrusion shrinkage	Decreases	Decreases
Extrusion smoothness	Increases	Increases
Extrusion rate	Decreases	Little
Rate of cure	Decreases	Little
Tensile strength	Increases	Decreases
Modulus	Increases to max. then decreases	Increases
Hardness	Increases	Increases
Elongation	Decreases to min. then increases.	Decreases
Abrasion resistance	Increases	Increases
Tear resistance	Increases	Little
Cut growth resistance	Increases	Decreases
Flex resistance	Increases	Decreases
Resilience	Decreases	Little
Heat Build up	Increases	Increases slightly.
Compression set	Little	Little
Electrical conductance	Increases	Little.

TABLE - 2

Grade	I_2 No. Mg/g	N_2 surface Area, M^2/g	Tint	DBP CC/100 gm.	Pour Density g/1
N 220	120	122	115	114	349
N 339	91	96	110	120	336
N 330	82	85	102	102	380
N 326	83	86	103	72	460
N 550	43	45	–	119	355
N 660	35	36	–	90	425
N 774	27	31	–	70	495

TABLE—3

PARTS CARBON BLACK REQUIRED FOR 10 POINT INCREASE IN COMPOUND HARDNESS

FORMER INDUSTRY TYPE	ASTM DESIGNATION	YOUR CODE NO.	NR	SBR	IIR	CR	BR	NBR	EPDM
SAF	N 110		15	18	13	12	22	17	24
ISAF LM	N 231		19	23	17	15	28	21	30
ISAF	N 220		17	20	15	13	25	19	27
ISAF-HS	N 234		16	19	14	13	23	18	25
—	N 299		17	21	16	14	26	20	28
HAF-LS	N 326		21	26	19	17	32	24	34
HAF	N 330		19	23	17	15	28	21	30
HAF-HS	N 339		17	21	16	14	26	20	28
—	N 351		19	23	17	15	28	21	30
FEF	N 550		23	28	21	18	34	26	37
GPF-HS	N 650		23	28	21	18	34	26	37
GPF	N 660		25	31	23	20	38	29	41
GPF-LS	N 642		28	34	25	22	42	32	45
SRF	N 774		28	34	25	22	42	32	45
SRF-LM	N 762		29	35	26	23	43	33	47

TABLE-4

Effect of various fillers in SBR 1500 Compound

Base formula SBR 1500	–100
Zno	–5
St. acid	–2
Antioxidant (Ketoneamine type)	–1. 5
Sulfur	–2
MBTS	–1.5
ZDC	–0. 1

Filler	Phr.	Opt. Cure time (397° F)	300% modulus PSI	TS PSI	Hardness Shore A	Tear lbs/in	Complication set
N 330	50	10	1880	3270	64	205	17
N 220	50	10	1900	3360	64	205	16
N 550	50	10	1580	2680	63	225	18
N 660	50	10	1150	2310	60	130	17
Dhiting	50	20	170	280	50	45	36
Hard Day	50	20	320	1400	51	105	38
Hisil 233	50	20	280	2010	59	185	

Table–5

CHOICE OF BLACK FOR SOME PRODUCT APPLICATIONS

Product	Black generally used
Tread Rubber compound	Generally N 330, Sometimes N 220 ora combination of N330 and N220
Passenger Tyre (SBR Base)	N 220 and N 330 most commonly used
Radial Passenger Tyre	N 339, Common N 330 and N 220 can be used.
Truck and bus (NR or NR BR blend)	N 220, N330 Common
Inner Tubes	N 660, N550, N 550/N 774 50:50 blend common
Carcass compoud	N 660, N 550 Common
Cushion gum	N 660 common
Flaps	N 660,N 774
Inking rolls	N 774, N 550
V Belts	Generally N 550 also N 774
Conveyer belt cover	N 330 or N 220 or a combination of both
Friction compound for conveyer belt	N 550 N 660 or N 774 common.

strength reaches an optimum value as filler loading increases. The optimum values are obtained at higher filler concentration with larger particle size filler. The maximum tensile values increase as the average particle size decreases and for the same material there is a correlation between particle size and tensile strength in amorphous rubber. However, different material with same average particle size used at or near their optimum loading give very different tensile strength.

Other than hydrated silica-other inorganic filler does not produce tensile strength any where near reinforcing blacks as may be apparent from fig. 11. The inability of inorganic fillers to equal the tensile strength reinforcement of carbon black at equal volume specific area and average particle size can be attributed to–(1) weak bonding and low interaction with rubber hydrocarbon phase, (2) difficult dispersion of high surface area hydrated silicas and silicates, (3) cure retardation and lower state of cure due to acidic surface characteristics. At high strain rupture is initiated by the formation of vacules at the filler rubber interface. Considerable efforts have been made to overcome these short–coming of silicas by surface treatment with coupling agent and incorporation of coupling agent during mixing, or even modifying the polymer with active functional groups. With these performances of silicas although improved- still it is far behind reinforcing blacks-particularly in resepect of abrasion resistance.

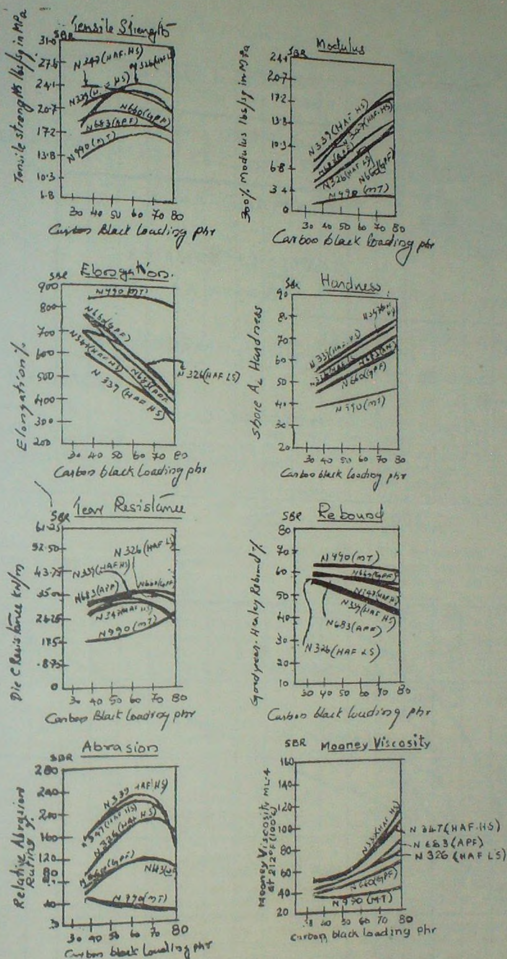
At a particular compound hardness the modulus of carbon black filled compound is much higher than that of a compound filled with an inorganic filler. Fig. 10 shows the modulus of SBR 1500 compound filled with different fillers at 55, 65 and 75 Duro hardness. High modulus performance of carbon black filled compound indicate high rupture energy and strain hysterisis.

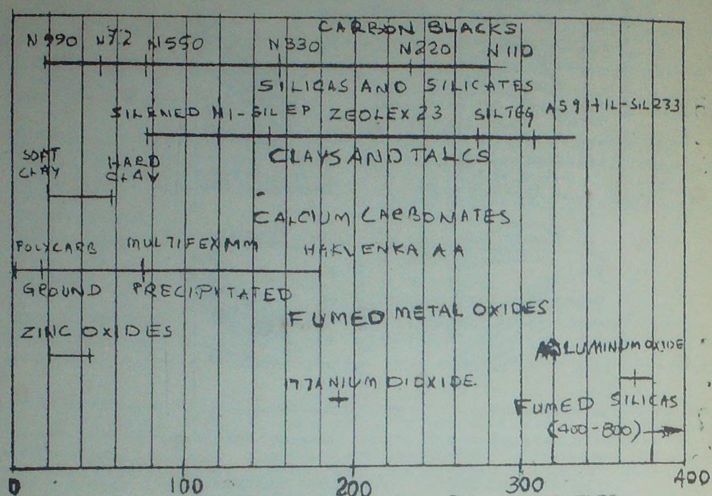
Compared to carbon black, inorganic filler has low levels of polymer filler bonding and the larger particle size varieties consists of individual nonaggregated particles which cannot immobilise or occlude significant amount of rubber phase. Smaller particle size hydrated silicas are aggregated and form transient structure but their low level of surface activity for polymer bonding results in small amounts of effectively immobilised rubber. Situation has somewhat improved with treatment of silica filler. Properties of SBR vulcanizate filled with different filler is given in Table-V.

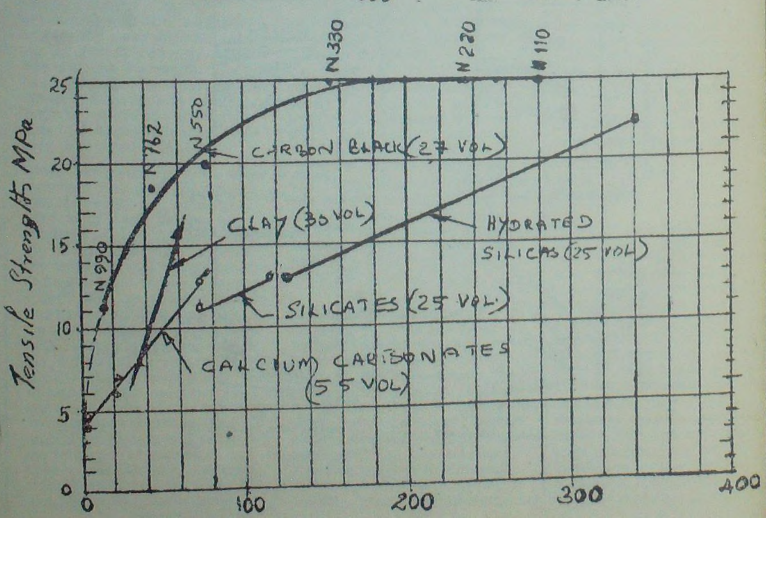
Precipitated silicas and silicates give lower extrusion die swell compared to high structured carbon black. In case of carbon black, die swell depends on structure and loading. At a particular loading of black, die swell decreases with increasing structure.

Conclusion

Inspite of its inherent black colour, carbon black continues to be the most versatile reinforcing filler for the rubber industry with tailor-made grades available for the compounder to meet his needs. Tremendous efforts made by silica manufacturers to improve its performance could not bring it on par with highly reinforcing tread black. Besides, high cost of silane coupling agent will also make the cost of silica prohibitive. Although some parts of black is some times replaced by silica in off the road tread compound, still perhaps there is no filler to replace carbon black


SBR Tensile Strength
Tensile strength lbs/sq in MPa
Carbon Black Loading phr
SBR Modulus
300% modulus lbs/sq in MPa
Carbon black loading phr
SBR Elongation.
Elongation %
Carbon black Loading phr
SBR Hardness.
Shore A Hardness
Carbon black loading phr
SBR Tear Resistance
Die C Resistance kN/m
Carbon Black loading phr
SBR Rebound
Goodyear-Healey Rebound %
Carbon black loading phr
SBR Abrasion
Relative Abrasion Rating %
Carbon black Loading phr
SBR Mooney Viscosity
Mooney Viscosity ML-4 at 212°F (100°C)
carbon black loading phr


CARBON BLACKS
N990 N762 N550 N330 N220 N110
SILICAS AND SILICATES
SILENED HI-SIL EP ZEOLEX 23 SILTEG AS9 HI-SIL 233
CLAYS AND TALCS
SOFT CLAY
HARD CLAY
CALCIUM CARBONATES
POLYCARB MULTIFEX MM HAKUENKA AA
GROUND PRECIPITATED
FUMED METAL OXIDES
ZINC OXIDES
ALUMINUM OXIDE
TITANIUM DIOXIDE
FUMED SILICAS
(400-800)
0
100
200
300
400


N330
N220
N110
N550
N762
N990
CARBON BLACK (27 VOL)
CLAY (30 VOL)
HYDRATED SILICAS (25 VOL)
SILICATES (25 VOL)
CALCIUM CARBONATES (55 VOL)
Tensile Strength MPa
25
20
15
10
5
0
0
100
200
300
400

news and notes

6% Rubber Growth Projected

The contours of a 15 year perspective plan drawn up recently for the rubber industry shows that a steady 6-8 per cent growth during the period can be maintained and a Rs [illegible]00-crore export target can be achieved by 2000 AD.

Broadly dividing the industry into tyre and non-tyre sectors, the plan has identified the industry's strength to achieve the targets, its weakness in the research and development sphere and manpower planning, and the constraints of the shortfall of essential raw materials such as natural and synthetic rubber.

The present profile of the industry reveals that 22 type companies with a total licensed capacity for 202.3 lakh tyres and an installed capacity of 184.63 lakh tyres per year had made 114.24 lakh tyres in 1985, showing only a 60per cent capacity utilisation.

In the non-tyre sector, there are about 125 medium units and more than 3,500 small units, making over 35,000 assorted items of finished rubber goods. In money terms the total output of the industry is valued at Rs 3000 crore, the employment generated so far is of the order of 2 lakh jobs. The rubber industry is the third largest contributor tothe country's exchequer paying about Rs 800 crore per year by way of taxes

Mr. M. K. Kapoor, President of the All India Rubber Industries Association says that the industry converts 2,20,000 tonnes of natural rubber (nr), 55,000tonnes of synthetic rubber (sr) and 40,000 tonnes of reclaimed rubber that the country produces every year and also the supplementary quantum of NR and SR imports, into value-added products. This helps India to rank 9th among the world's rubber goods manufacturing countries.

The strength of the industry has been demonstrated by its capabilities to manufacture the principal raw materials and a machinery indigenously. It has made beginning in creating centres of technical education and research.

The tyre sector will be establishing a Rs 50-crore tyre research centre intending to provide a pool of specially trained R and D manpower to help in fundamental and applied research. Besides, the link of Indian companies with their foreign collaborators is considered vital to a two-way transfer of information and technology.

In the sphere of technical man power it has been estimated that there are about 11,300 technically oriented personnel employed in the industry. In the next 10 years, this will increase by about 4,500 to around 15,800 persons (see tables).

The fundamental and applied research base is inadequate in the non-tyre sector, according to a paper 'Technical man-power' by Mr. M. M. Patel and Dr. R. K. Matthan. The Indian Rubber Manufacturers Research Association (IRMRA) could have been a useful focal point but it appears to have played a regressive role and become primarily a testing centre.

"The problems of IRMRA reflect the lack of support of this association by the industry and it is a pity that the competent nucleus of scientists, technologists and basic facilities are not utilised and developed in a more positive manner. With the tyre industry opting for its own facilities, the IRMRA is now more related to the non-tyre sector and this aspect could be taken note of."

The constraints inhibiting the industry's growth rate and exports are identified as the high rate of import duties and internal taxes. Import duties on natural and synthetic rubber are as high as 306 per cent. Tax on truck tyres is 54.4 per cent and on car tyres 53.8 per cent. If the taxes are reduced the industry promises to sell truck tyres at Rs. 2,885 against the present Rs 5,125 and car tyres at Rs 296 against the present Rs 640.

Table 1

Manpower utilisation estimate within the industry

Group Category			Current estimate level
I.	1	Technicians	4000
	2	Supervisors	3000
II.	1	Engineers (pro duction/design)	2000
	2	Technologists	1500
III.	1	Scientists	500
	2	R and D personnel	500
		Total	11300

financial institutions with power to make decisions across the table are fundamental to rapid industrial progress, he points out.

The concern over the shortfall of essential raw materials should ease if the hopeful view on natural rubber, presented by the Rubber Board Chairman, Mr. P. C. Cyriac becomes true in the next decade. Productivity measured in terms of yield per hectare during the past 25 years has gone up from 365 kg to 898 kg.

Natural rubber production figures show a rise from 25.697 tonnes in 1960-61 to 200,000 tonnes in 1985-86. The estimated production during 1986-87 is 220,000 tonnes. The area under rubber has increased from 130,000 hectares in 1960-61 to 362,000 hectares in 1985-86.

What brightens the natural rubber front is the promising yield in non-traditional areas of Tripura and Assam. Rubber tapping has

Table 2

Projected manpower growth estimates

Group and category			Annual %	Growth nos.	Additional in a decade	Total
I.	1	Technician	4	160	1800	5600
	2	Supervisors	3	90	900	3900
II.	1	Engineers	5	100	1000	3000
	2	Technologists	5	75	750	2250
III.	1	Scientists	4	20	200	700
	2	R and D personal	3	9	90	390
		Total		454	4540	15,840

The cost of indigenously produced raw materials are two to three times higher than the world prices, Mr K. M. Philip, one of the pioneers in the industry thinks. Once these constraints are removed it is within the capacity of the industry to create an export market for Indian rubber goods including tyres to a level of Rs 1000 crore by 2000 AD.

A major problem pointed out by Mr Philip is that the industry does not have easy availability of finance. It takes one or two years to tie up finance once a scheme is finally approved after one or two years of file pushing with the government. Private

already begun in about 430 hectares in Tripura and 130 hectares in Assam. Considering the poor quality of early planting in Tripura, the yield obtained now is very encouraging, according to Rubber Board assessment.

The Assam plantations which were high-yielding varieties, though maintained in an unsatisfactory manner have been giving yields of around 1,000 kg per hectare which is better than today's average production even in Kerala.

A review of the policy of capacity creation for synthetic rubber is called for production of SR started in 1963. At present two factories are producing SR with a total capacity of 52,000 tonnes. The total output in 1985-86 was 35,000 tonnes.

A cost-benefit analysis of SR and NR production shows that investment in NR production should be favoured in the interest of the country. A synthetic rubber plant is a more capital-intensive unit than the rubber plantation. Investment required per unit of rubber produced is three times more in the case of SR. A sizeable portion of this investment will have to be in foreign exchange.

An SR plant generates much less employment opportunities than what an equal amount invested in plantations can generate. One unskilled worker per hectare is the job potential in a plantation.

SR production requires costly energy inputs, while the rubber plant produces natural rubber as a result of photosynthetic action without any energy inputs.

While the SR plant produces effluents whcih call for costly treatment procedures to avoid environmental pollution, the rubber tree purifies the air and the environment by releasing oxygen into the atmosphere.

The rubber plantations which are generally raised along slopes with contour bunds and grown in association with a leguminous cover crop providing a ground cover, prevents soil erosion, regenerates soil and improves the micro climate of the area substantially.

Most of the areas considered fit for rubber cultivation in the north east and other new regions, are already badly denuded as a result of indiscriminate 'jhum' (shifting cultivation). By growing rubber on such lands they can be regenerated, the economically backward tribals and others given a livelihood and their entire pattern of life transformed, ushering in a social revolution in the backward regions, the paper says.

— P. G. Albert
Business Standard

The Publications of the Rubber Board

i. **Rubber - Malayalam Monthly**		
Annual Subscription	.. Rs.	5.00
Perpetual Subscription	.. Rs.	60.00
ii. **Rubber Board Bulletin - English**		
Quarterly - Subscription	.. Rs.	10 00
iii. **Rubber Statistical News**		
Monthly Subscription	.. Rs.	10.00
iv. **Indian Rubber Statistics**		
Annual Publication - Price	.. Rs.	50.00
v. **Rubber Grower's Companion-1986**		
(A combined handbook and diary) Price	.. Rs.	20.00
vi. **Directory of Estates and Holdings in India**		
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RUBBER BOARD
SASTRI ROAD, KOTTAYAM 686 001

Director (P & PR)

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KOTTAYAM 686 001 INDIA

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THE QUARTER

The Rubber Plantation Industry in India has made much headway in modernising the rubber plantations. The Industry which comprises both the producing and the consuming sectors has made rapid progress during the last 25 years. The productivity figures have gone up high in terms of yield per hectare. In the process of modernisation, many more steps are on the anvil. New areas are brought under rubber cultivation in non-traditional areas. The Rubber Board also envisages new programmes for the days to come.

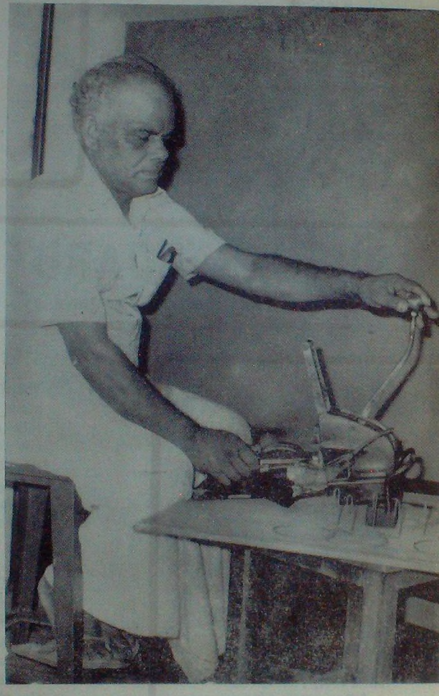
The wide spectrum of activities necessitates a broad thinking on the part of all concerned. With this end inview and to supplement the efforts of the Rubber Board, it has been decided to organise a Planters' Conference in August 1987. The Board also desires to have the participation of all progressive planters to this meet (details elsewhere).

A NEW DEVICE TO MAKE HARMLESS CUP-HOLDERS

Cup-holders are widely being used in rubber plantations. The coconut shell or cup used for collecting latex is put on the cup-holder attached to the rubber tree. The latex drips out from the tapping cut is collected in the coconut shell or cup placed on the cup-holder. Later it is transferred to buckets. Hitherto the plantations have been resorting to a conventional method by which a spout was fixed on to the bark to hold the cup. Subsequently when the hand made GI wire cup-holder appeared in plantations, it received sudden acceptance from the rubber planting community as it had twin advantages. This hand made cup-holder never interferes with the bark as the cup-holder is tied to the tree with strings. Now coconut shells are gradually replaced by plastic cups.

Though the advent of plastic cups is a step forward, the cup-holders remained to be a hand made product until recently when a breakthrough is made possible by Shri P. N. Krishnan of Ramapuram Bazar-PO, Kottayam who made his debut as an inventor of a simple portable cup holder making machine weighing 16 kgs. The hand-made cup holder lacked uniformity though it was produced in large quantities. Its price ruled high in the market.

The new machine designed and developed as against the conventional method of hand made technique, is though a reformation of the present form, has its own plus points. The machine made of pure steel can produce a cup holder in less than a minute. The piece of GI wire used for the production of a cup holder is about 26" in length. It is inserted into the machine, coiled around the disc and pressed putting a lever downwards. The final product is ready then with the attachment for tying. GI wire of 12 and 14 gauges are used for the cup holder. One kg. of 12 gauge GI wire can turn out 42 cup-holders whereas for a kg of 14 gauge GI wire can produce 70 pieces. The cost of 1 kg GI wire is Rs. 12/- Shri Krishnan sells 1 kg of cup-holders for Rs. 22/- whereas the current market price for a kg is Rs. 25/-. The cup- holders made by the machine are strong and sturdy. Krishnan believes that the cupholders produced by him are durable and it survives many seasons. The functioning is also simple. The notable components of the machine are a disc and a lever. Shri Krishnan who is basically an automobile mechanic took only 5 months to design and develop his machine. This invention, has no doubt made a valuable contribution to the technique of perfecting latex collection from rubber plantations without harming the bark of the trees.



— ARAVINDAN,
Publicity Officer

RUBBER PLANTERS' CONFERENCE

On
22nd August 1987
Saturday

at
Darsana Auditorium
Sastri Road
Kottayam

Organised by
THE RUBBER BOARD
KOTTAYAM

The Rubber Plantation Industry in India has outgrown other sectors of agricultural economy by leaps and bounds in recent times, even crossing the traditional frontiers. If this spectacular growth is to yield desired results, it should be modernised on scientific lines, ensuring the adoption of appropriate technologies developed as a result of problem oriented investigations in India and abroad. Already a lot of efforts are being put in now on an ongoing basis to diffuse the innovations to the end users in the field through different channels of communication.

To supplement this endeavour, the Rubber Board proposes to organise a one-day 'RUBBER PLANTERS' CONFERENCE on 22nd August 1987 at Kottayam. The Conference which is conceived as an exclusive exercise of 'Transfer of Technology', envisages to discuss in 5 Technical Sessions the following topics considered relevant and significant for inducing a qualitative change to the planting practices in vogue.

1) Rubber planting materials
2) Nutrition and Cultural Practices
3) Diseases and Pests
4) Exploitation
5) Processing

A series of scientific papers prepared in a popular style in English, covering the topics listed above will be presented by the scientists of the Rubber Research Institute of India at this conference.
A few progressive planters are also being persuaded to come out with papers for presentation so that their rich experience and gains worthy of emulation could be shared by the participants.

Venue — The Venue of the Conference is the DARSANA AUDITORIUM on SASTRI ROAD AT KOTTAYAM.

Fee — A delegate fee of Rs. 50/- per participant will be charged.

Medium — The medium of communication will be English as participants from States other than Kerala are expected.

Exhibition

A small exhibition is also planned to be organised at the Conference premises, where new materials and methods pertaining to improved techniques and higher productivity will be on display.

Tentative Programme

22nd August 1987

8.00 - 9.30 AM	—	Registration of Delegates
9.30 - 10.30 AM	—	Inaugural Session
10.30 - 11.00 AM	—	Tea/Coffee Break
11.00 - 12.00 Noon	—	Technical Session I
12.00 - 1.00 PM	—	Technical Session II
1.00 - 2.00 PM	—	Lunch Break
2.00 - 3.00 PM	—	Technical Session III
3.00 - 4.00 PM	—	Technical Session IV
4.00 - 4.30 PM	—	Tea / Coffee Break
4.30 - 5.30 PM	—	Technical Session V
5.30 - 6.15 PM	—	Concluding Session

You are invited to attend this Conference as a delegate. You may apply for registration along with the prescribed fee of Rs. 50/-(either as Demand Draft or Money Order) before 24th July 1987 to:

Shri. P. K. Narayanan
Convener
Rubber Planters' Conference Committee
Rubber Board
Kottayam 686 001
Kerala

Phone 3231-34 (Office) 8135 (Res.)
GRAMS: RUBRBOARD TELEX 888-205 RUBR IN

You may please show this circular to your colleagues and friends in the Rubber plantation industry also and direct them to register before the due date so that they could benefit by participating in this event. The conference committee will serve the Forenoon and Afternoon Tea/Coffee and Lunch to the registered delegates.

Conference Committee

A Working Committee, headed by the Chairman, Rubber Board has been constituted for the conduct of the Conference. Various Sub-Committees are also in position to take care of the organisational aspects.

South American leaf blight-a potential threat to the natural rubber industry in Asia and Africa

THOMSON T. EDATHIL
Rubber Research Institute of India, Rubber Board P. O. Kottayam-686 009, Kerala, India.

Abstract

South American leaf blight (SALB) caused by the fungus Microcyclus ulei (P Henn.) v. Arx is the main limiting factor to the development of the natural rubber (Hevea brasiliensis) industry in South and Central America. It also poses a great danger to the rubber grown extensively in Africa and South-east Asia. Present knowledge of its distribution, epidemiology and spore viability, the risks of its entry into Asia and Africa and its possible behaviour in these countries are reviewed. In the control of this devastating disease, application of defoliants and fungicides, breeding for leaf blight resistance and crown budding of high yielding susceptibe panel clones with leaf blight-resistant crowns are measures currently being investigated. Present quarantine regulations appear inadequate. The need for more rigorous measures are stressed.

Introduction

South American leaf blight is the most damaging disease of Para rubber *(Hevea brasiliensis)*. This disease is at present wholly confined to the American continent and has caused the abandonment of ambitious programmes of extensive rubber cultivation in the South American humid tropics during the early part of this century. Over 90% of the world's natural rubber requirement is being met by production from the Far East (Holliday, 1970). All the planted African and Asian rubber is extremely susceptible and the climatic conditions present in the rubber growing areas of Asian and African countries are comparable with that of the American tropics, hence introduction of leaf blight into these parts of the world could destroy all the existing plantations and the result would be disastrous to the entire world.

Historical background and distribution

In the past, this disease went unnoticed among the widely scattered wild rubber plants in the Amazon forest. But during the beginning of this century, when attempts were made to cultivate rubber on an extensive plantation scale in South America, the disease assumed epidemic proportions and almost destroyed all the early plantations resulting in the abandonment of rubber over large areas in Guiana, Panama and Costa Rica (Bodkin, 1922; Altson. 1924; 1926; 1951) In the existing plantations it reduced the yield by over 90% (Altson, 1923).

Leaf blight is present in Bolivia, Brazil, Peru, Ecuador, Colombia, Venezuela, Guyana, Surinam, French Guiana, Trinidad, Panama, Costa Rica, Nicaragua, ElSalvador, Honduras, Guatemala, Haiti, Belize and Mexico (Holliday, 1970; compagnon, 1976) (Figure 1).

The pathogen and its survival

The causal fungus *Microcyclus ulei* is specific to *Hevea* spp. Even though the fungus can affect petioles, green stems, inflorescences and fruits, the most obvious infection is on the young leaves. Symptoms of the asexual stage vary with the age of the leaf at infection. In the primary stage conidia develop mostly on the abaxial surface of 4–9 days old expanding tender leaves. They appear as grey-black dull lesions covered with olive-green powdery sporing masses. On the young infected leaves, lamina distortion, growth arrest, crinkling and shrivelling of leaflets, blackening, drying and abscission are common symptoms. Leaves 10-16 days old do not usually fall. In such cases infection produces irregularly outlined necrotic patches and the leaves become severely distorted, ragged and shot-holed. The conidial state is known as *Fusicladium macrosporum* sporum (Anstead, 1919)
The secondary stages develop on the adaxial surface of the leaves as it hardens. The black pycnidal from increases in number and size, forming clusters and ring-like groups, several millimetres across. Very rarely, the leaf falls after the emergence of pycnidia. By the time the leaf matures, the stomata become more and more massive because the ascocarp form is emerging. It develops as charcoal black bodies arranged around the margin of the holes in a series of rings. Infection results in repeated rounds of defoliation, dieback of the shoots and even death of mature trees (Figure 2) (Stahel, 1927; Holliday, 1970; Rao, 1973a).

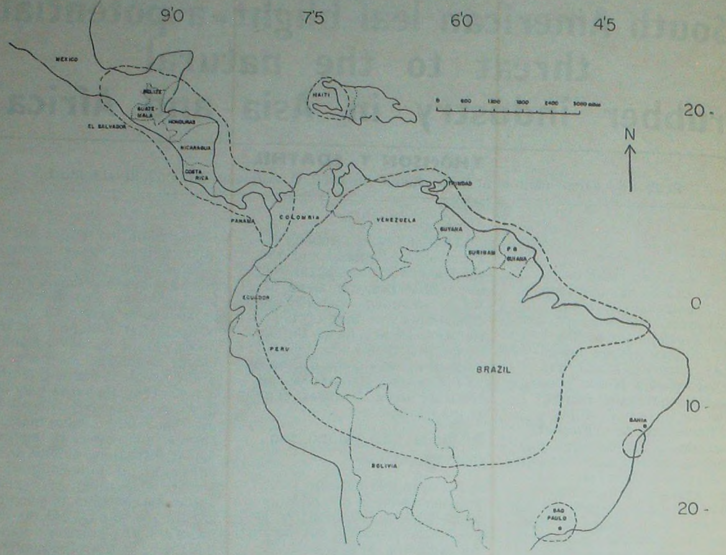


Figure 1. Countries in South and Central America where South American leaf blight is present. (Adapted from Holliday, 1970). ....national borders: ------limit of distribution or Mycrocyclus ulei *on* Hevea brasiliensis.

It was observed in Trinidad that conidia have a maximum dispersal in June and July and peak ascospore concentrations occurred in August to November during the wet season. (Chee, 1976c). In a mature stand or rubber, a fresh disease cycle probably starts when ascospores are released from leaves, falling due to wintering and also from infected leaves remaining on the trees. As infection builds upon the newly emerging flushes conidia take over the spread, during the wet season, to complete the disease cycle.

Viability of spores and methods of dispersal

Stahel (1917) reported that ascospores caused little infection in the field, but Langford (1945) observed that both ascospores and conidia did so and that conidia are of more practical importance. Recent investigations by Chee (1976b; 1976c and 1977) have shown that ascospores also infect young leaves and both the spore forms are equally important in completing the disease cycle. The view of Stahel about the non-infectiveness of pycnospores has been confirmed by the poor germination of these spores. Their production in abundance prior to the ascigerous stage suggests that they function as male gametes (spermatia) for fertilization.

Dry air currents up to km/h did not remove conidia of *M. ulei* from the leaves, whereas water applied on the conidial lesions instantly released the spores. This suggested that rain is highly important in the spread of leaf blight. Conidia are dependent on free moisture or a saturated atmosphere for germination and infection (Chee and Wastie, 1980). Studies on diurnal periodicity of dispersal revealed that significant increases in the number of conidia in the air was invariably associated with rain. Liberation of conidia at its peak about 10.00 a. m. and of ascospores is about 06.00 a. m. (Holliday, 1969; Chee, 1976c.) Rainfall probably has an initial effect of liberating spores through mechanical action (Hirst and Stedman, 1963).

It is believed that rain is the most effective disseminator of larger masses of the spores of *M. ulei* and wind is the chief means of dispersal (Langford, 1945). But high temperatures and intense irradiation during daytime are lethal to spores. Hence transmission of the pathogen by windborne spores to distant places is most unlikely, there as rain splashes help in the spread of thedisease in short distances. Stahel (1917) believed that conidia survive less than 24h and that ascospores survive about 6h. This may be true under dry conditions in the shade at high temperatures. Langford (1945) found that germination was still high after three days (27° C and 70% r.h.) but did not occur after seven days. De Jonge (1962) and Brookson (1963) observed that conidia survived for two weeks under normal laboratory conditions. The long survival period of conidia was confirmed by Chee (1976b), who observed that 50% of the conidia in leaf lesions still germinated after the leaf had been stored in a dessicator for 15 weeks, or frozen for two weeks or kept at 40°C for several days. However, the longevity of conidia decreases as relative humidity increases. In 85-95% r.h., conidia survive for 3 weeks and at 100% r.h. conidia are killed within one week. It seems probable, that leaf blight could be spread as conidia carried on plants, plant parts or man himself. This last means of dispersal is particularly important since conidia have been recovered from clothes and finger nails after a visit to a nursery infected with *M ulei* (Chee, 1980).

Until recently, very little information has been available on the survival of perithecia and ascospores. It was generally believed that ascospores survive longer than conidia since they are protected by perithecia. But the survival period of perithecia and ascospores differ. Perithecia on detached leaves can release ascospores in three days to three weeks, depending on the moisture content in them (Chee,1980). Leaves which fall during wintering discharge ascospores readily after rain. At 24°C, under moist conditions, perithecia lose their viability after 12 days on green leaves and after 9 days on fallen brown leaves. At the optimum temperature (24°C), ascospores germinate in 2.5 h in darkness and 6 h in light. Ascospores die at high humidity (>80%), but survive up to 15 days in a dessicator. They are killed by 4 minutes exposure to u. v. light. The germination rate of fresh conidia ranges from 10–90% whereas that of ascospores is consistently higher (Chee,1976a).

Weather conditions favouring the spread of the disease

Outbreaks of leaf blight occur when the daily temperature is under 22°C for longer than 13 hours, relative humidity over 92% for a period longer than 10 hours and rainfall above 1m m per day for the previovs seven days (Holliday, 1969; Chee, 1976c).

Rain

Showery rain, well distributed throughout the year, is more favourable to the disease than continuous periods of heavy rain (Stahel, 1917). According to Chee (1980) leaf blight is less severe in North-East Trinidad (annual rainfall 2500 mm or more) than in the North-west (annual rainfall 1300-2500 mm). Similarly, damage due to leaf blight is greater at Navajoa (East Guatemala, annual rainfall 2500 mm) than at Las Clavellins (West Guatemala annual rainfall 3500mm). Heavy rain for a long period can effectively wash off the available inoculum whereas humid conditions coupled with intermittent and distributed light showers favour disease development and dispersal. In Trinidad it was observed that conidia were completely removed from the lesions on days having 2 cm or more rain (Chee, 1980).

Rainfall in the rubber growing tracts of Asia and Africa would seem to be adequate for leaf blight to occur (2000–4500 mm annually). But the severity of the disease would depend on the pattern and distribution of rainfall. Over inland Malaysia the diurnal rainfall pattern has its peak during the mid or late after noon (Dale, 1959; 1960). In South India, when a north-easterly monsoon occurs during the afternoon or evening, such a pattern might lengthen the period of leaf wetness and hence the time favourable for infection.

Humidity

It was observed that conidia of *M. ulei* survive best under dry conditions, but high humidity is required for their production and germination (Chee, 1976b) Relative humidity of more than 95% for 10 consecutive hours for 18 days caused severe outbreak of *M ulei* on susceptible clones in Bahia, Brazil and in Trinidad (Chee, 1980). In central America it was reported that frequent dew formation on leaves for more than 8 hours is needed for *M. ulei* infection (Langford, 1945.) It would seem that relative humidity in most months of the year in Peninsular Malaysia is suitable for leaf blight. (Malaysian Meteorological Services, 1971–1973, 1975).

Temperature

From the experimental evidence on growth and conidial sporulation *in vitro*, conidial germination and ascospores discharge, it can be observed that the optimum temperature for *M. ulei* is 23°C or less (Holliday, 1970; Chee, 1976b). But in the laboratory trials of screening for clonal susceptibility by the leaf disc-inoculation method, it was observed that under a 16/8 h light/dark period of six days, 24°C-26°C is the optimum temperature for the development of lesions on inoculated leaf discs (Chee. 1976a).

Epidemiology

The severity of leaf blight in various localities in South America was related to the local climatic conditions. Leaf blight has reached Haiti and evidence suggests that it was brought over by wind and rain from Guiana and Trinidad (Compagon, 1976). It was observed by many people that sea breeze can reduce the disease intensity in coastal areas. This may be due to the shortening of

Figure 2. A young rubber plantation affected with Microcyclus ulei *in Itubera, Brazil.*

the period of high relative humidity. Thus *Hevea* plantings on the east coast of Trinidad suffered little infection (Rands, 1924; Stahel, 1927; Tollenaar, 1954).

In an epidemiological study of leaf bilght conducted in Itubera, Bahia, Brazil it was observed that the disease may occur in every month of the year and peak infection is attained between September and October when annual refoliation following wintering occurs. Most conidia were recorded in spore traps during September to December, which coincides with refoliation. Observations made at different heights of a hill revealed that severity of the disease was most at the bottom with highest aerial spore count as well as the largest number of falling leaflets. This was presumably due to the higher relative humidity (<95%) for longer periods at the bottom than at the summit or slope. Another interesting observation was that when spore traps were fixed at three different heights, viz 1,5 and 10 m each on summit, slope ands bottom of the hill, in all the case more counts of conidia were obtained in the spore trap kept at a height of 1 m. The catch gradually decreased with increase in height of exposure of the slides (Rocha and vasconcelos Filho, 1978). This indicates that for plimary infection of the disease in the nurseries, the pattern of spore dispersal is contributing factor in addition at humid microclimate and the presence of tender leaves throughout the year.

Possible introduction and likely behaviour of the disease in Asia and Africa

It can be argued that because leaf blight has not appeared during nearly 100 years of existence of *Hevea* in the Orient, it is unlikely that it will spread to South-east Asia and Africa. However it is dangerous to hold this view, considering for example the history of coffee leaf rust caused by *Hemileia vastatrix*. Originating from East Africa' the fungus almost destroyed the coffee plantation industry in Asia more than a century ago. The crop has since been grown primarily in Brazil, where it enjoyed complete freedom from coffee leaf rust up to 1970. However, during that year it was discovered that coffee rust had spread to Brazil also. It is believed that the disease came to Brazil from West Africa through uredospores in air currents across 1000 km of the Atlantic Ocean. But, on the other hand, conidia and ascospores of *M ulei* cannot be carried to such long distances by air currents since they are much larger spores (conidia measure 23–65 X 5 10 μm on an average). A carrier like the host plant, other plants or plant parts, animals or man carrying the spores of the pathogen on their body may be required for any spread of the disease to far away places. If leaf blight is introduced into Asian and African countries it will spread rapidly through the nurseries and the vast, often contiguous rubber plantations. (Hilton, 1955).

Frequent air travel from American tropics to Asian and African countries are the main chance for spreading this disease in these countries. The picture of leaf blight in tropical America suggests that it would follow a more or less similar pattern in Asia and Africa, because of the similarity of climatic conditions in the rubber growing areas-humid tropical rain forests converted to plantations. The likelihood of its becoming more destructive in these two continents than in the Americas is greater, because of the extremely high susceptibility of the high-yielding oriental clones planted over large areas (Rao, 1973b).

If we consider the different rubber producing countries all the evidence indicates that those which have a well distributed rainfall or prolonged periods of humidity at the time of refoliation are subject to the greatest danger of infection in the nurseries and also to the greatest danger of infection in the nurseries and also to the greatest risk of spread of the disease to the mature plantations. This appears to be the case of Malaysia, Sumatra, South west Sri Lanka, Southwest India, the Cameroon, Ivory Coast and the Congo basin of Zaire.

In countries situated in higher latitudes and which have a more or less prolonged dry season, it is certain that even if infection did occur the disease would be less serious. The risks of infection are obviously less if there is less likelihood of the various conditions favourable to the germination of spores occurring together. One can be sure, however, that there is no rubber producing country where those conditions are not found at least in certain sitess and at certain periods of the year, and where the disease would not become endemic after the primary infection.

It is extremely probable that if accidental introduction occurred in Africa or the Far East, even in areas where climatic conditions are not favourable to a serious form of the disease, then all other producing countries in Africa or the Far East would be infected later unless there was rapid and complete eradication of the disease at the first infection site (Compagnon, 1976).

Mycrocyclus infects young leaves and developing shoots, as does *Oidium heveae* Steinm and *Colletotrichum gloeosprioides* [Penz.] Sacc. For the outbreak of all these three diseases rainfall is the main predisposing climatic factor. In Brazil leaf blight develops strongly in the state of Bahia which has an evenly distributed annual rainfall exceeding 2100 mm. Rao. [1973a] compared the epidemiology of *M ulei* with those of *O. heveae* and *C gloeosporioides* and concluded that the epidemiology of leaf blight is closer to that of *C gloesporioides*. Chee [1980] considering the different climatic conditions in which leaf blight occurs, the biology of the fungus and mode of spore dispersal by rain and wind, stated that *M. ulei* could also behave like *O. heveae*, which survives the year round on scattered flushes on pollarded stumps, unhealthy plants under shaded conditions and in nurseries. This pathogen develops severely on the young leaves produced after wintering. *M. ulei* could similarly survive on the old leaves and provide an ascospore inoculum all year round [Chee 1976b].

Measures against the introduction and spread of South American leaf blight

Eradication

In case of an accidental introduction of this disease despite the phytosanitary measures, immediate adoption of eradication procedures should receive top priority. Destruction of the foliage and green shoots with the use of an appropriate defoliant would emliminate the opportunity for the pathogen to develop and sporulate. In Malaysia, as a precautionary test in the eradication of leaf blight, n-butyl 2,4,5-T was applied from the air to defoliate the rubber trees. A good result with a concentration of 5% [8% acid equivalent] in gasoline applied at the rate of 35 litres/ha was obtained. After one application, treated trees remained leafless for 4–6 weeks. Concentration was not critical in defoliation, but has marked effects upon the rate and amount of refoliation [Hutchinson, 1958]. Later, many similar trials have been conducted in Malayasia and a scheme for quick eradication of the disease in the event of an accidental introduction to South-east Asia has been worked out [Abdul Aziz, 1976; Lim and Hashim, 1977].

Aircrafts are essential for spraying large areas within a short period of time following a confirmed outbreak. It is also necessary to restrict movements of personnel through an infected area. An eradication belt of 500 meters wide around the infected area, which would be necessary [Rao, 1973b].

Chemical Control

Recent research on chemical control of leaf blight has produced good results in Brazil. From Belem, Rogers and Peterson [1976] reported good canopies and increased latex yield following chemical treatment. Rocha *et al* [1975] reported an increase in yield of 475 kg/ha following control of the disease. Alencar *et al* [1975) recorded an increase of 82.5% and Mainstone *et al* [1977] found that sprayed tasks yielded 60% more than the control tasks, with a maximum potential of over twice the yield of untreated tasks. It is therefore apparent that chemical control has great importance in combating the disease.

Nursery screening trials in Trinidad showed that four fungicides are effective in controlling leaf blight: thiophanate methyl [0.07% a.i.] benomyl (0.025% a.i] Chlorothalonil (0.15% a. i. and mancozeb (0.32% a.i.] Chee, 1978]. For suppression of conidial sporulation benomyl can be used, whereas thiophanate methyl [0 14% o.i.] inhibits the ascospore release. Hence, benomyl can be used during the early rounds in order to reduce sporulation of conidia and ascospores respectively [Chee, 1977; 1978]. The new systemic fungicide triadimefon has also shown promise. Thiophanate methyl, benomyl, chlorothalonil and mancozeb are being used on plantation scale in Brazil (Chee and Wastie, 1980]. Recently triadimefon [0. 015% a.i) triforine [0.038% a.i.] and bitertanol [0.03% a.i.] have also been shown to be effective in nursery trials. It was also observed that mixtures of systemic and protective fungicides are more effective than individual fungicides alone [Santos *et al*, 1984].

The use of various types of aircraft for spraying in Brazil against leaf blight has been discussed in detail [Matthews, 1976]. For aerial spraying, the concentration of fungicides used per ha is 300 gm Benlate [benomyl], 200 gm thiophanate methyl, 300 gm Bayleton [triadimefon], 1.6 kg Bravonil [chlorothalonil] or 2 kg Dithane M 45 [mancozeb For fogging, 200 g of thiophanate methyl or 1kg mancozeb per ha is used. Large scale fogging trials using three makes of fog generators are being conducted in Brazil. It was observed that, with an improved model of fog generator, about 200 ha can be effectively covered in a day. Fogging starts well before refoliation and continues for two months covering the entire refoliation period, with 12 rounds at an interval of 4–7 days. It has been claimed that 30-38% yield increase by fogging in the leaf blight-effected area in Brazil (Chee and Wastie, 1980; Martins e. Silva, 1978) was obtained.

In recent fogging trials conducted in India, against *Phytophthora* leaf fall disease, it has been observed that fogging is much cheaper than any other method of application (Thomson-*et al 1984*). Hence, fogging appears to have bright prospects in the control of leaf blight in the future, especially when encountering difficulty in securing sufficient numbers of aircraft in time.

Breeding for resistance

Breeding for disease resistance combined with high yield is the most important and permanent solution for combating leaf blight in Latin America and other parts of the World. The Ford Motor Company's breeding programmes have produced such promising clones as FX 25, FX 3899 and FX 3164 in Brazil while a similar effort by Firestone Rubber Company has produced numerous resistant clones in their MDF and MDX series in Liberia and Guatemala. *H. brasiliensis* from Madre de Dois and *H. benthamiana* from Rio Negro were found useful as sources of resistance against leaf blight (Subramanian, 1969). Of the vast number of resistant clones bred in Brazil only 14 of the first generation seem commercially acceptable for large scale planting. Among these only six clones are most generally acceptable: FX 25, 3810, 3899, 3925, IAN 710 and 717. Of these, four have the most effective resistant parent F. 4542 (*H. benthamiana*) and the other two have resistance from *H. brasiliensis* (IAN 710 from F 409 and FX 25 from F 351). One complicating factor noted is that in many instances susceptibility varies between localities. Thus FX2261 is susceptible in Belem and moderately resistant in Bahia, whereas FX 3899 and IAN 717 behave in the opposite fashion (Chee and Wastie, 1980). Breakdown of resistance by the occurrence of physiologic races is another problem encountered in breeding for resistance (Langdon, 1965)

Breeding for leaf blight resistance in Asia was primarily carried out by the Rubber Research Institutes of Malaysia and Sri Lanka. On the basis of an agreement signed in 1950 between RRIM and the Instituto Agronomico do Norte, Belem, Para, Brazil, exchange of clones between Malaysia and Brazil was started (Hilton, 1955). The leaf blight resistant clones imported into Malaysia during 1953/54 consisted of nine selections made in Fordiandia (six of *H brasiliensis*, three of *H benthamiana*), two selections of *H. brasiliensis*, seedlings of Belem origin and 14 selections from cross of Ford clones and

Eastern clones (F1) a total of 25 clones (Brookson, 1956).

During 1957, a total number of 42 leaf blight resistant clones were introduced into Sri Lanka on an exchange basis from USDA plant introduction Station, Miami, Florida. These consisted of 15 selections of crosses of *Microcyclus* resistant clones, mainly F 4542 with high-yielding Eastern clones and 13 selections of first out crosses of clone F 4542 to an Eastern clone (Baptiste, 1958, 1959) The performance of leaf blight resistant clones in Malaysia was promising. An illegitimate progeny of FX25 proved to be the best population for yield and vigour. *H. benthamiana* from Rio Negro and *H brasiliensis from* Madre de Dois gave lower yields compared with modern oriental selections but were, however fair, related to the original Wickham material. Nevertheless they are good sources of genes for resistance to *Mycrocyclus* (Subramanian, 1969).

Crown budding

The first attempt of crown budding with a leaf blight resistant crown on a high yielding trunk was made at Ford's Beltera in the Amazon Basin. All trees with eastern panel clones were top-budded with clones that had shown resistance to the disease at Fordlandia. Subsequently, this technique was practiced for a good number of years in the Americas (Tollenaar, 1959). Clones recommended for Crowns were FX 25, FX 614, FX 636, FX 645. FX 516, FX 2261, FX 2784, EX 3810, FX 3864, FX 3899, FX 3925, IAN 717, IAN 6486, IAN 7388, IAN 7390, IAN 7614AN 7657 and *H. pauciflora* clone PA 31 (Holliday, 1970; Pinheiro *et al* 1982).

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Strict phytosanitary and quarantine measures are being observed by Asian and African countries in importing plants, plant products and other materials from the leaf blight-endemic countries. (Anon, 1971; 1972). The RRIM has laid down the regulation that persons who are in contact with *M ulei* in leaf blight-endemic countries should arrange their visit to the East through Europe or temperate North America and stay there at least 4 days. Clothes, shoes, books and other personal belongings should be cleaned or disinfected there, during the stay. The International Rubber Research and Development Board (IRRDB) is also endeavouring to educate people about the danger of the spread of leaf blight by exhibiting posters in all international airports and by arranging training of scientists from leaf blight-free nations on leaf blight in Brazil.

Regional co-operation has been requested against introduction and spread of leaf blight. The measures recommended include strengthening plant quarantine, prompt action on eradication and establishment of country and regional committees entrusted with the duty to prevent introduction and spread of leaf blight. It is also stressed that an effective phytosanitary barrier is the only means to prevent the introduction of leaf blight (Rao, 1972, 1973 b).

The present quarantine measures would only be effective when the concerned person is well aware of the danger of the introduction of leaf blight into the disease-free areas. However, we need to reappraise these measures in the light of increased air travel from the American tropics to the Eastern hemisphere. Many of the travellers are not aware of the danger of leaf blight, and would not like to stop over in Europe or temperate North America. A quarantine break of journey in a temperate zone for about one week would seem superfluous unless all clothes are laundered and other personal effects disinfected, since the spore forms of *Microcyclus* can survive up to two weeks or even more in normal conditions.

Conclusion

South American leaf blight is the most destructive disease of *Hevea* rubber plant. Much progress has been made in the research on leaf blight in Brazil, the home of natural rubber. The possibility of the spread of this disease to the Eastern hemisphere is real Asian and African countries are much aware of this fact, and IRRDB and RRIM are taking great precautions to prevent the entry of leaf blight into the disease-free countries. However, the present phytosanitary and quarantine measures do not seem to be adequately effective in the prevention of intentional or non-intentional introduction of this disease. Therefore, the case for strengthening the quarantine measures is clearly strong.

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weeks. Concentration was not critical in defoliation, but has marked effects upon the rate and amount of refoliation [Hutchinson, 1958]. Later, many similar trials have been conducted in Malayasia and a scheme for quick eradication of the disease in the event of an accidental introduction to South-east Asia has been worked out [Abdul Aziz, 1976; Lim and Hashim, 1977].

Aircrafts are essential for spraying large areas within a short period of time following a confirmed outbreak. It is also necessary to restrict movements of personnel through an infected area. An eradication belt of 500 meters wide around the infected area, which would be necessary [Rao, 1973b].

Chemical Control

Recent research on chemical control of leaf blight has produced good results in Brazil. From Belem, Rogers and Peterson [1976] reported good canopies and increased latex yield following chemical treatment. Rocha *et al* [1975] reported an increase in yield of 475 kg/ha following control of the disease. Alencar *et al* [1975) recorded an increase of 82.5% and Mainstone *et al* [1977] found that sprayed tasks yielded 60% more than the control tasks, with a maximum potential of over twice the yield of untreated tasks. It is therefore apparent that chemical control has great importance in combating the disease.

Nursery screening trials in Trinidad showed that four fungicides are effective in controlling leaf blight: thiophanate methyl [0.07% a.i.] benomyl (0.025% a.i] Chlorothalonil (0.15% a. i. and mancozeb (0.32% a.i.] Chee, 1978]. For suppression of conidial sporulation benomyl can be used. whereas thiophanate methyl [0 14% o.i.] inhibits the ascospore release. Hence, benomyl can be used during the early rounds in order to reduce sporulation of conidia and ascospores respectively [Chee, 1977; 1978]. The new systemic fungicide triadimefon has also shown promise. Thiophanate methyl, benomyl, chlorothalonil and mancozeb are being used on plantation scale in Brazil (Chee and Wastie, 1980]. Recently triadimefon [0. 015% a.i) triforine [0.038% a.i.] and bitertanol [0.03% a.i.] have also been shown to be effective in nursery trials. It was also observed that mixtures of systemic and protective fungicides are more effective than individual fungicides alone [Santos *et al*, 1984].

The use of various types of aircraft for spraying in Brazil against leaf blight has been discussed in detail [Matthews, 1976]. For aerial spraying, the concentration of fungicides used per ha is 300 gm Benlate [benomyl], 200 gm thiophanate methyl, 300 gm Bayleton [triadimefon], 1.6 kg Bravonil [chlorothalonil] or 2 kg Dithane M 45 [mancozeb For fogging, 200 g of thiophanate methyl or 1kg mancozeb per ha is used. Large scale fogging trials using three makes of fog generators are being conducted in Brazil. It was observed that, with an improved model of fog generator, about 200 ha can be effectively covered in a day. Fogging starts well before refoliation and continues for two months covering the entire refoliation period, with 12 rounds at an interval of 4–7 days. It has been claimed that 30-38% yield increase by fogging in the leaf blight-effected area in Brazil (Chee and Wastie, 1980; Martins e. Silva, 1978) was obtained.

In recent fogging trials conducted in India, against *Phytophthora* leaf fall disease, it has been observed that fogging is much cheaper than any other method of application (Thomson *et al 1984*). Hence, fogging appears to have bright prospects in the control of leaf blight in the future, especially when encountering difficulty in securing sufficient numbers of aircraft in time.

Breeding for resistance

Breeding for disease resistance combined with high yield is the most important and permanent solution for combating leaf blight in Latin America and other parts of the World. The Ford Motor Company's breeding programmes have produced such promising clones as FX 25, FX 3899 and FX 3164 in Brazil while a similar effort by Firestone Rubber Company has produced numerous resistant clones in their MDF and MDX series in Liberia and Guatemala. *H. brasiliensis* from Madre de Dois and *H. benthamiana* from Rio Negro were found useful as sources of resistance against leaf blight (Subramanian, 1969). Of the vast number of resistant clones bred in Brazil only 14 of the first generation seem commercially acceptable for large scale planting. Among these only six clones are most generally acceptable: FX 25, 3810, 3899, 3925, IAN 710 and 717. Of these, four have the most effective resistant parent F. 4542 (*H. benthamiana*) and the other two have resistance from *H brasiliensis* (IAN 710 from F 409 and FX 25 from F 351). One complicating factor noted is that in many instances susceptibility varies between localities. Thus FX2261 is susceptible in Belem and moderately resistant in Bahia, whereas FX 3899 and IAN 717 behave in the opposite fashion (Chee and Wastie, 1980). Breakdown of resistance by the occurrence of physiologic races is another problem encountered in breeding for resistance (Langdon, 1965)

Breeding for leaf blight resistance in Asia was primarily carried out by the Rubber Research Institutes of Malaysia and Sri Lanka. On the basis of an agreement signed in 1950 between RRIM and the Instituto Agronomico do Norte, Belem, Para, Brazil, exchange of clones between Malaysia and Brazil was started (Hilton, 1955). The leaf blight resistant clones imported into Malaysia during 1953/54 consisted of nine selections made in Fordiandia (six of *H brasiliensis*, three of *H benthamiana*), two selections of *H. brasiliensis*, seedlings of Belem origin and 14 selections from cross of Ford clones and

Eastern clones (F1) a total of 25 clones (Brookson, 1956).

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NEW TECHNIQUE FOR LINING CANAL

The Indira Gandhi Canal project authorities are going for a new technique to line the 4,800 km long distributory system under stage II of the canal's construction. The Central Water Power Commission has given clearance on an experimental basis, according to a spokesman. If the work, comprising rubber lining with a single tile cover,proves successful, the benefit of the project would accrue two years ahead of schedule.

Stage I of the canal is lined with brick tiles while stage II is lined with brick tiles in the initial stages and with cement concrete block with low density polythene sheets at a later stage.

No good quality clay is available to manufacture brick tiles in the area where the work is now under execution. Moreover, the area never had any tile culture because of the easy availability of stone. If the current system of double tile coverage is retained, the lining of the 4,800 km long distributaries would require no less than 200 crore such tiles.

The alternative was suggested to the project organisation by a number of senior engineers who had worked in Iraq, Iran, Algeria and Egypt. Hungary and Japan are manufacturing the special type of rubber sheets.

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* The paper is reproduced from Tropical Pest Management, 1986 32(4), 296-303

NEW TECHNIQUE FOR LINING CANAL

The Indira Gandhi Canal project authorities are going for a new technique to line the 4,800 km long distributory system under stage II of the canal's construction. The Central Water Power Commission has given clearance on an experimental basis, according to a spokesman. If the work, comprising rubber lining with a single tile cover, proves successful, the benefit of the project would accrue two years ahead of schedule.

Stage I of the canal is lined with brick tiles while stage II is lined with brick tiles in the initial stages and with cement concrete block with low density polythene sheets at a later stage.

No good quality clay is available to manufacture brick tiles in the area where the work is now under execution. Moreover, the area never had any tile culture because of the easy availability of stone. If the current system of double tile coverage is retained, the lining of the 4,800 km long distributaries would require no less than 200 crore such tiles.

The alternative was suggested to the project organisation by a number of senior engineers who had worked in Iraq, Iran, Algeria and Egypt. Hungary and Japan are manufacturing the special type of rubber sheets.

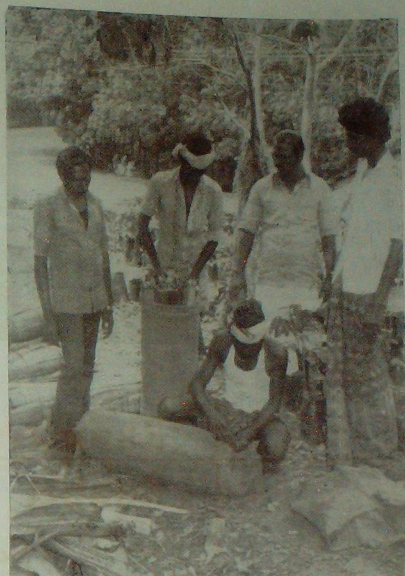
Railways too for Rubber Promotion

P. C. CYRIAC

The Trivandrum - Guwahati Express train is about to start on its long journey. The first platform of the Central Railway Station is extremely busy. People are moving around - some trying to get into the seats which they have located, the others searching the compartments for their berths, many others who have not been able to get bookings frantically rushing along the platform with their luggage and trying to squeeze into wherever possible. The porters hoot their way through pushing the trollies and carrying head-loads too. The vendors shouting aloud about their wares cause more confusion. In the midst of all this, some porters are energetically loading a special wagon at the end of the train, a VPU wagon which can carry 60, 000 budded rubber stumps. Bundles covered with gunny bags; thousands of them. A few curious people have collected around. They would have imagined that the bundles contained

eggs or some other perishable food material seeing the care with which they were packed and handled. None would have guessed that the bundles contained Rubber budgrafts pulled out from Nurseries a few miles away and carefully dressed and packed for undertaking the strenuous 4 day journey. Once the budded seedling is pulled out, its top portion, $1\frac{1}{2}$ – 2 inches above the bud union is cut back. Then the tap root is pruned to convenient length and the lateral roots around the collar region sliced after retaining to a length of $1\frac{1}{2}$ - 2". The cut end of the stem above the bud union is dipped in

melted paraffin wax to avoid dehydration. The budded stumps so prepared are wrapped up in banana sheath and they are ready to board the train. The Field Officers of the Rubber Board and the enthusiastic Railway Traffic people are around to ensure that the fragile bugrafts are provided with proper accommodation. These budgrafts are to find their home and roots ultimately in the fertile soils of the North East in Assam, Meghalaya, Tripura and Mizoram. Small farmers there who have become convinced about the viability of rubber are eagerly expecting their arrival. They would be transported to the fields from Guwahati Railway Station 4 days later by trucks and put in specially prepared polybag nurseries. The site which one saw at the Trivandrum Station on Thursdays between November and March last added a new feather to the already colourful cap of the Railways.



Between November and March a total quantity of 6 lakhs of rubber budgrafts were despatched like this. Generally we all read about only stories of bungling by public sector giants like Railways doing things in a mindless way. But the Rubber Board's experience has been different. It was pleasant journey all the way. For transporting this massive quantity of budgrafts, the Rubber Board considered different alternatives. Despatching by air, trucks and even by sea from Tuticorin to Haldia and from there by road the rest of the distance were examined. Ultimately taking into consideration all the factors including speed, the possibility of getting the plants damaged in transport and the cost of transportation, the choice fell on the Railways. The immediate aim in North East is to get rubber planted

in atleast 20,000 hectares between now and the year 1990 and 5000 ha. during 1987. The effort for making the prospective growers become familiar with the crop, its cultivation practice, its money making potential and its ability to prevent soil erosion and provide rural jobs was fruitful. We have to transport 20 lakhs of budded stumps to satisfy the demand which the Rubber Board's awareness campaign has generated there. With these 6 lakhs budgrafts now transported alone, it is expected that atleast thousand hectares would be made green and saved from soil erosion this season. After the rains come, this transportation will be resumed. Big nurseries are being commissioned fast in North East itself for generating the planting materials required for use there. (A few photographs of the massive transportation efforts may be seen)

RUBBER PACT

Asia's main rubber producers are ready for fresh talks with consumers on a new International Natural Rubber Agreement (INRA) and have pledged to approach such discussions in a constructive manner. Malaysia, Indonesia, Thailand and Sri Lanka said they hoped consumers would co-operate with them to resolve outstanding issues that have blocked agreement on a new pact. These points were made in a statement issued at the end of a three-day meeting of an Association of Natural Rubber Producing Countries (ANRPC) committee on INRA matters.

GUAYULE PROJECT

The US Departments of Defence and Agriculture, after months of negotiations have reached agreement on the continuation of the guayule commercialization project at Sacaton, Ariz. The USDA will take over administration of the programme to produce natural rubber from the desert shrub, while the DOD will provide $II.I million funding during the next two to three years.

POLYSAR DOUBLES

Following its takeover of Petrosar's chemical refinery, Polysar saw net profit more than double in the first nine months of 1987 to Can$ 17.3m ($ 12.5m). Sales for the Canadian synthetic rubber producer rose by 15.2 per cent to $I.5bn in the same period. In Polysar's third quarter report its president, Robert Dudley, attributed the good results to a general business upswing. This was aided, he said, by the full consolidation of the 60 per cent of Petrosar it acquired from the Canadian subsidiaries of Du Pont and Union Carbide, giving Polysar full ownership. Dudley said the Petrosar arm has now completed the second phase of its feestock felxibility programme, allowing it to use vacuum gasoil as a feedstock. The first phase of Polysar's latices joint venture with Shangahi Gao Qiao is scheduled to come on stream this year.

RUBBER CULTIVATION IN ORISSA

History has only very little to contribute on rubber cultivation in Orissa. Though the past few decades have no recorded development worth mentioning in respect of this plantation crop, there were few instances of fielding the experiment in a limited manner. Among the early entrepreneurs, the name of the then Maharaja of Mayurbanj is still remembered. 60 years ago he planted rubber in 6 hectares of land near Baripada in Mayurbhanj District. The trees though badly neglected since then, had comparable growth to any of the trees planted in the traditional rubber growing areas.

New trial plantations of rubber were established by the State's Soil Conservation Department in 1966-67 at Aiginia near Bhubaneswar in Puri District at Nilgiri in Balasore District and at Chennadhua near Baripada in Mayurbhanj District. They did not get adequate attention. Now 19 rubber trees are seen at Aiginia. They are fairly tall and healthy and indicative of the potential growth and development of rubber in Orissa. The trial planting at Nilgiri has totally failed due to poor site selection. At Chennadhua about 170 trees stand distributed over an area of about 2 hectares. Owing to lack of maintenance, the general growth is also far from satisfactory. However, the trees do not bear any visible signs of disease.

Owing to the neglect and improper maintanance, the trial plantations of rubber in Orissa have not registered a potential growth in the locality. The trees have not been subjected to any regular tapping although test tappings were carried out recently which yielded fair exudation of latex. In the case of rubber, vegetative growth, girthing of trunk, extent of canopy formation and bark characteristics are generally indicative of yield capabilities since in any given strain of rubber, latex production is directly linked to total biomas production.

Rubber cultivation was started in a systematic manner on 16th July 1984 at Sidingi near Pilasalki Minor Irrigation Dam in Phulbani District by the Soil Conservation Department. 2.00 hectares were planted with budded rubber plants supplied by the Rubber Board. The growth of the plants is reported to be satisfactory. The Rubber Board has granted subsidy under the Plantation Development Scheme to this plot.

Estate of Orissa Forest Corporation.

The State owned Orissa Forest Corporation has also taken up rubber cultivation in a big way. They have planted 20. 00 ha.

Rubber Board Regional Nursery, Khandagiri, Orissa
(More pictures on the following pages)

and 1000 budwood mother plants are available.

Encouraged by the performance of the successful plantations so far established, the Rubber Board has taken up keen interest in promoting rubber cultivation in Orissa by strengthening its infrastructural net work in the State for rendering need based service, both financial and technical to those who volunteer to plant rubber in various Districts in the State identified feasible for this crop. A full fledged Zonal Office of the Rubber Board in charge of a Deputy Rubber Production Commissioner assisted by a Deputy Development Officer and 4 Field Officers stationed at Bhubaneswar, Berhampur and Dhenkanal

in 1985 and 24.00 ha. in 1986 in Dhany Reserve Forest area of Puri District. They had started a rubber seedling nursery of 17,000 plants in 1985 out of which 7,600 plants were successfully budgrafted and raised in polythene bags in November 1986. During 1986 they had raised another seedling nursery with 25,000 plants for budgrafting in 1987. They had also established a budwood nursery with 2,000 plants of high yielding varieties like RRII 105, GT 1, PB 235 etc.

For the 1987 planting they have raised 18,000 budded plants in polythene bags and nearly 30. 00 ha. can be planted with successfully grown up plants from this nursery. The growth and other behaviour of the plants in this plantation appear to be satisfactory.

Saptasajya Plantation

In Saptasajya Kamar of Dhenkanal District, another plantation of 1.00 ha. was also started in 1984. Since the planter who started the cultivation there left the scene, the plot is now in a neglected condition.

There is a good rubber nursery in an area of five acres near the Deer park at Kapilash in the land leased out by Debator, Dhenkanal, where 14,000 seedlings

has already started functioning from September 1986.

A rubber seedling nursery of 2.4 ha. has already started at Khandagiri near Bhubaneswar to ensure availability of high yielding planting materials during the next planting season in June-July. This nursery can supply upto 25,000 budded plants of superior strains adequate to cover an area of around 45 hectares.

Rubber Board has also started the work of establishing a Regional Centre (for undertaking investigative research studies on the special problems of rubber in Orissa) on 100.00 acres at Kamakhya Nagar in Dhenkanal District.

The efforts for getting 600.00 acres of Government land for establishing a Nucleus Rubber Estate and Training Centre at the forest land in Kapilash in Dhenkanal District are also progressing.

Board is also on the lookout of a suitable plot of 25.00 acres for rubber nursery to be established during this year itself for distribution of available planting materials for 1988.

Voluntary Agencies

Yet another step initiated by the Rubber Board for promoting rubber cultivation in Orissa is by involving voluntary agencies for raising rubber saplings in polythene bags sufficiently in advance. This would enable its members to obtain vigorous budgrafts for field planting in July 1987. 69 such voluntary agencies were contacted by our Field Staff and 12 of them have taken up the work. The Technical Officers of the Board will give necessary guidance and knowhow for raising nurseries. The polythene bags and plants needed for raising the nurseries are supplied free of cost to the Voluntary Organisations besides advancing Rs. 2/- per bag as cost of maintenance of the nurseries. 1,71,500 polythene bags valued at Rs. 2.8 lakhs were supplied to them during last December/January.

One consignment of 24,000 budded rubber plants is brought from Kerala and planted in the filled up bags of 4 such organisations. Another consignment of 25,000 plants is expected to be supplied immediately.

Marching Forward

Indications are that the stage in Orissa is set for massive development of rubber plantation. Recently the Government of Orissa have decided to encourage rubber planting by allotting 1000 ha each for rubber plantation to Orissa Forest Corporation, Similipahar Forest Development Corporation and Orissa Plantation Development Corporation. OPDC has already submitted a scheme for taking up rubber plantation in 500 ha. in various plots situated in Puri, Dhenkanal and Mayurbhanj Districts. The Deputy Rubber Production Commissioner of the Zonal Office has already visited various plots primarily selected by OPDC to assess the suitability of such lands.

With the whole hearted support and patronage of all concerned, rubber cultivation in Orissa will extend to new areas in the near future.

— K. K. KURIAN
Dy. Development Officer

EXXON CHEMICAL EXPANDS EP RUBBER FACILITY

Exxon Chemical affiliate, Socabu, has completed on schedule a 30% expansion to 65000 tonnes a year at its ethylene-propylene rubber plant at Notre Dame de Gravechon. EP and EPDM polymers, which Exxon Chemical markets under the Vistalon name, are widely used in the automotive, electrical, construction and polymer modifications sector. In addition to the French plant, Exxon Chemical operates a 70 000 tonnes a year plant at Baton Rouge, Louisiana in the US

IN THE MARKET

Naphtha prices reached a peak of $ 171–175/ton cif but have since fallen back to $ 167–170/ton. This is still some $ 8/ton up on a week earlier. Prices are firming in line with crude and other oil products and on the back of strong demand since freezing weather hit Europe. Butadiene prices are firm at up to $ 220/ton fob with product in very tight supply. Problems in Antwerp are hitting production and strike action is affecting distribution. Contract prices look like settling at FFI, 800–1,900/ton.

Progress in Production and Specifications of Crumb Rubber

Dr. E. V. THOMAS

Natural Rubber is extracted from the bark of the trunk of *Hevea Brasiliensis* trees by a process of controlled wounding, called tapping. The milky white tree sap called latex is processed either into dry forms of rubber or as concentrated latex depending on the facilities available in the rubber estate. In conventional methods latex is processed into sheet or crepe rubber. The field coagulum rubber is processed as Estate Brown Crepe (EBC) remilled crepe and or flat crepe. The sheet or crepe rubber produced by processing the crop from rubber plantations is graded by the visual comparison methods. The details of this system of classification is evolved by the Rubber Manufacturers Association, New York and it is given in the "Green Book". The latest edition of the Green Book was published under the direction of Part II of the fourth international rubber quality and packing conference held in Brussels, Belgium in June 1968 and is endorsed by 19 countries having direct dealing in natural rubber.

In the visual classification system there are 35 grades within eight types of natural rubber, all of which are produced from the latex of '*Hevea Brasiliensis*'.

The classification system is based on visual examination of rubber and it is not helpful in judging the inherent technological properties of rubber. This also gives room for malpractices. From 1945, after the IInd World War many manufacturers in developed countries started using factory made synthetic rubbers. Several Scientists in different parts of the World evolved procedure for production of different types of rubber like polymeric materials. By 1965 many factories in U. S. A, Germany, U. K. and Japan switched over completely to product mixes which contained either only synthetic rubbers or only very little of natural rubber. Thus the natural rubber producers in South-East-Asian countries faced a serious problem in the marketing of their produce in the face of competition from different types of synthetic rubbers. The advantages claimed by manufacturers for different types of synthetic rubbers are the following.

1) Uniformity in properties, as the synthetic rubbers are prepared in factories under pre-determined conditions.
2) Technical specification of product
3) The flexibility of being processed in tailor cut forms as per requirement of the consumers.

So the natural rubber producing countries made earnest efforts to improve the appearance, presentation and grading of the rubber produced by them and the developments seen today in production of technically specified rubber (TSR) and crumb rubber are the result of this.

Natural rubber processed as crumb rubber is marketed in appearance, grading and packing similar to those of synthetic rubbers. This modern form of processing natural rubber is adopted by the rubber plantation industry to improve its competitive position against the synthetic rubber industry.

The important unit operations in the processing of natural rubber as crumb rubber are listed under.

1) Coagulation
2) Dewatering, blending and dirt removal
3) Size reduction
4) Drying
5) Baling, packing and grading.

Coagulation

Rubber is extracted from the rubber trees as a milky white dispersion called latex. From this colloid, rubber is precipitated by addition of an electrolyte. In plantations this is brought about by addition of acid and this process is called coagulation. In the production of crumb rubber from field coagulum, acid coagulation step is not needed as this from of rubber is collected from the field already in coagulated forms.

Coagulation is done in large tanks after bulking and blending the latex from different sources in a central tank. This procedure is useful in ensuring uniformity to the latex. Coagulation is brought about by addition of formic acid or other suitable coagulants. For production of viscosity stabilised rubber (Constant Viscosity) addition of chemical is done prior to coagulation. Bleaching agents, if any, added in processing are also incorporated in latex prior to coagulation. If oil extended rubber is to be produced oil emulsion is added to latex before acid coagulation.

Size reduction, de-watering and dirt removal

In this stage rubber coagulum is crumbled mechanically to small pellets of 0.1 to 2 mm size. Such disintegration of coagulum is helpful in removal of trapped dirt and foreign matter. Crumbs are received in a pool of water and blended properly to reduce variability in the processed material. Crumbling is brought about by the combined action of a series of machinery like macerators, crepers, hammer mills etc. Shredders, extruders etc. are also used in some factories for this. In the hevea crumb process crumbling is brought about by mechano-chemical action. Here the chemical crumbling agent used is castor oil. But in most factories chemical crumbling agents are not used now. Crumbling of coagulum is useful in ensuring proper blending of the raw rubber from various sources and also for removal of foreign matter.

Drying

Rubber crumbs in the wet stage will have water content in the range of 16 to 22 percent. This is dried in a current of hot air. The final moisture content in dry crumbs should be below 0.5 per cent. The drying temperature employed is in the range of 80 to 110°C. The duration for drying is four hours.

Baling, Packing and grading

The dry crumbs are pressed in hydraulic passes in the shape of solid blocks of definite dimensions. These blocks are wrapped in polythene sheets which are compatible with rubber. Samples of rubber are taken from the corners of the blocks for assessing the conformity of the material to set standards. Grading of the rubber so processed is based on the analytical results.

ISI Standards for raw natural rubber

Specifications for raw natural rubber is given in the IS document No. 4588. The parameters prescribed for raw rubber as per this document are given in Table 1. It may be seen from the document that the properties specified for raw natural rubber are dirt content, ash, volatile matter, nitrogen centent, plasticity and plasticity retention index. Each property prescribed gives useful information to the consumer. Dirt content and ash will give information on foreign matter present in rubber. Since the maximum content of these impurities are specified in each grade, adulteration of rubber at any stage can be checked effectively. Volatile matter specification is helpful in ensuring complete drying of rubber. If a high value is observed in this property the indication is that the rubber is not dried properly. Nitrogen content value is specified to avoid chances of contamination/admixture of rubber with low grade rubber like skim rubber. Specification for initial plasticity and plasticity retention index are technologically very significant properties. The former gives information on the viscosity/molecular weight of rubber while the latter gives the tendency of rubber to degradation by heat. It is not necessary to state here that the conventional visual classification system gives no useful information to the consumer other than the visual appearance of it. So all progressive and modern factories in major consuming countries are now giving preference in the use of technically specified natural rubber in place of visually graded sheet or crepe rubbers.

Specially processed natural rubber

Natural rubber can be processed for specific applications and in forms which consume less energy during processing. The following chart may be seen in this context for assessing the processing advantages of modern forms of processed rubber.

Conventional sheet/crepe	Solid block rubber (TSR)	Constant Viscosity rubber	OENR-L
↓	↓	↓	↓
Unload to factory	Unload to factory	Unload to factory	Unload to factory
↓			
Clean Bale surface			
↓			
Bale cutting			
↓	↓		
Premastication	Premastication		
↓	↓	↓	↓
Mixing chemicals	Mixing chemicals	Mixing chemicals	Mixing chemicals
↓	↓	↓	↓
Compound	Compound	Compound	Compound

It may be seen from the chart that the new forms of processed rubber can provide considerable benifits to the consumers. These rubbers can also contribute to substantial saving in energy at the mixing and compounding stages. Use of latex stage compounds and carbon black master batches can provide still better results in energy saving. Use of these master batches and latex compounds can minimise air pollution and factory floor contamination. Following histogram may also be seen to study the extent of energy saving possible by using specially processed NR (Fig. 1).

Constant Viscosity natural rubber (CV Rubber)

Natural rubber undergoes hardening during storage by intermolecular cross link reactions because of the presence of active groups in the poly isoprenic chain structure. In C V rubber, these active aldehydic groups are rendered inactive by reactions with hydroxylamine hydrochloride. The resultant rubber maintains its viscosity at constant level, just as in the case of most mineral purpose synthetic rubbers. The manufacturers who procure CV rubber gets consistency in properties for their rubbercompounds. In Malaysia around 12 per cent of the total SMR production is in the form of CV rubber. These rubbers are used in production of high quality engineering goods like mountings, bearings, suspension units etc. They are also good in making extruded or injection moulded goods.

Carbon black rubber master batches from latex

In this process carbon black is admixed with rubber latex in the plantations. The resultant product are useful in saving energy and for keeping the factory floor clean. Air pollution can also be minimised in the areas where factories are located by using this material.

Polymer blends

In most rubber products it is advantageous to use a blend of two or more polymers. Previously only elastomers were used in such blends. But now thermo plastic polymers having compatibility with natural rubber are also used. Blends of natural rubber and emulsion poly buta diene were prepared in latex stage and evaluated by the Rubber Research Institute in 1979. The results show that there is scope for popularising this type of rubber.

General purpose natural rubber (GP SMR)

This is a viscosity stabilised general purpose grade of natural rubber. Consumers of this grade of rubber can do away with pre-mastication. In GP rubber three types of raw materials are used, viz. factory processed latex, sheet material and field coagulum. These are processed separately and blended in predetermined ratio after viscosity stabilisation. Dry coagulum materials are given viscosity stabilisation by using a proper dispersion of mercaptans and hydroxylamine neutral salts in water. Coagulum treated in this mixture gives viscosity stabilisation only when it is dried at a temperature of around 100°C. In Malaysia around 4 per cent of the SMR produced is GP Rubber. It is reported that GP rubbers are specially suited in production of tyres, belts and hoses.

SP Rubber

This is partially vulcanised natural rubber. Its main application is in the production of goods which have strict diamentional specifications. This rubber finds application in the production of extruded and calendered products. Dye swell will be reduced appreciably by use of this item in extrusion compounds. Several grades of SP rubber are available commercially based on the extent of vulcanised rubber present in the mix.

Low protein rubber

This is a new grade of natural rubber with low nitrogen and ash contents. It is produced by treating natural rubber latex with anenzyme which breaks down the naturally occuring proteins into water soluable products that are washed away during manufacture. DPNR will not absorb water. So variation in properties of scorch or cure by water absorption can be avoided. Also water absorption by rubber products adversely affects electrical properties. Low protein natural rubber gives higher resistance and lower creep for the vulcanisates.

Production of TSR in major NR Producing countries

There has been substantial growth in production of TSR in major rubber producing countries like Malaysia and Indonesia. The growth in production of TSR in Malaysia may be seen from the following graph.

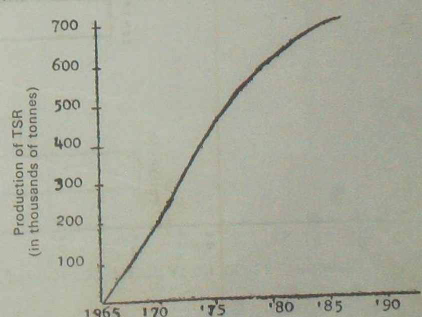
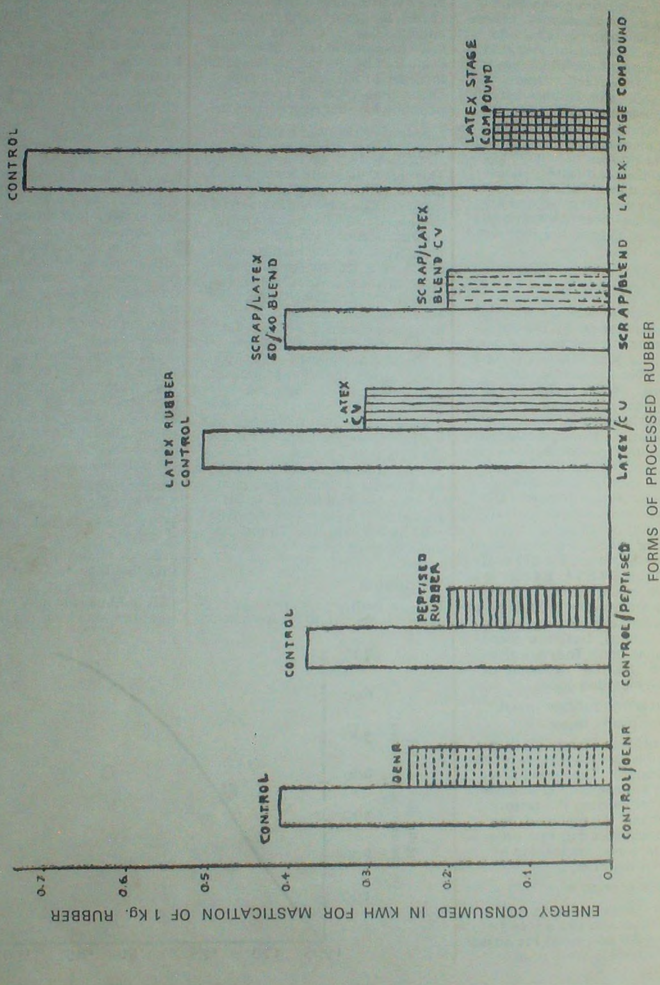


Fig. 1 ENERGY SAVING OF THE PROCESSED RUBBERS



IS : 4588-1977 (Indian Standard)

SPECIFICATION FOR RUBBER, RAW NATURAL (Second Revision)

Table 1 Chemical Requirements for Natural Rubber (Clauses 3 & 4.2)

Sl. No.	Characteristic	Requirement for					Method of Test Ref : to
		ISNR 5 (Special)	ISNR 5	ISNR 10	ISNR 20	ISNR 50	
i)	Dirt Content, per cent by mass, Max	0.05	0.05	0.10	0.20	0.50	NR: 1 of IS:3660 (Part 1)–1966*
ii)	Volatile matter, per cent by mass, Max	1.0	1.0	1.0	1.0	1.0	NR:2 of IS:3660 (Part 1)–1966*
iii)	Ash, per cent by mass, Max	0.6	0.6	0.75	1.0	1.5	NR:3 of IS:3660 (Part 1)–1966*
iv)	Nitrogen, per cent by mass, Max	0.7	0.7	0.7	0.7	0.7	NR:11 of IS:3660 (Part III)–1968**
v)	Initial plasticity, Min	30	30	30	30	30	NR: 12 of IS:3660 (Part III)–1971***
vi)	Plasticity retention Index (PRI), Min	80	60	50	40	30	MR:13 f IS:3660 (Part III)–1971***

* Methods of test for natural rubber, Part I
** Methods of test for natural rubber, Part II
*** Methods of test for natural rubber, Part III

Table IV
SMR specifications, grade types and grade codings mandatory from January 1, 1979

(Property (a))	SMR CV	SMR LVb	SMR L	SMR WF	SMR 5	SMR GP	SMR 10	SMR 20	SMR 50
	Latex grade				Sheet material grade	Blended grade	Field grade		
	Viscosity-Stabilized					Viscosity stabilized			
Dirt retained on 45 um aperture (max., % wt)	0.03	0.03	0.03	0.03	0.05	0.10	0.10	0.20	0.50
Ash content (max, % wt)	0.50	0.50	0.50	0.50	0.60	0.75	0.75	1.00	1.50
Nitrogen content (Max,% wt)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Volatile matter (max.,% wt)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Wallace plasticity number, Po (min).	—	—	30	30	30	—	30	30	30
Plasticity Retention index (PRI) (min)	60	60	60	60	60	50	50	40	30
Colour index (Loyibond scale) (max.)	—	—	6.0	—	—	—	—	—	—
Mooney Viscosity ML I+4,100°C	-(c)	-(d)	—	—	—	-(e)	—	—	—
Cure	R(f)	R(f)	R(f)	R(f)	—	R(f)	—	—	—
Bale marking colour (g)	—Black—			Light green		Blue	Brown	Red	Yellow
Bale identification strip colour	Orange	Magenta	Transparent colourless				Opaque white		
Standard bale wrapping				Transparent and colourless					

a) Based on ISO test methods
b) Contains 4 of light non-staining mineral oil. Additional producer control parameter: Acetone extract, 6-8%(wt)
c) Three Mooney viscosity classes (sub-grades), viz CV50, CV60 CV70, the classification (producer) limits being 45-55, 55-65, 65-76 Mooney units respectively.
d) One Mooney viscosity class, viz LV50, the classification (producer) Limits being 45-55 Mooney units.
e) One Moodney viscosity class, the classification (producer) limits being 58-72 Mooney units.
f) Cure information is provided in the form of a rheograph (R)
g) The colour of the printing on the bale identification strip.

Table V Requirements

Characteristic	Limits for grade of rubber: CV	L	5	10	20	50	Test method
	Colour Grade: Green	Green	Green	Brown	Red	Yellow	
Dirt content, %(m/m) retained on 45 um sieve max.	0.05	0.05	0.05	0.10	0.20	0.50	ISO 249
Initial plasticity, min.	—	30	30	30	30	30	ISO 2007
Plasticity retention index (PRI), min.	60	60	60	50	40	30	ISO 2930
Nitrogen content, % (m/m) max.	0.66	0.66	0.66	0.66	0.66	0.66	ISO 1656
Velatile matter content, % (m/m) max.	0.8	0.8	0.8	0.8	0.8	0.8	ISO 248 (oven method at (100± 5° C)
Ash, %(m/m) Max.	0.6	0.6	0.6	0.75	1.0	1.5	ISO 247
Colour index, max.	—	6	—	—	—	—	ISO 4660
Mooney viscosity, ML (1+4) 100°C	*	—	—	—	—	—	ISO 289

* Producer viscosity limits on production only, 60± 5

It may be seen from the graph that in Malaysia production of TSR was started in 1965 and after this there is steady growth in its production. Today almost 40 percent of the natural rubber produced in Malaysia is marketed under SMR Scheme.

The following table gives the percentage of different grades of SMR being produced in Malaysia for the past four years.

Table II
Changes in percentage of SMR Grades

Year	SMR production percentage						
	5L	CV	5	10	20	50	GP
1975	12.0	11.2	8.4	15.7	48.8	1.8	—
1980	8.9	13.2	5.8	16.6	53.4	0.8	0.5
1985	8.8	10.6	3.7	21.4	51.3	0.3	3.3

It may thus be seen that the production of higher grades of specified rubber are remaining at comparatively lower levels. This is because the consuming industries prefer to use lower grades of SMR which are available at lower price. Same trend is seen in other producing countries also. Table below gives the production of TSR in major rubber producing countries.

Table III
Production of TSR (in thousands of tonnes)

Year	Country					
	Singapore	Malaysia	Indonesia	Thailand	Srilanka	India
1980	76.3	564.8	658.3	90.1	8.5	2.2
1981	64.5	613.9	563.5	75.8	14.6	2.1
1982	47.6	579.4	579.8	79.9	10.8	2.1
1983	50.6	708.8	709.6	73.8	5.4	2.4
1984	49.6	767.1	783.9	76.5	8.1	4.6
1985	38.8	754.4	774.3	95.0	14.0	6.7

All the rubber producing countries in the world are thus encouraging production of technically specified rubber and the consuming industries give preference in use of this type of rubber in their applications.
The progress recorded in Indian TSR factories is not satisfactory in the earlier years. India started production of TSR in 1974.
But even in 1983 total production of TSR in Indian factories remained at the same level as in the first year of production. There is a visible trend of growth in TSR production in India now. It is expected that the annual production of TSR will reach 10,000 tonnes by the end of 1987. Some countries like Nigeria and Ivory Coast have managed to convert almost all of their rubber production in specified forms. But the total production of NR in these countries are very small.

Suggested production programmes for TSR in India

Natural rubber production in India has reached 210,000 tonnes per year. Almost 20 percent of this is available as field coagulum rubber. This type of rubber is now sold mostly as estate brown crepes and or remilled crepes. Part of it is converted to TSR also. It is desirable to convert all of the field coagulum as TSR. For this it will be necessary to provide assistance in conversion of some of the existing crepe mills to TSR factories.

Ten to fifteen percent of the rubber produced is converted to concentrated latex. The balance 65 per cent is processed as Ribbed Smoked Sheet. Many small farmers who do this processing are not bestowing proper attention to ensure production of good quality rubber sheets. Besides many units have no facilities for smoke drying sheet rubber. So around 20 percent of the Ribbed Sheet produced are marketed as off sheets. It is possible to use such off sheets in producing GP Rubber by blending with field coagulum and latex rubber after proper treatment for viscosity control.

In all producing countries around ten percent of the rubber produced is processed as high quality rubber like CV rubber. This type of material can be used in engineering applications and in products which need rigorous service properties. Two or three factories have to concentrate in the production of such high quality latex grade crumb rubber.

There is also need for production of speciality rubbers like OENR, SP. rubber and graft rubbers. It is felt that an intensive campaign will help in establishment and viable operation of three or four factories for producing these special grades of NR.

Complaints on use of TSR

There are some complaints from consumers on quality of TSR produced in different factories. These complaints are based on degree of dryness of the material or on presence of foreign matter, or on the level of degradation of rubber. Some complaints received on the TSR produced in India are also on these lines. The producing units should bestow personal attention to avoid such complaints. Every consignment should be tested and marketed only with ISI mark. Consignments failing to prescribed specifications should be reprocessed.

Developments in TSR

Modifications in specifications of natural rubber are reported mostly from Malaysia. The SMR grades were first specified in 1965. Main changes were incorporated in it in 1979.

Revised specifications for different SMR grades is given in Table IV.

A one day conference of the producers and consumers of technically specified rubber (TSR) was organised at the Rubber Board, on 17 May 1987 by the Board's Technical Consultancy Division. The conference evoked enthusiastic

TSR TURNS FAVOURITE

THOMAS OUSEPH

response from the tyre sector and the non-tyre sector and almost all the producers and suppliers of TSR took part in the deliberations. Hard days for TSR are almost over.

Emergence of TSR

Technically specified rubbers made their debut in India 15 years ago. Since then they have managed to maintain their foothold on the consumption arena through thick and thin. Nevertheless, their share in the NR production of 220,000 tonnes during 1986/87 was only about 8,000 tonnes; just below 5% of the total production. The Indian consuming industry was almost apathetic to this development in the initial years. Lack of demand had worked against the enthusiasm of planters to produce more TSR. Since domestic production could not entirely meet the demand for NR, the visually graded sheet rubber was sold in the market like hot cakes. Indian rubber producers have been remaining in the sellers market because of this peculiar situation. Though technically specified rubbers made their appearance in South-East Asia during the mid-sixties and were making inroads into the ribbed smoke sheet market, India began thinking about TSR production only when NR consumption received a setback during the mid-seventies. NR faced demand recession for a few years in the 1970s. In the face of excess supply consumers preference for quality materials suddenly surfaced and they wanted improvement in quality for raw rubber. This paved the way for the emergence of TSR in India. But visually graded sheet rubber held the ground strongly since the surplus situation was only a passing phenomenon. As the cousumption improved and the supply failed to meet the demand, the quality consciousness among the consumers received a severe jolt. They purchased whatever was available, and were not prepared to give due premium for the technically specified quality material.

Crumb rubber

One of the forms of TSR produced in India is crumb rubber. Crumb rubber is costlier than sheet rubber because of the additional expenses involved in its production. Sheet making needs only a mechanical device and a smoke house, no electrical energy is needed in its production. The roller is run by the hands to turn out sheets and they are dried in smoke houses or over kitchen hearths. The problem of pollution is not serious since the sheets are made in thousands of rubber plantations spread far and wide across the rubber growing belts in rural areas. But energy is necessary to process the field coagulum— in size reduction, dewatering and dirt removal, to set in motion the machinery like macerators, crepers, shredders, hammer mills etc, in drying crumbs and pressing them into blocks, and for treatment of effluents. There is organised labour to whom statutory wages, overtime allowance, sickness benefit, gratuity, bonus etc have to be paid. These make TSR costlier. However, the buyers generally had reservations in paying more. The reason for the slow progress of TSR in India is more economic than technical.

The situation has been gradually changing of late, which is a welcome trend. Many consumers are now complaining about inadequate supply of TSR; they want a commitment from the suppliers about making available a definite quantity.

Quality Problems

Scrap rubber, otherwise known as field coagulum, is the starting material for producing TSR grades ISNR-20 and ISNR-10. The major portion produced is ISNR-20. This is used mainly by the tyre sector. There were divergent views at the conference about its quality; some spoke about its low quality as compared to the Malaysian counterpart SMR-20. Dr SN Chakravarty of Mody Rubber Ltd was vehement in his demand for improvement in quality of ISNR-20. Sri Sen Gupta of JK Tyres went a step further; he had no qualms to say that not only ISNR-20 but even ISNR-10 is inferior in quality to SMR -20 as the manganese content is high in some cases. As a matter of fact manganese does not find a place in the chemical requirements for natural rubber as per specification prescribed in IS: 4588-1977 of the Bureau of Standards (ISI).

TSR praised

But the representative of Apollo Tyres had something different to say. He asserted that ISNR-20 is comparable in quality to SMR-20. Dr UK Banerjee of Good Year India could not concede that SMR-20 is superior to ISNR-20; he stated that he has all the data to show that SMR-20 is in no way superior to ISNR-20. Good Year is incidentally the largest single user of ISNR–20 in the country. Dr Banerjee found that compared to general purpose synthetic rubbers ISNR-20 is better in quality. The synthetic rubber as available in India today is of bad quality. Many consumers are using it ignorant of this fact. TSR would be a better alternative; as there is energy saving in its use as compared to ribbed smoked sheets of natural rubber,

Whatever be the merits of ISNR-20 vis-a-vis SMR-20, there was unanimity in view that ISNR-20 does not have technological properties of RMA–4. They wanted improvements in properties of ISNR-20 to match the quality of RMA-4. Though about 45,000 tonnes of scrap rubber is produced in the country, a year the quantity converted into TSR is only about 8,000 tonnes. This is too low. The consumers wanted to get enough quantity of TSR at a reasonable price.

Contaminated scrap

Low quality of the scrap rubber and its collection process stand in the way of making good quality crumb rubber. If processing is done with fresh scrap, the crumb rubber turned out would keep the standard. The mode of collection of scrap rubber in the country lends room for contamination. Small vendors go round the rubber plantations and collect the scrap. They store it until they get a sizable quantity for sale to the dealers. By the time the scrap reaches the processor through rubber dealers it gets badly contaminated. Unprocessed natural rubber is highly susceptible to bacterial action due to contamination in keeping. This contamination tells upon the quality of TSR produced.

The producers of TSR spoke about the additional expenses involved in TSR production. TSR gives advantages to the manufacturers through process saving and energy saving. They wanted the manufacturers to share with them a potion of the saving thus achieved, by offering to ISNR-20 the same price as for RMA-4. Representatives of the tyre companies were prepared to pay the price of RMA-4 to ISNR-20 provided the quality is comparable.

RPS an answer

Sri PC Cyriac, Chairman, Rubber Board stated that it is not difficult to overcome the problem of contamination. He pointed to the village level Rubber Producers Societies (RPS) organised recently, which could collect fresh scrap from the plantations and pass on to the processing units without loss of time. The Rubber Board is currently promoting organisation of such RPSs throughout the length and breadth of the rubber growing areas offering technical and financial assistance. These can function as a link between the planters and the processing units to collect fresh scrap in addition to their main function of collecting latex. Once fresh scrap is available to the processing units ,the problems in quality of ISNR-20 could be overcome.

There was a plea for making latex stage compounding as such compounds will have ready market in view of energy saving. The producers promised to make the compounds and announced their readiness to make even constant viscosity and superior process rubbers. These forms of rubbers hold out promise for process advantage. There is scope for use of more latex grade crumb in the form of SP rubber. This has export market. Latex crumb is not found economic in India in view of the high price for latex concentrates. However, many of the participants made a note of optimism that in course of time the price of concentrated latex may return to a reasonable level as a number of latex processing units are coming up.

Quality through process design

Regarding quality, the views of Sri Cyriac were very candid. Quality cannot be simply inspected into a product particularly at the last stage. It is to be done right from the beginning, from the stage of selecting the raw material. First of all the process has to be designed properly to get good quality material. Once a reasonable amount of care is taken in designing and acting upon the process, it is not difficult to achieve production of good quality material. He announced the Rubber Board's readiness to give technical assistance even to private sector TSR units to ensure proper designing of the process and improve quality of the material, charging nominal fees. If the manufacturing industry feels that the present ISI specifications do not cover all the criteria for TSR, they may make suggestions, which could be considered for modifying the specifications. Once this is done, inconsistency in quality can be overcome.

On the question of better availability of TSR, he pointed out that three more processing units have been commissioned in the co-operative sector recently, even though constraints in power supply and scarcity of water had affected production initially. TSR production is set to make a record this year, it will not be less than 15,000 tonnes as against 8,000 tonnes during 1986/87.

He said that the potential of non-tyre industry is very high in our country. In the non-tyre sector there are a large number of labour intensive items which can be manufactured in the country and exported. For most of them either centrifuged latex or latex crumb could be an ideal raw material.

Assistance for crepe unit conversion

There was also a view that crepe rubber does not match the qualities of crumb rubber and therefore the crepe rubber units should be converted into crumb rubber units. Sri Cyriac offered the technical assistance of the Rubber Board in converting crepe mills into crumb rubber making units and for arranging credit finance to meet expenses involved in the conversion.

RMA reference Samples

Sri Cyriac released on the occasion reference samples of raw rubber grades RMA 1 to 5 by giving a set of samples to the Managing Director of the Kerala State Co-operative Rubber Marketing Federation. In the system of visual grading prevalent in the country the samples will be of immense help to the trading and consuming interests to determine the correct grades of sheet rubber. The samples are available from the Rubber Board. Each set of sample costs Rs 250/-.

Two papers were presented at the technical session of the seminar, one by Dr U K Banerjee, Technical manager of Good Year India Limited, which viewed TSR from the consumer's point of view. The second paper was presented by Dr E V Thomas, Dy. Director in charge of the Technical Consultancy Division in the Rubber Board, on the progress in production and specification of the crumb rubber. Both papers were received well, judged from the lively discussions that followed. □

BLIGHT OF THE RUBBER PLANT

The World faces a potentially disastrous wipeout of its rubber plantations: the agent, a South American leaf blight fungus, *Microcyclus ulei*. Thomson Edathil from the Rubber Research Institute of India highlights the grave risk to *Hevea brasiliensis* (Para rubber) in Africa and the Far East from the movement of people and plant material (*Tropical Pest Management*, vol 32, p 296).

The disease is at present confined to the humid tropics of South America Huge plantations in Guiana, Panama and Costa Rica were abandoned early this century when the disease reached epidemic proportions. Yields fell dramatically and, as a result, we now depend on the Far East for 90 per cent of our rubber.

Infected rubber plants show different forms of the blight. Young leaves (4-9 days old) show characteristic distortions and lesions on their underside. A noticeable olive-green powder contains millions of asexually produced spores which are dispersed to other plants or branches as they are dislodged by rain. The new leaves are destined to fall from the plant, but not so older ones, which continue as a source of infection.

Secondary stages in the growth cycle of the fungal intruder appear on the topside of older leaves later in the year. Dark rings contain spores probably from sexual reproduction. These leaves fall during the natural wintering period, from August to November; carrying with them a source of infection for the new foliage that emerges with the reappearance of persistent rains.

Edathil has considered how effectively the growth and development of *M.ulei* is tied to prevailing weather conditions in the tropics of South America. Outbreaks of leaf blight occur when daily temperatures are less than 22°C for longer than 13 hours, rainfall is greater than 1 millimetre per day for seven days, and relative humidity is at least 92 per cent for 10 hours or more. The disease does better where rainfall is even throughout the year.

These climatic conditions are, if anything, ideal in the important plantation areas in Malaysia and South India. More over, the high-yielding varieties grown in these huge areas are highly susceptible to the blight. The chances are that if the fungus were introduced, a devastating epidemic would take place. Could this spread be prevented using existing methods and materials?

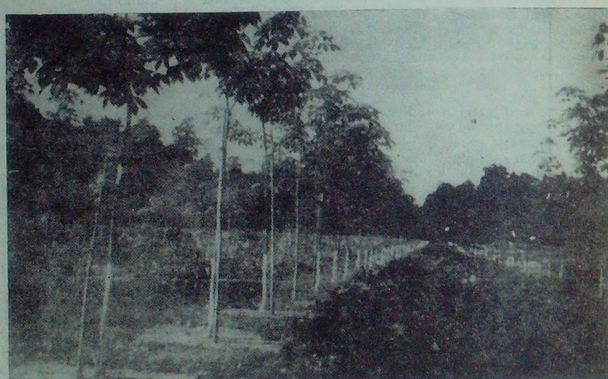
Edathil advocates that the best cure is prevention. This is a realistic option because of limits placed on the long distance dispersal of the leaf blight. *M. ulei* cannot be borne on air currents because exposure to intense irradiation and high temperature destroys the asexual spores; and the secondary over-wintering spores are too heavy. However, spores have been found under fingernails and in clothes, following someone's visit to a plantation nursery harbouring the fungus.

(New Scientist 26 February 1987)

AFFORESTATION BY RUBBER PLANTATIONS

P. S. KURIAKOSE

Forests were once considered as inexhaustible source for the food, fodder and fuel for the human race. Exploitation of forests started generations back. Forests are even today a rice bowl for millions. The unrestricted exploitation results in denuded forest lands. It leads to very unfavourable consequences such as large scale erosion, floods and deposition of silt in river beds of dams for irrigation and hydro electric projects. Even major climatic changes are apprehended.



The cry for afforestation is heard from all centres. The social reformers, and governments, display advices to 'plant trees and prosper," and "plant trees for your future generation." Plantation of trees under social forestry programme is going on but that alone does not take us to the desired goal to bring greenary over nude land surface within the country.

Rubber is a perennial tree that can stand for 40 to 50 or more years, grows to a height of 15/20 metres with profuse branching and canopy and yields good quantity of bio-mass. The valuable strategic raw material rubber is also synthesized in the body of the rubber tree. It can be exploited by a restricted simple exploitation methed from the bark of the tree in the form of latex. We can produce raw rubber that is essentially required for the industrial growth and welfare of people. The country is producing nearly 50,000 tons less raw rubber than what is required by our own industries within the country.

The shortage is made good by import of raw rubber from the neighbouring rubber producing countries at a loss of the very valuable foreign exchange. India is predominantly an agricultural country. Plenty of suitable bare land is available on the hill sides in various parts of each State. The Rubber Board had conducted agro-climatic suitability survey for rubber cultivation in each State. Leaving out the traditional belt of rubber growing areas of Kerala and Tamil Nadu, more than a lakh hectares of suitable land is easily avilable in non-traditional areas in all the north eastern States. Trials conducted in all the NE States have yielded encouraging results. Consistent research works in the Regional Research Centre are going on. People have started rubber plantations in a small way with encouraging results.

The Rubber Board, a statutory body of the Government of India, is working earnestly for increased production of rubber in the country. The immediate goal is to meet the steady indigeneous demands. The prospects of export of raw rubber and value added industrial products are very bright.

Looking forward, the need of rubber in the country will increase to double fold in a decades time. The rubber plantation is a forest under control. It brings in all the environmental favours of forests and yields the valuable raw rubber. □

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THE RUBBER BOARD

KOTTAYAM 686 001 INDIA

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PC Cyriac IAS

Secretary
V Bhaskara Pillai

Rubber Production Commissioner
P Mukundan Menon

Director of Research
Dr. MR Sethuraj

Project Officer
CM George

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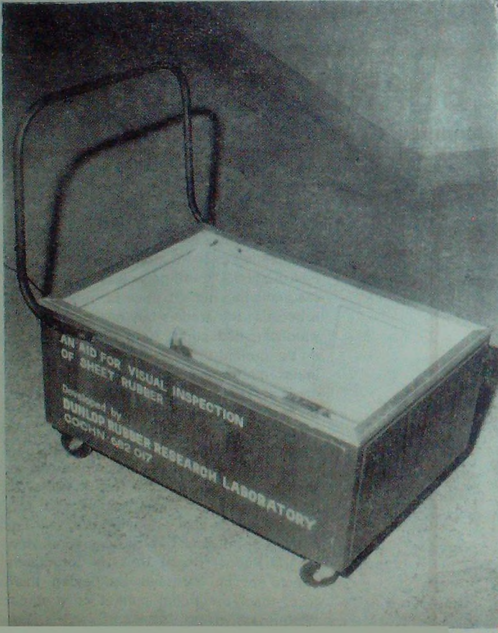
THE QUARTER

Rubber producers all over have been complaining to the Rubber Board that they realise only 30 to 40 paise less per kg than the prevailing market price for rubber. This is because the traders buy raw rubber from producers deducting 30 to 40 paise per kg on the ground that the Govt of Kerala has imposed a turnover tax on the transactions made by them. In respect of sales tax, there is no cause for anxiety, as it has been settled to the advantage of traders. The turnover tax proposed to be levied at 0.5% will not in any way affect small traders as their turnover will be only less than Rs. 25 lakhs per annum. Those who exceed this limit would do well by paying the tax out of the profit reaped. It is the considered view of the Rubber Board that the producers should not be harassed by paying them less than the ruling market price under the pretext of tax burden.

AN AID FOR VISUAL INSPECTION OF SHEET RUBBER

Ribbed smoked sheet rubber and crepe rubber are graded by visual inspection and comparison against visual standards. When a sheet rubber is inspected, it is held against sun light to observe defect like presence of bark specks, bubbles, etc. It will be very strenuous for a grader who will have to inspect about 3,000 sheets per day. In order to facilitate visual inspection of sheet rubber Dunlop Rubber Research Laboratory at Cochin has developed an aid.



The equipment is a wooden box of dimensions: 75 cm x 55 cm x 30 cm fitted with two parrallel tube lights (each 60 cm length and 20 W power) 15 cm apart on the floor of the box. Using anodised aluminium beadings, the box is covered with a 6 mm glass pane. The inner side of the box is painted with white enamel paint to give proper reflection of light. Mounted on 4 trolley-wheels of 10cm diameter each, the box is provided with a handle like a perambulator and also with an electric cord of about 15 m length. Hence the the visual aid could be pushed conveniently inside a rubber godown. Repairing or replacing of tube lights could be carried out by opening a hinged door provided at one of the larger sides of the box.

Sheet rubber could be visually inspected against tube light illumination just like X-ray picture examination.

The height of the box will be very convenient for a godown worker to place on the glass top of the box a sheet rubber as it is peeled off from a bale. It will be also convenient to an inspector perched on a chair.

The equipment will be very useful in rubber grading especially in Ill-lit godowns. Using the aid, rubber could be examined in dawn or dusk and during rainy or shiny days. In locations where lighting power is not available, a pre-charged emergency lamp of 40 W power could supplement the tube lights of the equipment. The cost of the aid is Rs. 1,200.

— C. R. ANANDAN

A Novel Instrument for Polybag Planting

— ARAVINDAN PUBLICITY OFFICER —

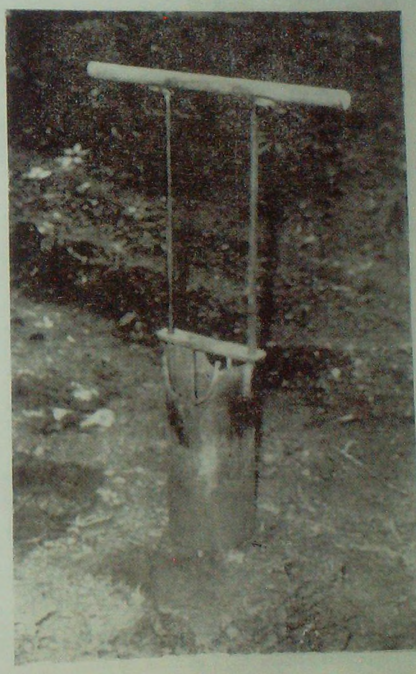
An unsophisticated instrument, though semingly so simple, is functionally so useful. The instrument developed by Tomy George, Kallivayalil makes the planting of poly bagged rubber seedlings easy. It saves time and money too.

Pitting is necessary to provide favourable conditions for the early establishment and growth of the young plant. The size of the pits depends upon the type of the planting material used and the nature of the soil. The standard pits recommended for rubber plantations are of 90x90x90 cms or 75x75x75 cm sizes. The top soil is mixed with Mussorie Phos and compost or cowdung. Planting is done after filling the pits with topsoil duly mixed with Mussorie phos and compost or cowdung.

When the polybag plants are to be transplanted, the required quantity of soil depending on the size of the polybags is removed and then the plant is fixed there in the pit. The soil could be easily removed by the application of this instrument.

An iron cylinder is fully pressed into the soil and when the cylinder is pulled up to its normal position, the quantity of soil which needs to be removed is collected in the cylinder itself. The soil can be removed later. Polybag plants could then be fixed in the pits.

The size of the polybags recommended are 55x25 cms, 60x30cms and 65x35 cms. The instrument is developed to accommodate the polybag of the size 55x25 cms which is very commonly used everywhere. The instrument to suit other sizes can also be fabricated if required.



The most important accessory of the machine is the 16 gauge cylinder casing made of iron. The two iron bars are connected with a footrest at the top and a disc at the bottom. This is called the plunger. The top of the plunger is fixed with a handle, the length of which is 2 ft. While the cylinder casing is pressed into the soil, the plunger moves upwards holding a quantity of soil collected. Before another application, the soil needs to be removed from the cylinder with the help of the plunger. The pit is then made ready for fixing the polybag plant. The process includes the removal of polybag which is to be cut with a razor blade. The cost of the machine is Rs.300/- approximately.

Usually 445 plants are allowed in one hectare of land. As claimed by Tomy George, if this machine is used for polybag planting, two labourers would complete the whole work in 5 minutes. On the basis of this calculation 12 pits could be completed in an hour. Even if 2 is not taken into account, the remaining pits could be 10 per hour. Based on the above figures, if two labourers work for a day, they will plant a total of 80 plants. On the other hand if conventional implements are used for this operation, two labourers would plant only 34 plants. The total cost for this comes to Rs. 683/- per hectare if the wages of a labourer remain Rs. 26/-. But if the instrument is used for planting, employing two labourers, the cost per hectare could be reduced to Rs. 372/-. A part of the expenditure incurred for purchasing the machine has also been included here. Thus, the new instrument if applied for planting, would save slightly more than Rs.300/-per hectare.

Though Tomy George is an engineer by profession, he is a good rubber planter too.

His address,
Tomy George
Kallivayalil
Poovarany P. O.
Palai.

Crisis management group to tackle drought

The Minister of State for Agriculture Mr Yogendra Makwana informed the Lok Sabha that the Government had set up a Crisis Management Group in the Ministry of Agriculture to tackle the unprecedented drought on a war footing. The Group has senior officers of various Ministries as members. It would attend to the day-to-day problems of the States to provide them speedy relief.

Admitting that this was perhaps the worst ever drought in the century he said that even though contingency plans were made to face it, they had to be revised frequently as the situation continued to be grim. The worst hit areas were Saurashtra, Kutch, parts of MP, Rajasthan, Western UP, Punjab and Haryana. He disclosed that the Prime Minister had written to the States to set up high level committees under the aegis of the Chief Minister for dealing with the drought situation.

RUBBER PLANTATION INDUSTRY IN INDIA : A REVIEW

The Rubber Plantation Industry has recorded commendable progress in the post-Independent era. The area under rubber and the production during the period have increased. Attempts for organised development of Rubber Plantation Industry were started with the constitution of the Rubber Board in 1957. This was soon followed by schemes designed to help small holders to meet their general and specific needs such as loans for maintenance of immature areas, subsidy for manuring and control of abnormal leaf fall disease, domonstration and training in correct methods of cultivation and tapping, financial assistance for co-operative processing and marketing etc. Timely improvements were also made to accommodate the requirements of the changing times.

The Rubber Research Institute of India came into existence in 1955. It marked the beginning of systematic research in the field of natural rubber.

Rubber cultivation gradually spread to non-traditional areas such as North Eastern Region, Orissa, Goa, Maharashtra etc. The results reveal that commercial planting can be successfully undertaken in some of the areas in these states on extensive scale.

1. Introduction

Rubber plantation industry provides the principal raw material required for the rubber goods manufacturing industry which produces a variety of products which are indispensable in modern life. Rubber plantation in the country give direct employment to around 225,000 persons. In addition to this, sizeable number of persons also depend on processing, transporting, marketing and other related activities in the indutstry. The value of crop harvested annually amounts to over Rs. 350 crores. The crop contributes to the economic prosperity of the rural areas in the rubber growing tracts. Rubber plantations bring about the much needed ecology restoration of the countryside and supply fuel wood, timber, vegetable oil, oil cake and honey as bye-products.

The general view of a rubbe· plantation with budded plants

The traditional rubber growing region in India is the hinterlands of the south west coast comprised of parts of Kerala, Kanyakumari District of Tamil Nadu and certain limited areas of Dakshina Kannada and Coorg districts of Karnataka. The area under rubber in India at the end of 1985-86 was 369,000 hectares. During the year, Kerala State accounted for 88% of the total area under rubber, Tamil Nadu 5% and Karnataka 3%. The balance 4% is contributed by Tripura, Meghalaya, Assam, Mizoram, Nagaland, Andaman & Nicobar Islands, Goa etc. The annual growth of area and production of rubber was as shown in Table-1.

2. Development of the rubber plantation industry:

The rubber plantation industry has recorded commendable progress in the post-Independence era. The area under rubber has increased from 63,000 hectares in 1947-48 to 369,000 hectares in 1985-86. Production of natural rubber during the period has increased from 15,000tonnes to 200,465 tonnes and productivity measured in terms of yield per hectare has gone up from 320 kg. to 898 kg. However, India continued to be a net importer of natural rubber, except during the short period from 1970-71 to 1977-78. During this period, the domestic production was sufficient to meet thedemand and in fact small quantities were exported during the years 1973-74, 1974-75, 1976-77 & 1977-78 as a measure to remove the glut in the market

The most important accessory of the machine is the 16 gauge cylinder casing made of iron. The two iron bars are connected with a footrest at the top and a disc at the bottom. This is called the plunger. The top of the plunger is fixed with a handle, the length of which is 2 ft. While the cylinder casing is pressed into the soil, the plunger moves upwards holding a quantity of soil collected. Before another application, the soil needs to be removed from the cylinder with the help of the plunger. The pit is then made ready for fixing the polybag plant. The process includes the removal of polybag which is to be cut with a razor blade. The cost of the machine is Rs.300/- approximately.

Usually 445 plants are allowed in one hectare of land. As claimed by Tomy George, if this machine is used for polybag planting, two labourers would complete the whole work in 5 minutes. On the basis of this calculation 12 pits could be completed in an hour. Even if 2 is not taken into account, the remaining pits could be 10 per hour. Based on the above figures, if two labourers work for a day, they will plant a total of 80 plants. On the other hand if conventional implements are used for this operation, two labourers would plant only 34 plants. The total cost for this comes to Rs. 683/- per hectare if the wages of a labourer remain Rs. 26/-. But if the instrument is used for planting, employing two labourers, the cost per hectare could be reduced to Rs. 372/-. A part of the expenditure incurred for purchasing the machine has also been included here. Thus, the new instrument if applied for planting, would save slightly more than Rs.300/-per hectare.

Though Tomy George is an engineer by profession, he is a good rubber planter too.

His address,

Tomy George
Kallivayalil
Poovarany P. O.
Palai.

Crisis management group to tackle drought

The Minister of State for Agriculture Mr Yogendra Makwana informed the Lok Sabha that the Government had set up a Crisis Management Group in the Ministry of Agriculture to tackle the unprecedented drought on a war footing. The Group has senior officers of various Ministries as members. It would attend to the day-to-day problems of the States to provide them speedy relief.

Admitting that this was perhaps the worst ever drought in the century he said that even though contingency plans were made to face it, they had to be revised frequently as the situation continued to be grim. The worst hit areas were Saurashtra, Kutch, parts of MP, Rajasthan, Western UP, Punjab and Haryana. He disclosed that the Prime Minister had written to the States to set up high level committees under the aegis of the Chief Minister for dealing with the drought situation.

RUBBER PLANTATION INDUSTRY IN INDIA : A REVIEW

The Rubber Plantation Industry has recorded commendable progress in the post-Independent era. The area under rubber and the production during the period have increased. Attempts for organised development of Rubber Plantation Industry were started with the constitution of the Rubber Board in 1957. This was soon followed by schemes designed to help small holders to meet their general and specific needs such as loans for maintenance of immature areas, subsidy for manuring and control of abnormal leaf fall disease, demonstration and training in correct methods of cultivation and tapping, financial assistance for co-operative processing and marketing etc. Timely improvements were also made to accommodate the requirements of the changing times.

The Rubber Research Institute of India came into existence in 1955. It marked the beginning of systematic research in the field of natural rubber.

Rubber cultivation gradually spread to non-traditional areas such as North Eastern Region, Orissa, Goa, Maharashtra etc. The results reveal that commercial planting can be successfully undertaken in some of the areas in these states on extensive scale.

1. Introduction

Rubber plantation industry provides the principal raw material required for the rubber goods manufacturing industry which produces a variety of products which are indispensable in modern life. Rubber plantation in the country give direct employment to around 225,000 persons. In addition to this, sizeable number of persons also depend on processing, transporting, marketing and other related activities in the indutstry. The value of crop harvested annually amounts to over Rs. 350 crores. The crop contributes to the economic prosperity of the rural areas in the rubber growing tracts. Rubber plantations bring about the much needed ecology restoration of the countryside and supply fuel wood, timber, vegetable oil, oil cake and honey as bye-products.

... of a rubber plantation with budded plants

The traditional rubber growing region in India is the hinterlands of the south west coast comprised of parts of Kerala, Kanyakumari District of Tamil Nadu and certain limited areas of Dakshina Kannada and Coorg districts of Karnataka. The area under rubber in India at the end of 1985-86 was 369,000 hectares. During the year, Kerala State accounted for 88% of the total area under rubber, Tamil Nadu 5% and Karnataka 3%. The balance 4% is contributed by Tripura, Meghalaya, Assam, Mizoram, Nagaland, Andaman & Nicobar Islands, Goa etc. The annual growth of area and production of rubber was as shown in Table-1.

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A plantation in flat, gently slopy land

and to ensure economic price to the rubber growers. Currently about 85 per cent of the demand is met by the domestic production.

Schemes aimed at organised development of rubber plantation industry in the country were started with the constitution of the Indian Rubber Board in 1947. During the period from 1947 to 1956, the Board's activities were mainly confined to the distribution of high yielding planting materials and dissemination of cultivation and production knowhow on very limited scales. With the amendments of the Rubber (Production and Marketing) Act in 1954 and framing of the Rubber Rules, the role of the Board (by then renamed as the Rubber Board) in the development of the rubber plantation industry was clearly defined. The Board was also vested with appropriate powers for implementing the development schemes. In the wake of this, the Replanting Subsidy Scheme, which was the first major development scheme taken up, received sanction of the Government and was launched in 1957. Five years later, a modest scheme for giving interest-free loan assistance to small holders for expanding their holdings to viable units by newplantlng was introduced. This was soon followed by schemes designed to help small holders to meet their general and specific needs such as loans for maintenance of immature areas, subsiby for nanuring and control of abnormal leaf fall disease, demonstration and training in correct methods of cultivation and tapping, financial assistance for co-operative processing and marketing etc. The schemes were subjected to constant reviews for bringing about possible improvements.The Rubber Research Institute of India, under the Rubber Boardcame into existance in 1955 making the beginning of systematic research in the field of natural rubber. In 1979-80, for the first time, a subsidy cum credit scheme was launched on a pilot basis for encouraging new planting Noticing the excellent response to the scheme, an integrated scheme for accelerating new planting and replanting was started from 1980-81.

The remunerative market price and the financial and technical assistance granted under the scheme resulted in appreciable increase in newplanting and replanting during the period from 1980-81 to 1984-85. Against the target of planting in 60,000 hectares, the achievement was 63, 000 hectares. However, there has been a set back in the planting tempo during 1985-86 and 1986-87 owing to the reduction in the financial incentives granted during the VII Plan period under the scheme.

3. Production and consumption of natural rubber-targets and achievements.

The production target fixed for natural rubber by the Planning Commission for the terminal year of the VII Plan is 265,000 tonnes. Against this the achievement and estimated production are as shown below:-

		(tonnes)
1985-86	: 200,465 (Actuals)	
1986-87	: 220,000 (Latest-estimate)	
1987-88	: 255,000 (Estimate)	
1988-89	: 250,000 (Estimate)	
1989-90	: 265,000 (Estimate)	

The consumption of natural rubber during 1985-86 was 235,440 tonnes. Estimates for 1986-87 is 254,000 tonnes and for 1987-88 272,000 tonnes. By 1989-90, consumption is estimated to exceed 310,000 tonnes and by the turn of century it may exceed 500,000 tonnes.

4. Imports of natural rubber:

In order to bridge the gap between demand and supply, natural rubber is imported through the State Trading Corporation and distributed to actual users. The rubber is distributed during the lean production months of natural rubber ie; June-August and February-March. Supply-demand situation is reviewed periodically and imports are regulated to bridge the gap.

The quantity and value of natural rubber imported during the last few years by the State Trading Corporation of India were as shown below:

Year	Quantity (tonnes)	Value (Rs lakhs)
1980-81	9,250	950
1981-82	42,750	3,667
1982-83	31,659	2,480
1983-84	32,175	3,566
1284-85	32,408	3,529
1985-86	38,538	3,713

In addition, small quantities of rubber are also imported directly by the manufacturers / exporters under the export promotion scheme.

The imported rubber is now distributed at a fixed price of Rs. 1,650/-per quintal (for RSS-3 Grade) by adjusting the import duty suitably.

The deficit to be met by import during 1986-87 is estimated by the Govt. as 40,000 tonnes and the entire quantity has been imported during April to August 86 period. Preliminary estimate of deficit for 1987-88 is 35,000 tonnes.

5. Price of natural rubber:

In February 1986' Govt. approved a bufferstock scheme with a view to maintain a stable price for natural rubber which would be remunerative to the rubber growers and fair to the rubber user industry. Under the scheme, prices of RMA-4 variety of natural rubber will be maintained at a level of around Rs. 150 per quintal within a price band of Rs. 1600 and Rs. 1700. STC is operating the scheme. The average size of the bufferstock approved is 2,500 tonnes.

From about the middle of September 86 to the middle of January 1987, the market price was at or below Rs.1600 and STC had to carry out floor price support operations. STC entered the market on 29th September and continued its operations till about the middle of January 1987. They were purchasing rubber from the rubber growers through the Kerala State Co-operative Rubber Marketlng Federation and Kerala State Warehousing Corporation. Initially the prices cffered were Rs. 1600 for RMA-4 grade and Rs. 1550 for RMA-5 grade. From 5th January 1987, the prices offered were raised to Rs. 1620 and Rs. 1570 respectively. Due to the entering of STC, market price has improved to reasonable level. Under the price support operations, STC has purchased 6,735 tonnes of rubber (4785 tonnes of RMA-4 and 1950 tonnes of RMA-5). From 12th January 1987, market price exceeded Rs. 1600 per quintal for RMA-4 grade.

A study on the cost of production has been carried out by the Cost Accounts Branch of the Ministry of Finance as per the direction of the Govt. The monthly variations in the market price of rubber are given in the Table-6 attached.

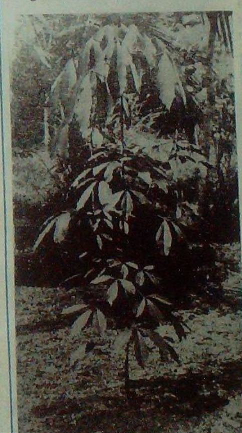
6. Rubber Development Schemes.

i) *Rubber Plantation Development Scheme (Newplantation and Replantation)*

For accelerating newplanting and replanting, a subsidy cum credit scheme known as Rubber-Plantation Development Scheme, was under implementation during the VI Plan period. It had replaced 3 separate schemes which were under implementation earlier for assisting newplanting and replanting viz Loan Scheme for newplanting and maintenance (1966-67 to 1978-'79), Replanting Subsidy Scheme (1957-58 to 1979-80) and Newplanting subsidy Scheme (1979-80),

The scheme has made excellent progress. Against the target of planting of 60,000 hectares, the achievement was around 63,000 hectares.

During the VII Plan period, under the Rubber Plantation Development Scheme-Phase II, the following assistancs are greanted for



Nine months old young budded plant

encouraging and assisting new-plantation and replantation:-

1) Cash subsidy at the rate of Rs. 5000 per hec. to small growers (holding up to 5 hec. of land under rubber) in traditional areas and to all growers in non-traditional areas.

2) Supply of polybag plants with a subsidy of Rs. 6/- per plant to all growers in all areas subject to a maximum of Rs. 2700 per hectare.

3) Interest subsidy at the rate of 3 % on loans from financial institutions to all growers in non-traditional areas and to small growers in traditional areas.

The target is to plant 40,000 hectares (newplanting 30,000 ha. and replanting 10,000 ha.) during the plan period. During the years 1985-86 and 1986-87, the area estimated to be planted under the scheme is 25,000 hectares.

ii Distribution of planting materials

High yielding planting materials required by the rubber plantations are made available partly from the Board's nurseries and partly from private nurseries. At present the Board is maintaining 16 nurseries with a production capacity of 1.4 million plants per year.

The planting materials from Board's nurseries are distributed to small holders at 25% concessional rates. Functioning of Board's nurseries not only ensure supply of quality materials but also exercises a much needed moderating influence on general market prices.

The supply from Board's nurseries is sufficient to meet about 15% of the total annual demand. The balance is produced and supplied by the rubber grower's nurseries and private commercial nurseries. The total demand for planting materials is being fully met.

III) Processing and marketing of small holders' rubber

About 75% of the rubber produced in the country is accounted for by small holders. The rubber produced by most of the small holders is of poor quality as they have to process their produce without proper facilities and know-how.

In order to improve the processing and marketing in small-holding sector, the Board has taken various measures.

Under the Rubber processing Component of the World Bank Aided Kerala Agricultural Development Project 6 rubber processing units (including the expansion of one unit) have been set up in the Co-operative Sector. The total production capacity of these units is 15,000 tonnes.

Financial and technical assistances are provided in the form of share capital contribution and working capital loan to co-operatives of small rubber holders for establishing or expanding processing units or undertaking rubber marketing. Smoke houses constructed and operated by co-operatives or group processing centres would attract payment to the extent of 75% of the cost as subsidy.

The Board has recently launched a scheme for subsidising the cost of standard type of rollers purchased by small holders to the extent of 50% or Rs. 3500per set, whichever is less. Small smoke house constructed by small holders will similarly receive Rs. 5000 as 50% subsidy in cost.

A net work of 33 co-operative societies have been organised in the small holding sector. They are engaged in rubber marketing and distribution of inputs required for the rubber plantations. A federation of the rubber marketing co-operatives known as Kerala State Co-operative Rubber Marketing Federation Ltd. is also operating, which

Seedling nursery

besides acting as a pivotal organisation in rubber marketing, undertakes fertiliser mixing and distribution, soil testing and leaf analysis, distribution of chemicals and fungicides and arranging aerial spraying. Under the Rubber Processing Component of the Kerala Agricultural Development Project (KADP), the federation has also established a block rubber processing unit. It has a net work of sales depots in all the important rubber consuming centres in India. During the year 1985-86, the Federation marketed about 21,000 tonnes of rubber which is about 15% of the rubber produced by the small holders in India. The programme is to further strengthen and expand the co-operative net work by granting financial and technical assistance.

iv) Extension, training and supplies

The activities under this head are aimed at giving general education and training to rubber growers and providing them with assistance and incentives for adoption of modern technology in planting, maintenance, crop exploitation, processing and marketing. The various action programmes under implementation towards modernisation of small holding sector are the following:

1. Running of tappers training schools
2. Popularising the use of power operated low volume sprayers and dusters for plant protection in small holdings.
3. Popularising rainguarded tapping.
4. Popularising cover cropping
5. Operating an effective communication service for the betterment of small holders.
6. Operating technical consultancy service.

The Rubber Board is now running 6 tappers training schools to train the small holders/tappers in scientific tapping.

Abnormal leaf fall and secondary leaf fall are two fungal diseases which annually ravage rubber plantations. These are controlled by prophylactic spraying/dusting of copper fungicides/sulphur dust. Newly developed power sprayers/dusters need to be popularised among growers in this regard. Board is offering 50 per cent subsidy on their cost to co-operatives and 25 per cent subsidy to individual small holders.

Another step taken to step up the rubber production is to popularise rainguarding in rubber holdings. Materials required for rainguarding will be supplied through co-operatives at 50 per cent subsidised rates. Rubber is recommended to be grown in association with a creeping leguminous ground cover crop which benefits in soil erosion control, soil enrichment, moderation of soil temperature, checking of weed growth etc.

The small growers, by and large, neglect this important practice for the basic reason that seed material is costly and its availability poor. The Board is making bulk purchase of the seeds and distributing the seeds at 25% subsidised rate.

The Board is also conducting mass-contact campaigns by organising seminars/study classes in all important rubber growing areas. Discussions on different aspects of rubber cultivation and production led by technical/scientific officers are held on these occasions. Exhibitions are also organised with a view to educating the growers on improved scientific cultivation and production of rubber. The rubber tapping demonstrators attached to the important Regional Offices of the Board are also visiting rubber holdings and imparting training in correct methods of tapping.

The technical consultancy unit recently established renders services for project preparation, feasibility and marketability studies, physical and analytical tests of rubber and rubber products, development of rubber com-

A nursery of budded stumps in poly bags pound and rubber products and conducting advisory and training services for rubber processing and product manufacturing.

7. Expansion of rubber cultivation in non-traditional areas-measures being taken.

Surveys and trial plantations carried out in non-traditional areas such as in North-Eastern Region, Orissa, Goa and Maharashtra have revealed that commercial planting can be successfully undertaken in some of the areas in these States/Union Territories on extensive scale. The quantum and distribution of annual rainfall which mainly govern the growth and yield of rubber, are obtained in satisfactory measure and pattern over vast stretches of areas for North-Western Region, Goa, etc. It has been proved that through extensive trial cultivations, the mild winter prevailing in the plains in the North-Eastern Region, does not significantly affect growth and yield of rubber. Areas which can be considered to be marginally suited for rubber from the point of view of rainfall are available on large scale in southern parts of Konkan region of Maharashtra and certain parts of Andhra Pradesh, Orissa, West Bengal and Madhya Pradesh. Utilisation of such areas for rubber planting would be worthwhile in the present context of shortage of natural rubber. Cost of cultivation and maintenance of rubber plantations in these marginal areas is rather low on account of availability of comparatively cheap labour. Therefore, the lower yields realised would be to a great extent compensated by reduced cost. Development of rubber plantations in such areas is sought by local Governments with a view to bringing about rural employment soil conservation etc. Availability of timber at cheap costs from rubber plantations is also pointed out as an added attraction of the proposition. In the Report of the Sub Group on Rubber of the Working Group on Plantations Crops (1984), the extent suitable for raising plantations in non-traditional areas is estimated as shown below:

Tripura	: 30,000 ha.
Assam	: 50,000 ,,
Goa & Maharashtra	: 30,000 ,,
A & N Islands	: 20,000 ,,
Orissa	: 50,000 ,,
Other States/ Union Territories	: 35,000 ,,
Total	: 215,000 ha.

The general view of a rubber plantation planted with budded plants

Rubber Board has been assisting the State Governments/Union Territories concerned in ear-marking areas suitable for planting rubber, procuring high yielding planting materials etc. It has also been imparting training to technical officers deputed by plantation agencies in these States/Union Territories. The Rubber Board has opened two zonal offices, one each at Gauhati (Assam) and Bhubaneswar (Orissa) and a number of Regional Offices to take care of the developmental needs of the areas. Regional Research Centres have been established in various regions to tackle the special problems encountered in those regions.

State Government/Union Territories concerned are also taking various measures for raising rubber plantations in the respective States/Union Territories. Governments of Tripura, Assam, Maharashtra, Arunachal Pradesh and Andamans & Nicobar Islands have set up public sector corporations for large scale development of rubber plantations. The Soil Conservation Departments of Assam, Meghalaya and Mizoram and Forest Departments of Nagaland, Manipur and Goa are running trial plantations. The extent brought under rubber in the non-traditional States/Union Territories at the end of 1985-86 was as follows:

Tripura	:	8,200 ha.
Meghalaya	:	1,600 ,,
Assam	:	1,425 ,,
A & N Islands	:	850 ,,
Mizoram	:	720 ,,
Nagaland	:	720 ,,
Goa & Maharashtra	:	700 ,,
Manipur	:	450 ,,
Others	:	85 ,,
Total	:	14,750 ha.

Schemes for accelerated development of rubber plantation in non traditional areas

a) North Eastern Region.

A scheme for accelerating the development of rubber in the North-Eastern has been approved by the Government in May 1984. The following are the main programmes envisaged under the scheme:

i) Board's organisational machinery in the region to be reorganised and strengthened.

ii) Research activities to be made more broad based and dynamic.

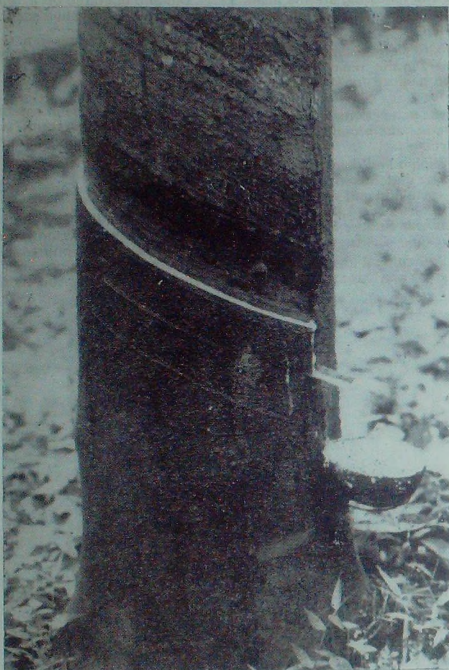
iii) Training and demonstration to be undertaken locally on a sustained and well organised basis in a 1,000 hectare Nucleus Rubber Estate and Training Centre (NRETC).

iv) Information and communication services to be organised and operated on a widespread and effective scale.

The scheme envisages planting in 24,000 hectares during 1984-85 to 1989-90 with an outlay of Rs. 6.18 crores.

A zonal office has been established at Guwahati (Assam) with a Jt. Rubber Production Commissioner in charge of the entire development activities in the region. Under the Zonal Office, 5 regional offices one each at Agartala (Tripura), Guwahati (Assam), Silchar (Assam), Tura (Meghalaya) and Diphu (Assam) are opened. Extension and information services run by the

A well grown budded stump raised in polybag



The high yielding variety R R I I 105 under tapping

Board so far have created wide spread awareness of technical and economic aspects of rubber cultivation in Assam, Tripura, Meghalaya and parts of Manipur, Mizoram and Nagaland. Activities in this regard include conduct of exhibitions, group meetings, training in skilled activities, method demonstration, publication of leaflets, newspaper articles and broadcast of radio talks. Study tours of local entrepreneurs to rubber plantations in Kerela and Tamil-Nadu are also promoted. To meet the growing demand for planting materials in the region 4 nurseries; one each at Agartala, Tura, Diphu and Silchar have been opened during 1986-87. The Research component of the scheme approved by the Government provides for establishing a complex of 4 regional research centres under the control of Project Co-ordinator. Regional research centre established at Agartala in Tripura prior to the approval of the scheme has now an extent of 77 hectares planted for various field experiments. New research stations have been started at Sonaipur near Guwahati (Assam), at Ganol near Tura (Meghalaya) and at Kolasib (Mizoram). Lands have been acquired for the purpose, 50 ha. at Sonaipur, 20 ha. at Ganol and 150 ha. at Kolasib. An additional station for a high altitude research has also been started at Darachickgre in Meghalaya for which 50 ha. land has been obtained. Various experiments are in progress in these stations with specific reference to the local problems. These Research Centres have been provided with scientific and other staff and required vehicles.

Owing to various problems, Govt. of Tripura could not handover the ear-marked 1000 ha. of land to the Board for the establishment of the NRETC. A nursery of over 35,000 polybagged plants raised during 1986 could not be therefore brought to benefit in establishing the station. The plants were distributed to local growers. However, during February 1987, the State Govt. handed over to the Board about 404 ha. of land at a different location for the centre. Work on new nursery and development of the land are now being taken up. It is hoped that planting in 50 to 100 ha. could be carried out during 1987. In the mean time, a few demonstration plots on small holdings in Tripura have been set up in 1986-87 in order to serve part of the demonstration needs in the state. It is proposed to acquire larger plots in other states with a view to setting up smaller sized NRETCs at different places of importance.

During last 3 years, rubber planting has been got undertaken in the region as follows:-

1984-85	: 850 ha.
1985-86	: 1750 ,,
1986-87	: 3000 ,,

b) Andaman & Nicobar Islands

In May 1986, Govt. approved a scheme for establishing a Nucleus Rubber Estate and Training Centre for Andaman and Nicobar Islands by converting the existing Research cum Development Station. The outlay approved under the scheme is Rs.1.14 crores during the VI

Plan period. The extent under rubber at the station is 202 hectare at present. Necessary technical personnel have since been posted to the station. The Board is now arranging for taking up the various construction works envisaged in the scheme such as of rubber processing factory, labour barracks, fencing roads, training schools etc. Necessary plan and estimates are under preparation. A Regional Office of the Board is also functioning in the Islands to take care of the development needs of the region. A nursery is also maintained in the Islands.

c) Other non-traditional areas:-

The Board has opened a Zonal Office at Bhubaneswar (Orissa) in 1986 to serve the States of Orissa, Andhra Pradesh and Madhya Pradesh and field offices at Dhenkanal and Berhampur in Orissa and at Gokavaram in East Godavari District of Andhra Pradesh. Measures are under way for opening regional research stations and demonstration and training centres. About40 ha. of private land in Dhenkanal District in Orissa has been acquired on lease for establishment of Regional Research Station. The plot is under development. Two nurseries, one each in Orissa & Andhra Pradesh have been established for raising and distributing high yielding planting materials. A number of group meetings have been organised during the current year to explain the prospects of rubber cultivation in these states. As a result a lot of enthusiasm has been generated particularly in Orissa to plant rubber.

A Region al Office of the Board is also functioning in Ponda (Goa) to promote the developments in Goa & Maharashtra region.

8. Rubber Research Institute:

The Rubber Research Institute of india was established in 1955. Now it has 7 research divisions namely Agronomy & Soils. Botany, Mycology & Plant Pathology, Rubber Chemistry, Physics & Technology, Plant Physiology & Exploitation, Economic Research and Biotechnology. The Institute has a central experiment station in about 250 hectares in Kerala. A trial rubber plantation project was started in Dapchari (Maharashtra) in 1981. A research complex has been established in North Eastern Region with headquarters at Gauhati. The complex has stations in Meghalaya (Tura and Darachikgri), Assam (Sonaipur), Mizoram (Kolasib) and Tripura (Taranagar). It will cater to the demands of the North-Eastern States in conducting location specific research, provide technical advice and improved planting materials, etc. A Hevea Breeding Station is under establishment with substations in Kanyakumari (Tamil-Nadu) and in Puthur (Karnataka). 40 ha. of land has been taken over for establishing a regional research station in Dhenkanal District in Orissa.

9 Cess on rubber

Section 12 of the Rubber Act, 1947. empowers the Board to collect a duty of excise (cess) on all rubber produced in the Country. By an amendment of the Rubber Act, the mode of assessment and collection was

The process of tapping is defined as an operation of controlled wounding. It is a skilled job.

changed from 1.4. 1961 and cess is levied and collected from manufacturers of rubber goods from that date on the basis of their half yearly return of purchase/acquisition of rubber other than sole crepe. In the case of sole crepe, the duty is collected from producers themselves. The cess thus collected are deposited in the Consolidated Fund of India as provided under Section 12 (7) of the Act. The cess is collected at the rate of 50 ps. per kg. from 24th August 1984.

Collection of Cess on Rubber

		(Rs./lakhs)
1980-81	:	624.83
1981-82	:	602.86
1982-83	:	641.20
1983-84	:	691.73
1984-85	:	756.91
1985-86	:	962.60
1986-87	:	941.55

10. Synthetic rubber-production, consumption, import stock and capacity utilisation by the existing producers.

To meet the growing gap between production and consumption, a synthetic rubber factory having a capacity for producing 30,000 tonnes of Styrene Butadiene Rubber (SBR) per annum was established at Bareilylin Uttar Pradesh. The factory which is owned by M/s. Synthetics & Chemicals Limited commenced production in 1963. It is now roducing Nitrile Rubber also in limited quantities within a licensed capacity of 2,000 tonnes per annum. A second synthetic rubber plant established at Baroda in Gujarat State for manufacturing Poly Butadiene Rubber (BR) went on stream in 1978. The capacity of this factory is 20,000 tonnes per annum and it is established by M/s. Indian Petro-Chemicals Corporation Limited.

During 1985-86, production of SBR, nitrile and BR were 19,889 tonnes, 137 tonnes and 14,732 tonnes respectively, making the total production, 34, 758 tonnes.

For the annual trend in production, consumption, import and price of synthetic rubber, see Table–8 attached.

11. Plantation labour welfare schemes of the Rubber Board

One of the main duties of the Rubber Board under the Rubber Act is to secure 'better working conditions and provisions and improvement of amenities and incentives for workers". To achieve these objectives, the Rubber Board has been implementing 3 schemes viz. 1) Children's Educational stipend Scheme, 2) Capital Grant Scheme and 3) Distress and Prolonged Ilness Relief Scheme.

a) Children's Educational Stipend Scheme

This scheme was introduced in 1957. The details of expenditure etc. under the scheme for the last five years are as shown below:

Year	No. of children benefited	Amount Rs.
1981-82	1075	2.59 lakhs
1982-83	3000	6.00 ,,
1983-84	4050	6.67 ,,
1984-85	4275	6.33 ,,
1985-86	4450	7.80 ,,

b) Capital Grant Scheme

This scheme was introduced (in 1957) for giving grants for provision of beds in hospitals/construction of hospital wards for the benefit of rubber plantation workers. The expenditure incurred during the last 5 years are as follows:

1981-82	: Rs. 2.40 lakhs	No expenditure was incurred during the years 1982-83 to 1984-85
1985-86	: Rs. 0.25 lakhs	

The operation of the scheme has been discontinued as it did not confer the benefits envisaged to a satisfactory level

c) Distress and Prolonged Illness Relief Scheme.

This scheme was introduced in 1975. But due to poor response from workers the scheme was not under effective operation since then. The Board is evolving a simplified scheme conferring enhanced benefits.

The Board has drawn up a Pilot Scheme for Group Insurance cum Depositit for the rubber Plantation workers in the unorganised sector and it is under implementation from 1986.

12. Membership in the international organisations.

India is maintaining close association with several international organisations connected with rubber. The Association of Natural Rubber producing Countries (ANRPC) is an inter-governmental organisation with Malaysia, Indonasia, Thailand, India, Sri Lanka, Singapore and Papua New Guinea as members. The objectives of the ANRPC are (i) to bring about co-ordination in the production and marketing of natural rubber (ii) to promote technical co-operation amongst members and (iii) to bring about fair and stable price for natural rubber. The Association with its headquarters is Malaysia organises periodical meetings and symposia and project studies to achieve the objectives

The International Rubber Study Group (IRSG) is also an inter-governmental organisation of natural and synthetic rubber producing and consuming countries with headquarters in London. At present 27 countries are members of this Organisation. The object of IRSG is do provide a forum for the discussion of problems affecting the production and consumption of, and trade in, natural and synthetic rubbers and to collect and disseminate comprehensive statistical information thereon.

The Rubber Research Institute of India under the Rubber Board is a member of International Rubber Research and Development Board (IRRDB). The organisation is established to foster co-operation among members in research and development activities relevant to the production, processing and usage of natural rubber, to provide a forum for concerted action on technical matters of mutual interest to members and to arrange funding, supervision and co-ordination of technical activities carried out on co-operative basis among members. The IRRDB arranges meetings, seminars and conferences and collects and disseminates among members technical and other information on rubber. Natural rubber research institutes of Brazil, Cameroon, China, India, Indonesia, Coted' Ivoire, Malaysia, Nigeria, Sri Lanka, Thailand and Vietnam are members of this organisation.

13 World position of rubber

India is the 5th largest producer of natural rubber. However, her share in the world production is only 4.3%. The leading rubber producers are Malaysia, Indonesia, Thailand, China, India & Sri Lanka. As regards productivity, India is ranked second amongst the major rubber producing countries. Malaysia, Indonesia, Thailand and Sri Lanka are exporting bulk of their production to other industrialy advanced countries. For country-wise area and production, see Table-II attached.

14 Financial outlay and achievements

Total outlay approved for VI Plan for rubber development schemes was Rs. 36 crores.

CONTRIBUTIONS PAID TO INTERNATIONAL ORGANISATIONS DURING THE LAST FEW YEARS BY INDIA

	IRSG Rs.	ANRPC Rs.	IRRDB Rs.
1981-82 :	114,797	83,693	148,612
1982-83 :	108,668	104,878	160,000
1983-84 :	109,441	123,471	39,578
1984-85 :	108,577	131,809	52,707
1985-86 :	138,752	137,466	182,616
1986-87 :	159,386	143,884	207,836

ANNUAL EXPENDITURE UNDER PLAN AND NON-PLAN SCHEMES EXPENDITURE (Rs-/lakhs)

Year	Plan	Non-Plan	Total
1980-81	336.86	157.61	494.47
1981-82	480.35	179.34	659.69
1982-83	720.35	201.53	921.88
1983-84	780.72	258.81	1039.53
1984-85	891.60	251.58	1143.18
1985-86	1100.64	495.70	1596.34

Scheme-wise expenditure is given in Table-12

The outlay approved for Plan Schemes for VII Plan period was Rs. 53.43 crores; of which allocation for 1986-87 is Rs. 14.96 crores.

Table-1

TOTAL AREA, PRODUCTION AND PRODUCTIVITY OF RUBBER

	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
			(Total area '000 hectares)			
Kerala	247.1	262.6	278.0	294.3	312.0	326.7
Tamil Nadu	15.5	15.7	16.0	16.3	16.5	16.7
Karnataka	8.5	8.9	9.5	10.1	10.8	11.2
Tripura	3.2	4.1	5.0	6.0	7.2	8.2
Others	3.7	4.2	4.7	5.0	5.3	6.5
Total	278.0	295.5	313.2	331.7	351.8	369.3
			PRODUCTION (tonnes)			
Kerala	140,320	139,435	152,662	162,212	172,092	184,563
Tamil Nadu	10,446	10,510	9,700	9,736	10,603	11,025
Karnataka	2,128	2,606	3,070	2,785	3,095	4,090
Tripura	55	85	108	132	150	173
Others	151	234	310	415	510	614
Total	153,100	152,870	165,850	175,280	186,450	200,465
			YIELD PER HECTARE (kg.)			
Kerala	780	770	828	864	890	879
Tamil Nadu	1077	1060	967	917	991	1044
Karnataka	531	600	704	538	577	729
Tripura	—	—	—	—	—	—
Others	—	—	—	—	—	—
Total	788	779	830	857	886	898

Figures for 1985-86 are provisional.

Table–2

MONTHWISE PRODUCTION OF NATURAL RUBBER

(tonnes)

Month	1980-81	1981-82	1982-83	1983-84	1984-85	85-86	86-87
April	11610	12070	12450	5820	13920	12450	14880
May	15350	15360	16250	15530	17550	17650	19850
June	7750	7355	9720	14980	8290	9555	13560
July	7580	8040	9030	10940	8780	9745	13725
Aug.	8650	9730	11570	11060	13165	14920	16020
Sept.	16960	9860	15250	13410	17885	19710	20780
Oct	17830	17980	19320	21550	20130	22450	24535
Nov.	18300	19200	19455	21460	22525	24760	25545
Dec.	19770	21760	21360	21830	22980	25910	26775
Jan.	15800	17840	17900	19230	20335	21615	22265
Feb.	5855	5750	5730	9350	9630	9650	9735
Mar.	7645	7925	7815	10120	11260	12050	12000*
TOTAL	153100	152870	165850	175280	186450	200465	219670

(*Estimate)

Table–3

GRADEWISE PRODUCTION OF NATURAL RUBBER

(tonnes)

Year	RMA sheets	Pale latex crepes	Latex concentra-tes (drc)	Block rubber (crumb)	Others	TOTAL
1980-81	104,890	1,720	13,200	2416	30,874	153,100
1981-82	101,700	1,350	16,120	1855	31,847	152,870
1982-83	112,340	1,900	16,020	2240	33,350	165,850
1983-84	121,565	2,180	16,930	2919	31,686	175,280
1984-85	130,090	2,405	18,420	4955	30,580	186,450
1985-86	135,430	2,410	22,665	7385	32,575	200,465
1986-87* (April to December)	117,420	2,170	18,645	5535	31,900	175,670

* Provisional

Table–4

MONTHWISE CONSUMPTION OF NATURAL RUBBER

(tonnes)

Month	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
April	12850	14670	15320	16755	17090	18380	20645
May	13080	13975	15760	16750	17200	18290	21730
June	14030	15385	16130	16050	18415	18535	20960
July	14815	14730	17050	17280	18245	19690	20870
Aug.	14790	14650	16550	17200	17940	18615	21170
Sept.	14950	15200	15600	17525	18060	19470	20865
Oct.	14050	15115	15860	17240	16820	19720	19675
Nov.	15500	16490	16750	17950	16650	20420	21095
Dec.	15465	17600	17410	19530	18920	21250	23615
Jan.	14690	17595	16390	17550	19365	20940	22685
Feb.	14330	16340	16215	17600	19550	19715	21725
Mar.	15080	16670	16510	18050	19255	20415	22000*
Total	173630	188420	195545	209480	217510	235440	257035

(*Estimate)

Table–5

MONTHWISE STOCK OF NATURAL RUBBER

(Stock at the end of each month in tonnes)

Month	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87
April	43970	34752	38440	32500	47180	49210	52730
May	46240	41784	39330	31280	51285	51795	64600
June	40055	38697	36720	32300	43230	48600	67760
July	32820	36109	38250	28785	35650	43840	73180
Aug.	26700	31177	39670	40590	34380	44200	69700
Sept.	28700	35640	50050	36850	43300	44570	69720
Oct.	32500	38910	53800	41180	46610	47200	75220
Nov.	35300	41720	56640	44750	52785	52460	79700
Dec.	40100	45919	60600	47360	57950	58160	83010
Jan.	41215	46750	62100	58890	59200	59830	82810
Feb.	38340	40480	51660	51840	55310	58520	72200
Mar.	33700	39700	43400	45150	54250	55360	62000*

Note: 'Stocks' refer to stock with rubber growers, dealers, processors, STC and manufacturers.

(*Estimate)

Table-6

AVERAGE PRICE OF RMA-1 TO 5 GRADES AND UNGRADED RUBBER IN KOTTAYAM MARKET

(Rs./quintal)

	RMA–1	RMA–2	RMA–3	RMA–4	RMA–5	Ungraded Rubber
1977-78	681	666	653	642	630	632
1978-79	1017	1002	979	965	946	953
1979-80	1080	1067	1053	1035	1017	1017
1980-81	1302	1283	1263	1242	1216	1212
1981-82	1532	1521	1484	1460	1437	1431
1982-83	1523	1504	1465	1440	1419	1409
1983-84	1834	1820	1779	1751	1719	1708
1984-85	1721	1698	1678	1655	1607	1587
1985-86	1862	1825	1765	1732	1685	1661
Jan. 86	1883	1825	1756	1729	1686	1669
Feb. ,,	1847	1810	1736	1694	1682	1672
Mar. ,,	1845	1805	1744	1726	1717	1714
Apr. ,,	1815	1795	1771	1734	1723	1706
May ,,	1905	1830	1765	1738	1714	1706
June ,,	1813	1760	1748	1680	1650	1620
July ,,	1790	1730	1705	1669	1584	1566
Aug. ,,	1795	1742	1722	1686	1591	1552
Sept. ,,	1732	1702	1652	1605	1532	1501
Oct. ,,	1713	1684	1645	1584	1517	1496
Nov. ,,	1719	1680	1648	1591	1519	1505
Dec. ,,	1701	1680	1639	1598	1529	1508
Jan. 87	1705	1675	1655	1633	1594	1585
Feb. ,,	1784	1762	1729	1675	1654	1649
March ,,	1833	1810	1768	1729	1710	1709
1986-87	1775	1738	1704	1660	1610	1592
April 87	1885	1865	1840	1816	1802	1802

Table–7

MONTHLY AVERAGE PRICE OF RMA 1, 3, 4, AND UNGRADED RUBBER IN KOTTAYAM

(Rs. per quintal)

Month	RMA 1	RMA 3	RMA 4	Ungraded Rubber
April 1980	1100	1075	1049	1023
May ,,	1100	1070	1058	1026
June ,,	1128	1090	1068	1048
July ,,	1279	1251	1222	1200
Aug. ,,	1378	1312	1288	1249
Sept. ,,	1384	1331	1323	1297
Oct. ,,	1374	1335	1311	1269
Nov. ,,	1283	1242	1218	1178
Dec. ,,	1334	1284	1265	1240
Jan. 1981	1421	1372	1349	1308
Feb. ,,	1402	1375	1357	1338
Mar. ,,	1447	1415	1395	1369
Apr. ,,	1504	1480	1464	1439
May ,,	1574	1545	1515	1477
June ,,	1540	1516	1499	1464
July ,,	1575	1449	1390	1351
Aug. ,,	1517	1489	1455	1424
Sept. ,,	1435	1425	1412	1389
Oct. ,,	1493	1427	1404	1373
Nov. ,,	1467	1111	1392	1359
Dec. ,,	1537	1461	1443	1415
Jan. 1982	1540	1504	1484	1463
Feb. ,,	1584	1553	1528	1497
Mar. ,,	1620	1546	1533	1517
Apr. ,,	1658	1605	1580	1561
May ,,	1630	1580	1560	1524
June ,,	1608	1576	1545	1526
July ,,	1690	1610	1579	1565
Aug. ,,	1659	1595	1594	1544
Sept. ,,	1472	1465	1462	1360
Oct. ,,	1358	1321	1258	1219
Nov. ,,	1446	1321	1302	1272
Dec. ,,	1387	1281	1252	1228
January 1983	1418	1347	1311	1303
Feb. ,,	1485	1447	1421	1405
Mar. ,,	1460	1435	1419	1399
Apr. ,,	1624	1614	1608	1587
May. ,,	1920	1848	1826	1766
June ,,	1900	1846	1823	1763
July ,,	....	1845	1780	1722

Month	RMA 1	RMA 3	RMA 4	Ungraded Rubber
Aug. 1983	1937	1885	1848	1801
Sept. ,,	1885	1844	1819	1778
Oct. ,,	1754	1693	1684	1639
Nov. ,,	...	1765	1739	1702
Dec. ,,	1869	1820	1797	1749
Jan. 1984	1833	1770	1745	1708
Feb. ,,	NA	1689	1688	1629
Mar. ,,	1785	1725	1668	1646
Apr. ,,	...	1715	1694	1667
May ,,	...	1695	1683	1633
June ,,	1829	1795	1760	1708
July ,,	1885	1849	1885	1728
Aug. ,,	...	1827	1811	1690
Sept. ,,	...	1668	1651	1579
Oct. ,,	...	1621	1605	1565
Nov. ,,	...	1572	1548	1494
Dec. ,,	1676	1607	1580	1504
Jan. 1985	1672	1617	1562	1458
Feb. ,,	1617	1574	1553	1500
Mar. ,,	1649	1592	1574	1521
Apr. ,,	1688	1627	1608	1580
May ,,	1819	1766	1729	1651
June ,,	1846	1748	1723	1655
July ,,	1876	1790	1746	1715
Aug. ,,	1918	1805	1775	1706
Sept. ,,	1935	1839	1781	1678
Oct. ,,	1945	1823	1785	1672
Nov. ,,	1857	1797	1772	1623
Dec. ,,	1886	1745	1716	1616
Jan. 1986	1883	1756	1729	1669
Feb. ,,	1847	1736	1694	1672
Mar. ,,	1845	1744	1726	1714
Apr. ,,	1815	1771	1734	1706
May. ,,	1905	1765	1738	1706
June ,,	1813	1748	1680	1620
July ,,	1790	1705	1669	1566
Aug. ,,	1795	1722	1686	1552
Sept. ,,	1732	1652	1605	1501
Oct. ,,	1713	1645	1584	1496
Nov. ,,	1719	1648	1591	1505
Dec. ,,	1701	1639	1598	1508
Jan. 1987	1705	1655	1633	1585
Feb. ,,	1784	1729	1675	1649
Mar. ,,	1833	1768	1729	1709
Apr. ,,	1885	1840	1816	1802

Table-8

PRODUCTION, CONSUMPTION, IMPORT AND STOCK OF SYNTHETIC RUBBER

(Tonnes)

	Production	Consumption	Import	Stock at the end of the month/year
1977–78	27,288	36,150	9,935	10,443
1978–79	28,054	40,470	13,309	10,700
1979–80	29,524	43,238	17,314	15,200
1980–81	25,293	47,050	17,492	10,900
1981–82	28,499	52,650	29,659	16,200
1982–83	30,290	55,250	24,550	15,700
1983–84	32,270	62,300	30,000	8,980
1984–85	37,669	65,400	24,000	11,650
1985–86	34,758	70,035	31,000	14,470
April 86	2,402	5,325	2,976	14,920
May ,,	3,354	5,590	3,304	16,345
June ,,	3,309	5,315	2,971	17,305
July ,,	2,993	5,330	2,500	18,100
Aug. ,,	1,932	5,745	2,447	17,500
Sept. ,,	3,586	5,890	2,381	17,050
Oct. ,,	3,040	6,230	2,141	16,800
Nov. ,,	3,357	6,350	2,384	17,300
Dec. ,,	3,247	6,585	2,370	16,330

Import figures from 1983–84 onwards are provisional.
Import figures from 1985–86 onwards are incomplete.

Table-9

GRADEWISE PRODUCTION OF SYNTHETIC RUBBER

(Tonnes)

	SBR	Nitrile	Polybutadiene	Total
1977–78	26,692	596	....	27,288
1978–79	22,461	198	5,395	28,054
1979–80	20,269	908	8,347	29,524
1980–81	18,642	203	6,448	25,293
1981–82	16,561	522	11,416	28,499
1982–83	13,669	576	16,045	30,290
1983–84	20,081	719	11,470	32,270
1984–85	20,826	386	16,457	37,669
1985–86	19,889	137	14,732	34,758
1986–87 (April to December 86)	15,574	421	11,225	27,220

Table-10

PRICES OF VARIOUS GRADES OF SYNTHETIC RUBBER

(Rs. per 100 kg.)

Grade	Styrene Butadiene (Ex Bareilly price) 1500/1502/1552	1712/1752	1958/1941	Poly Butadiene Ex Baroda price 1203	1220
1977–78	855	805	1420		
1978–79	909	858	1440	853	853
1979–80	1222	1134	1732	976	976
1980–81	1507	1317	2019	1224	1224
1981–82	1729	1542	2130	1414	1414
1982–83	1833	1634	2210	1477	1477
1983–84	1853	1651	2226	1477	1477
1984–85	2086	1808	2382	1698	1676
1985–86	2350	2110	2736	1928	1907

Note: The prices are exclusive of excise duty and other taxes.

Table-11

AREA PRODUCTION AND EXPORT OF RUBBER BY MAJOR RUBBER PRODUCING COUNTRIES

	Estimated area under rubber in 1985 (million hectares)	Production ('000 tonnes)	Export ('000 tonnes)
Malaysia	1.95	1469	1465
Indonesia	2.65	1130	1001
Thailand	1.53	726	685
India	0.36	198	NIL
Sri Lanka	0.21	137	120
China	0.51	190	NIL
WORLD	7.66	4340	3595

Note: The above 6 Countries together contribute around 89% of world production of rubber.

DROUGHT AND THE RUBBER PLANTING

THOMAS OUSEPH

Drought has become a recurring feature in Kerala in recent times. The State was hit by a severe drought in 1983. It was followed by three successive droughts; in 1985, 1986 and 1987. Most severe was the last. The summer was very intense in 1987 and the rainfall was most scanty, reported to be the lowest in the last 50 years. When thundering downpours usually rock the State during July/August every year even going to the extent of causing recurring floods, the sun sent down burning rays on almost all the days during the months this year. The monsoon rains arrived very late and disappeared after a brief spell.

In recent years droughts and floods have been taking a heavy toll of the rubber plants in Kerala. The 1985 drought was followed by a flood. The flood was more aggressive; it destroyed agricultural crops all through the State. Flood relief measures were launched by the Government of Kerala to compensate at least partially the loss incurred by the agriculturists. Flood and landslides affected newly planted rubber in many areas. Fresh plantings were either buried under landslides or washed away or submerged under water. The Kerala Government extended for rubber cultivation as part of the relief measures financial assistance to raise polybag plants through rural cooperatives for supply to the affected small growers at subsidised rate.

The 1986 drought caused havoc in almost all the newly planted areas. Though rubber can fairly tolerate many vagaries of the weather, lakhs of plants established in the field during 1985 dried up in the pitch of the heat. Branches of yielding trees dried up in many places especially in areas where soil depth was low. Through there was no total loss of trees in any plantation, several small holders complained of trees loss at the rate of 10 to 15 per acre. There were also instances of larger casualties.

The impact of the drought was more severe on rubber seedlings. On a rough estimate about 60 lakhs of budded plants were put in the field covering about 12,930 hectares in Kerala during 1986. Of this about 7.22 lakhs perished in the scorching sun. A quick estimate made by the Rubber Board collecting data through its field network indicated that 19,130 units planted in the small sector were hit by the drought, with an average of 14% loss in plants. In about 200 cases the loss was as high as 100%. A vast majority of the units-about 14,000-lost only less than 10% of the plants. The data, as compiled from the field reports, are given elsewhere.

Planters have now to think of water management techniques in their estates to protect the plants from the summer heat, since recurring droughts pose a major threat to agricultural crops. Localised water conservation like taking extra pits in between rows of plants for collecting water and keeping moist the soil layers, drip irrigation and contour terracing in association with establishment of leguminous ground cover could help the soil to retain moisture throughout the year.

The drought of 1987 virtually swept the state. It arrived in two spells; during March/April/May and July/August. By the first affront yield of the rubber trees was affected. It has been estimated that about 6,000 tonns of rubber worth over Rs. 10 crores was lost since latex flow from the trees was reduced as the moisture content in the soil drastically came down.

The second spell seriously affected the planting operations of the year. June/July is the period for rubber seedlings to be put in the field. Several growers had made arrangements for planting material procurement and preliminary field preparations. Information available from various areas indicate that not even 40% of them have carried out planting because of scanty rainfall. In the case of those who had planted this year a sizable percentage of the budded plants have dried up. But fields that were planted with polybag plants were practically free from casualties In many rural villages several owners of land were waiting till the middle of August for a favourable climate to attempt planting, after the preliminary operations like clearfelling, pitting, filling etc were done. In North Kerala where the rainfall has been extremely low a large number of planters have not been able even to attempt pre-planting operations.

Planting material sellers were also in a quandary. Nursery owners who raised large quantity of plants irrigating them in the summer months by bringing water from distant places in tanker-laden lorries, faced demand recession for a sizable portion of their produce. This recession will most probably affect the planting material availability during the next year. If the unsold budded plants remain in the nurseries, they will get overgrown by the time the next planting

ESTIMATE OF DROUGHT CASUALITIES IN 1986 RUBBER PLANTING IN SMALL HOLDINGS

Sl. No.	Region	No. of small holdings planted	Area (ha)	Total failure		Pratial failure								Total no. of plants lost
						Upto 10%		Above 10% & upto 25%		Above 25% & upto 50%		Above 50 %		
				Unit	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	
1.	Trivandrum	1.400	800			785	579	275	100	200	80	140	50	50,000
2.	Punalur	1,400	850			1,400	850							40,000
3.	Pathanamthitta	1,350	950			870	610	330	235	100	70	50	35	63,000
4.	Changanacherry	600	300			372	186	180	90	36	18	12	6	16,000
5.	Kottayam	850	300			770	252	50	30	20	10	10	8	18,000
6.	Kanjirappally	1,500	900	100	40	400	260	300	200	400	250	300	150	1,50,000
7.	Palai	1,400	840	14	8	1,100	660	250	150	30	18	6	4	35,000
8.	Thodupuzha	600	300			535	274	50	20	10	4	5	2	15,000
9.	Muvattupuzha	1,700	1,100			1,400	900	150	100	100	65	50	35	40,000
10.	Ernakulam	1,100	450	10	4	465	187	385	153	240	106	....	....	28,000
11.	Trichur	1,000	900	50	45	500	450	250	225	150	135	50	45	25,000
12.	Palghat	1,100	880	15	12	760	608	206	165	87	70	32	25	60,000
13.	Nilambur	1,540	1,960	30	30	940	1,330	270	300	134	150	166	150	82,000
14.	Calicut	750	600			400	320	200	160	150	120	....	....	20,000
15.	Tellicherry	900	600			900	600							25,000
16.	Thaliparamba	1,000	500			1,000	500	46	12	40	15	35	23	25,000
17	Kanhangad	940	700	1	2	818	648							30,000
	Total	19,130	12,930	210	141	13,415	9,205	2,942	1,940	1,697	1.111	856	533	7,22,000

DROUGHT AND THE RUBBER PLANTING

THOMAS OUSEPH

Drought has become a recurring feature in Kerala in recent times. The State was hit by a severe drought in 1983. It was followed by three successive droughts; in 1985, 1986 and 1987. Most severe was the last. The summer was very intense in 1987 and the rainfall was most scanty, reported to be the lowest in the last 50 years. When thundering downpours usually rock the State during July/August every year even going to the extent of causing recurring floods, the sun sent down burning rays on almost all the days during the months this year. The monsoon rains arrived very late and disappeared after a brief spell.

In recent years droughts and floods have been taking a heavy toll of the rubber plants in Kerala. The 1985 drought was followed by a flood. The flood was more aggressive; it destroyed agricultural crops all through the State. Flood relief measures were launched by the Government of Kerala to compensate at least partially the loss incurred by the agriculturists. Flood and landslides affected newly planted rubber in many areas. Fresh plantings were either buried under landslides or washed away or submerged under water. The Kerala Government extended for rubber cultivation as part of the relief measures financial assistance to raise polybag plants through rural cooperatives for supply to the affected small growers at subsidised rate.

The 1986 drought caused havoc in almost all the newly planted areas. Though rubber can fairly tolerate many vagaries of the weather, lakhs of plants established in the field during 1985 dried up in the pitch of the heat. Branches of yielding trees dried up in many places especially in areas where soil depth was low. Through there was no total loss of trees in any plantation, several small holders complained of trees loss at the rate of 10 to 15 per acre. There were also instances of larger casualties.

The impact of the drought was more severe on rubber seedlings. On a rough estimate about 60 lakhs of budded plants were put in the field covering about 12,930 hectares in Kerala during 1986. Of this about 7.22 lakhs perished in the scorching sun. A quick estimate made by the Rubber Board collecting data through its field network indicated that 19,130 units planted in the small sector were hit by the drought, with an average of 14% loss in plants. In about 200 cases the loss was as high as 100%. A vast majority of the units-about 14,000-lost only less than 10% of the plants. The data, as compiled from the field reports, are given elsewhere.

Planters have now to think of water management techniques in their estates to protect the plants from the summer heat, since recurring droughts pose a major threat to agricultural crops. Localised water conservation like taking extra pits in between rows of plants for collecting water and keeping moist the soil layers, drip irrigation and contour terracing in association with establishment of leguminous ground cover could help the soil to retain moisture tnroughout the year.

The drought of 1987 virtually swept the state. It arrived in two spells; during March/April/May and July/August. By the first affront yield of the rubber trees was affected. It has been estimated that about 6,000 tonns of rubber worth over Rs. 10 crores was lost since latex flow from the trees was reduced as the moisture content in the soil drastically came down.

The second spell seriously affected the planting operations of the year. June/July is the period for rubber seedlings to be put in the field. Several growers had made arrangements for planting material procurement and preliminary field preparations. Information available from various areas indicate that not even 40% of them have carried out planting because of scanty rainfall. In the case of those who had planted this year a sizable percentage of the budded plants have dried up. But fields that were planted with polybag plants were practically free from casualties In many rural villages several owners of land were waiting till the middle of August for a favourable climate to attempt planting, after the preliminary operations like clearfelling, pitting, filling etc were done. In North Kerala where the rainfall has been extremely low a large number of planters have not been able even to attempt pre-planting operations.

Planting material sellers were also in a quandary. Nursery owners who raised large quantity of plants irrigating them in the summer months by bringing water from distant places in tanker-laden lorries, faced demand recession for a sizable portion of their produce. This recession will most probably affect the planting material availability during the next year. If the unsold budded plants remain in the nurseries, they will get overgrown by the time the next planting

ESTIMATE OF DROUGHT CASUALITIES IN 1986 RUBBER PLANTING IN SMALL HOLDINGS

Sl. No.	Region	No. of small holdings planted	Area (ha)	Total failure		Pratial failure								Total no. of plants lost
						Upto 10%		Above 10% & upto 25%		Above 25% & upto 50%		Above 50 %		
				Unit	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	Units	Area (ha)	
1.	Trivandrum	1.400	800			785	579	275	100	200	80	140	50	50,000
2.	Punalur	1,400	850			1,400	850							40,000
3.	Pathanamthitta	1,350	950			870	610	330	235	100	70	50	35	63,000
4.	Changanacherry	600	300			372	186	180	90	36	18	12	6	16,000
5.	Kottayam	850	300			770	252	50	30	20	10	10	8	18,000
6.	Kanjirappally	1,500	900	100	40	400	260	300	200	400	250	300	150	1,50,000
7.	Palai	1,400	840	14	8	1,100	660	250	150	30	18	6	4	35,000
8.	Thodupuzha	600	300			535	274	50	20	10	4	5	2	15,000
9.	Muvattupuzha	1,700	1,100			1,400	900	150	100	100	65	50	35	40,000
10.	Ernakulam	1,100	450	10	4	465	187	385	153	240	106	....	....	28,000
11.	Trichur	1,000	900	50	45	500	450	250	225	150	135	50	45	25,000
12.	Palghat	1,100	880	15	12	760	608	206	165	87	70	32	25	60,000
13.	Nilambur	1,540	1,960	30	30	940	1,330	270	300	134	150	166	150	82,000
14.	Calicut	750	600			400	320	200	160	150	120	....	....	20,000
15.	Tellicherry	900	600			900	600							25,000
16.	Thaliparamba	1,000	500			1,000	500							25,000
17	Kanhangad	940	700	1	2	818	648	46	12	40	15	35	23	30,000
	Total	19,130	12,930	210	141	13,415	9,205	2,942	1,940	1,697	1.111	856	533	7,22,000

season starts. Overgrown seedlings are hard to be pulled out and difficult to get established in the field. Most nurseries do not have reserve space for sowing seeds to raise stock seedlings for next year's budding programme. Unless the budded plants are pulled out, vacant space will not be available for raising stock seedlings for next year's budding. Therefore nursery people may think of polybagging the unsold plants. This has two-fold advantages. They can ensure space for sowing seeds to raise stock seedlings and prepare healthy polybag plants which may fetch a better price next year. Polybag plants would be a better alternative to planting budded stumps from the point of view of easy establishment and uniform growth in the wake of the wavering weather conditions.

Ecologic imbalance is attributed to be one of the reasons for the recurring drought. It is well known that there should be forest cover in at least one-third of a country's land area to keep the balance of the nature. But reports appearing in the Press give a disturbing reading. The forest wealth in India has been reduced to 22 per cent and in Kerala to less than 10% of the land area over the last 30 years owing to poaching and indiscriminate destruction of trees and consequent on proliferation of hydro-electric projects and mining activities. This massive destruction is causing, as experts assert, alternating floods and droughts. Though the State is alive to the dangers of tapering forest cover, afforestation programmes taken up have not been large enough to meet the deficiency. Lack of care has caused lakhs of plants raised in the social forestry programmes to die unatural deaths. Maintenance of the plants should get as much importance as fresh planting if the afforestation artempts are to become successful.

Forests are known for their capacity to make a large part of the rain water seep down into the soil layers. Leaves and other organic matter falling to the ground decay and mix with the soil to form humus. This humus attract and retain large amount of rain water, just as a sponge absorbs and retains water, and makes the water sink down into the soil. Trees cycle up this water to the atmosphere through the process of transpiration. Tree-roots go into the soil, in the sub soil moisture and bring it up to the leaves. This moisture evaporates into the air through stomata, the tiny holes in the leaves. The water particles thus escaping the leaves load the air with moisture. This moisture-laden air joins the wandering clouds driven in by the monsoon winds, and cause them to cool down and bring about precipitation under favourable circumstances. Once tree growth is destroyed, generation of the natural medium to impregnate the air with water particles and induce rainfall is forestalled. In the absence of the medium to abet and solidify the wandering clouds into water drops, the winds take away the clouds to distant places. At times condensation may take place and rain drops may trickle down on the way. This points to the possibility of rains becoming scarce. Scanty rainfall causes the water level in the sub soil to drastically come down. The scorching summer dessicates the soil. The process culminates in the land turning into a desert.

There are other reasons also for the low rate of rainfall. One section of the meteroloists feel that the rain deficiency is caused by the weakening of the monsoon winds in the South Asian region by the depression in the Bay cf Bengal. Another section postulates a theory that the existence of a thick snow-cover over the Himalayas which melts during the summer months prevents depression in the Bay of Bengal. Yet another section relates the drastic climatic change to the 'El Nino' phenomenon linked with the Indian monsoon. Their reasoning is that when the surface temperature goes up in the Southern Pacific Ocean, India gets a deficient rainfall. It is stated that this year the temperature in the Pacific Ocean region increased in the months just prior to the monsoon months. Many others feel that there are several factors beyond these reasonings. Scientists all over the world are now labouring hard to find the root cause of this cataclysmic change.

Of late the weather has been exhibiting unpredictable vagaries in the country. When West Bengal and Assam submerged under floods caused by excessive rainfall, most other regions in the country wilted under the sweltering heat. This contrasting pehnomenon is baffling administrators and scientists alike. Whatever be the reasons, the safest bet appears to be a quick greening of the waste and fallow lands in the country extending to 145 million of hectares, for bringing about a climatic moderation. Two years ago the Prime Minister had stressed, while proposing to set up a National Wasteland Development Board, the need for regenerating five million hectares of wasteland every year by raising suitable plant species. True, investment of a colossal magnitude would be needed for this. Finance is hardly a problem for such a venture, since the World Bank woulp gladly come forward to extend liberal credit to such an environmental upgradation programme. □

DISCRIMINATORY FERTILIZER USAGE IN RUBBER — A CASE STUDY

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The necessity of manuring rubber for growth of plants and for production of latex has been well established (1, 2, 3). In our Country, systematic manuring has been started from 1955 onwards (4). Fertilizer recommendation for this purpose was formulated based on the results of nutritional studies conducted in other rubber growing countries and also taking into consideration the agroclimatic conditions prevailing in our rubber growing tract. These recommendations continued till 1966 when general fertilizer recommendations were formulated based on the nutritional experiments conducted in our country (Table 1). Simultaneously RRII has introduced the concept of discriminatory fertilizer usage which is found to be more beneficial than adopting general fertilizer application. This paper deals with some of the aspects on current fertilizer practices recommended by the RRII with special emphasis on discriminatory fertilizer usage.

General fertilizer recommendations

As in other crops, Nitrogen, Phosphorus and Potassium are the major nutrients in rubber. Eventhough the nutrient removal through latex is only around 10 kg Nitrogen, 5 kg Phosphates and 10 kg Potash for a high yielding clone producing 1500 kg of rubber, the requirement of these nutrients for growth is found to be enormously higher. In order to quantify the requirements of these elements nutritional trials were conducted at different locations of the rubber growing tract. Along with this tentative general fertilizer recommendations were formulated based on the experiments conducted in other rubber growing countries. 8:12:10, 8:12:12 and 8:10:12 were the recommendations formulated in this manner. These recommendations prevailed till 1966 when new recommendations were evolved based on the results of trials conducted at RRII (5). As per this 10:10:4:1.5 mixture was recommended for rubber in the immature phase and a 10:10:10 mixture for the mature.

During 1968 experiments were started to study the effect of growing cover crops in rubber plantation and it was found that this practice resulted in considerable savings in nitrogeneous fertilizers. Based on this 12:12:12 mixture was introduced for legume cultivated area and 15:10:6 mixture for non-legume areas. Soil fertility evaluation studies conducted by RRII revealed that Magnesium status is high in some of the rubber growing tracts and hence magnesium was deleted from the mixture recommended for such regions. These regions included Kanyakumari, Trichur, Palghat, Malappuram, Calicut, Cannanore, Kasaragod, Karnataka, Goa and Maharashtra. In these regions, instead of 10:10:4:1 5 NPK Mg mixture, a 12:12:6 NPK mixture has been recommended for immature rubber.

Discriminatory fertilizer usage

The main feature of this procedure is to make fertilizer recommendation based on analytical values of soil and leaf samples collected from estates/small holdings. Aspects like past manuring history, type of planting material, cultural practices adopted etc are also taken into consideration while issuing recommendation. Critical levels (Table 2 a, 2 b) have been fixed, both for soil and for leaf to simply classify them as low, medium and high.

By adopting this procedure, it is possible to limit the use of fertilizers just according to the requirement of the plant.

In several instances indiscriminate use of fertilizers has led to nutritional imbalances. Use of high potash mixtures in the immaturity phase has often lead to onset of late dripping and brown bast. In one of the company estates in which incidence of brown bast was high it was found that 685 kg of K 20 was applied in place of 197 kg of K 20 recommended by RRII. Once the trees are affected, it is very difficult to bring the trees back to the normal condition. Since prevention is always better to apply fertilizers judiciously than to follow indiscriminate method of fertilizer application.

Savings in fertilizer cost is one of the major attractions for adopting this method. In order to quantify the benefits we have selected ten estates and the savings in fertilizer cost have been worked out (Tables 3, 4, 5). It is seen that substantial amounts are saved by these estates by adopting this procedure. The method of discriminatory approach has received much popularity among planters as is evidenced from the increase in the number of estates adopting this method (Table 6).

In order to sharpen the accuracy of the discriminatory approach, follow up studies are being conducted in estates wherever always a control plot of general fertilizer recommendation is kept for comparison.

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Table-1

GENERAL FERTILIZER RECOMMENDATION FOR IMMATURE AND MATURE RUBBER (DOSES IN kg/ha)

I year	10:10:4:1.5	NPK Mg
II year	40:40:10:6	,,
III year	50:50:20:7.5	,,
IV year	40:40:16:6	,,
V year onwards	30:30:30	NPK

Table-2 (A)

SOIL FERTILITY STANDARDS

Parameters	Low	Medium	High
Organic Carbon %	0.75	0.75 — 1.50	1.50
Available P (mgs/100 gm soil)	1.00	1.00 — 2.50	2.50
Available K (mgs/100 gm soil)	5.00	5.00 — 12.5	12.50
Available Mg (mgs/100 gm soil)	1.00	1.00 — 2.50	2.50

Table-2 (B)

CRITICAL LEAF NUTRIENT LEVELS

Parameters	Low	Medium	High
% N	3.00	3.00 — 3.50	3.50
% P	0.20	0.20 — 0.25	0.25
% K	1.00	1.00 — 1.50	1.50
% Mg	0.20	0.20 — 0.25	2.50

Table–3

COST OF FERTILIZER SAVED IN 1985

Sl. No.	Estates	No. of fields	Area (Ha)	Cost of ferti-lizers saved (Rs.)	Cost of ferti-lizers saved per hectare (Rs./Ha)
1.	Keeriparai	17	488	14048	28.80
2.	Sittar	24	561	15511	27.60
3.	Shaliacary	49	382	28862	75.50
4.	Lahai	44	787	37567	47.70
5.	Kumbazha	30	718	60902	84.8
6.	Malankara	29	234	20666	88.30
7.	Pudukad	11	235	38696	164.60
8.	Kundai	22	430	48200	112.00
9.	Thiruvampadi	7	199	7589	38.0
10.	Kinalur	29	955	10820	11.30

Table–4

COST OF FERTILIZER SAVED IN 1986

Sl. No.	Estates	No. of fields	Area (Ha)	Cost of ferti-lizers saved (Rs.)	Cost of ferti-lizers saved per hectare (Rs./Ha)
1.	Keeriparai	17	488	13559	27.80
2.	Sittar	25	638	1504	2.40
3.	Shaliacary	49	382	30998	81.10
4.	Kumbazha	36	848	50568	59.60
5.	Koney	19	358	10399	29.0
6.	Malankara	23	241	22241	92.30
7.	T. R. & T.	20	310	16901	54.50
8.	Pudukad	11	262	35172	134.20
9.	Thiruvampadi	19	576	22751	39.50
10.	Kinalur	30	975	51805	53.0

Table–5

COST OF FERTILIZER SAVED IN 1987

Sl. No.	Estates	No. of fields	Area (HA)	Cost of fertilizers saved (Rs.)	Cost of fertilizers saved per hectare (Rs./Ha)
1.	Keeriparai	17	488	2666	5.50
2.	Sittar	23	655	22618	34.6
3.	Shaliacary	50	398	15965	40.10
4.	Lahai	40	800	42231	52.80
5.	Koney	20	360	18253	50.70
6,	Malankara	37	258	8675	33.60
7.	T. R. & T.	20	300	5488	18.30
8.	Pudukad	11	262	31213	119.10
9.	Kundai	32	708	65259	92.10
10.	Thiruvampadi	21	534	18701	35.0

Table–6

NUMBER OF SAMPLES ANALYSED AND AREA COVERED (Estate Sector)

Year	No. of samples		No. of estates	% of mature area covered
	soil	leaf		
1984	1020	684	42	30
1985	1151	792	45	32
1986	1536	966	52	38

ADVANCED PLANTING MATERIALS: A COMPARATIVE COST BENEFIT STUDY*

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Introduction

The performance of advanced planting materials, like polybag plants and stumped buddings, is compared with budded stumps and the comparative cost of establishing and the benefits of each are analysed to finally recommend an ideal cost effective system of planting.

Apart from budded stumps, the only advanced planting material used at present is polybag plants, and to a very limited scale, the stumped budding (perhaps only by the AVT Group).

Polybag plants of course are now very widely used in preference to budded stumps. You would be hearing from the paper of Mr. Lamech of our R & D Wing, that yield from the tree is mainly dependent on inherent genetic factors, with, of course, management practices, exploitation methods etc. Whether the planting method or use of advanced planting materials like polybag plants, will have any effect on the yield capacity of the plants is probably an unknown question. What we are aiming at now is on the economics of the different planting materials.

Percentage Survival and Tappability

The AV Thomas Group commenced polybag planting in 1979 and have put large areas since then under this method. The performance of these areas are seen in TABLE-1 where a comparison between polybag plants, budded stumps and stumped buddings are seen with regard to the percentage survival and percentage tappability, based on the initial original stand.

Table-1

PERCENTAGE SURVIVAL AND TAPPABILITY

Field & Planting Material	Original Stand	Percentage survival	Percentage tappability	Census at
1979 GT 1 Polybag plants	715	99.30	59.00	6 yrs 7 months
1979 GT 1 Budded stumps	4754	98.40	54.00	-do-
1980 GT 1 Polybag plants	5307	97.11	69.90	-do-
1980 GT 1 Budded stumps	2126	87.70	57.38	-do-
1981 GT 1/105 Polybag plants	8543	97.62	61,43	6 years
1981 PB 235 Budded stumps	642	98.13	89.09	6 years
1981 GT 1 Stumped buddings	925	98.49	91.89	4 yrs 7 months (Had a girth of 46.1 cm in Nov. 1985 *ie* at 4 yrs 4 months)

* The paper was presented at the Rubber Planters' Conference held at Kottayam on 22nd August 1987. The views expressed by the author are his own and do not reflect the official opinion of the Board.

Table-2
GIRTH INCREMENT TREND – (in cms at 150 cms height)

Field/Planting Material	1st Yr.	2nd Yr.	3rd Yr.	4th Yr.	5th Yr.	6th Yr.	7th Yr.	Remarks
1979 GT 1 Polybag plants		13.35	20.28	25.88	35.74	42.67	46.78	6 yrs. 7 months
1979 GT 1 Budded stumps		11.35	18.37	24.21	34.82	42.42	46.90	-do-
1980 GT 1 Polybag plants	9.98	16.47	21.90	32.38	39.98	46.20	52.60	6 yrs. 9 months
1980 GT 1 budded stumps			18.78	29.21	36.00	41.10	46.10	-do-
1981 GT 1/105 Polybag plants		12.32	21.62	31.15	37.81	45.24		5 yrs. 7 months
1981 PB 235 Budded stumps		12.12	24.16	35.07	43.00	51.29		-do-
1981 GT 1 Stumped buddings	12.00	19.20	32.50	41.50	48.13	53.40		(Had a girth of 46.1 cms in Nov. 1985 itself ie 4 yrs 4 months but taken for tapping at 4 yrs 7 months in March 1986)

From this Table, the following inferences can be drawn.

1) The percentage of both survival and attainment of tappable girth is better in the case of polybags than in the case of budded stumps in 1979 and 1980 replantings.

2) In the 1981 planting, both survival and tappability percentage are higher in the case of budded stumps for two reasons.

   a. The clone is PB 235.

   b. This was planted in the lower regions where the soil moisture was higher due to the presence of a stream.

3) In all the three areas survival rate of polybags is quite high at above 97%, and this is with about 2 to 3% supplies of vacancies only.

In the case of budded stumps, survival is high but it is with 10–15% supplies of vacancies.

4) It can also be seen that polybag plants do attain tappable girth slightly ahead of budded stumps, but the time taken will depend on several other factors as well.

5) The most important aspect to note, is that stumped buddings have come into tapping in 4 years 7 months with a very high survival rate of 98.49% and tappability at 91.89%.

Girth Increment

In TABLE-2 we see the girth increment trend of the above mentioned planting material, from which the following conclusions can be made.

1) In 1979 Replanting the initial advantage of polybag has been wiped out in 6 years time, when both polybags and budded stumps attained a girth of over 42 cms. But one thing to be noted here is that the smaller number of polybag plants ie. 715 plants (Ref. TABLE–1) had all been planted on hill tops while the larger number of budded stumps ie. 4754 plants, had been planted on both hills and valleys

2) In 1980 replanting, girthing has been definitely better in the case of polybag plants; almost 6 months ahead compared to budded stumps.

3) The results in 1981 replanting seem to be at variance with the above, and this can mainly be attributed to clonal characteristics.

4) Stumped buddings in the case of girthing, also is far ahead of both polybags and budded stumps. Tapping girth is attained in about 4 years 7 months.

General Conclusions from the above data

a) With regard to survival and attainment of tappable girth, at least as far as Shaliacary Estate is concerned, Stumped buddings should be preferred, provide the constraints regarding preparation of sufficient planting material are surmounted.

b) Polybag plants can come into bearing 3–6 months ahead of budded stumps.

c) Survival rate of polybag plants is definitely higher.

The Economics of Planting Materials-A Comparison

The economics of using Budded stumps, Polybag plants and Stumped buddings is given below in TABLE–3.

Table-3

ECONOMICS OF THREE DIFFERENT PLANTING MATERIALS

Particulars		Budded Stumps	Polybag Plants	Stumped Buddings
Cost of Planting material–ex nursery		Rs. 3.50	8.75	5.50
Cost of Planting		Rs. 0.30 3.80	1.46 10.21	0.55 6.05
Cost per Hectare ie. 445 plants		Rs. 1691/-	4543/-	2692/45
Cost of Maintenance per Hectare–				
	1st year	7400/-	7400/-	7400/-
	2nd year	4900/-	4900/-	4900/-
	3rd year	3550/-	3550/-	3550/-
	4th year	2900/-	2900/-	2900/-
	5th year	2700/-	2700/-	1800/-*
	6th year	2600/-	2600/-	
	7th year	2600/-	1300/-**	
Total Replanting Cost/Ha.		28341/-	29893/-	23242/45
Additional Cost of supplies		255/- (@ 15%)	138/- (@3%)	— (@1.5%)
	TOTAL	Rs. 28596/-	30031/-	23242/45
Expenditure + or — over budded stumps		—	+ 1435/-	—5353/75
Extra crop over budded stumps at 5 yrs 7 months		—	—	935 kgs
at 6 yrs 7 months			370 kgs	1200 ,,
Extra crop harvested			370 kgs	2135 kgs

* Reduction in maintenance cost as Stumped buddings come into tapping in 4 years 7 months, therefore a proportionate reduction.

** Polybag plants come into tapping 6 months earlier, therefore a proportionate reduction in maintenance cost.

Conclusions

rom TABLE-3, it could be noted hat:

) Polybag planting, although it costs Rs. 1435/- more per hectare until it is brought into tapping, comes into bearing at least 6 months ahead, more than covering the additional expenditure incurred in the first 6 months itself.

) The planting density is taken as 445 plants per hectare for all three types of planting.

the final stand at the time of apping is to be 375/380 per ectare, the initial density of 445 definitely called for in the case f budded stumps; since a loss of 5% is to be expected.

) With a loss of only 3% in the case of polybag plants, should we plant 445 plants? If it is to get a stand of 375/380 plants, we need plant only 390/395 plants, thereby saving expenditure on 50 plants. This is again an invisible advantage of using polybag plants instead of budded stumps.

) The uniformity obtained in polybag plants is definitely higher than in budded stumps, for the simple reason, that sprouting takes place at different times. Although it is said that if budding is at about the same time and cut back also, sprouting will be uniform, in practice this is not usually experienced.

n the case of polybag plants, plants are already grown and material of the same size and number of whorls can be planted together ensuring better uniformity.

5) Added to this wherever the climate is less than ideal, there appears to be no doubt that polybag plants will give a better establishment than budded stumps.

Suggestion No. 1

On the basis of the above, if the choice is between budded stumps and polybag plants, I would personally recommend polybag planting because of:

a. Higher survival rate
b. Higher percentage of tappability
c. Better uniformity
d. Earlier yield
e. Lower costs due to the possibility of reduction in initial stand
f. Better resistance to climatic variations.

However there is the other planting material of stumped budding. From TABLE-3 it will be noticed that the cost of establishing one hectare of stumped buddings is the lowest at Rs. 23250/–, the survival rate is the highest, percentage tappability is the highest, loss in the field is the lowest, and it gives you a return two years ahead of budded stumps and 1½ years ahead of polybag plants.

The question arises as to why this is not adopted widely inspite of all these profound advantages. To my mind, the reasons are:

a. Very few people know that there is a method like this.
b. Those who have heard about it, have not seen a stumped budded area.
c. They have not studied the economics of it.
d. They lack the technical knowledge of preparing the stumped budding for planting.
e. People are afraid that they will lose a lot of plants in the field. They will; if proper care is not taken and if watering for a few days is not resorted to if required for.
f. The Rubber Board itself to my knowledge has not taken sufficient initiative to propogate or popularise such an eminently advantageous method.

Suggestion No. 2

a. Planters must certainly go all out for using stumped buddings as planting material, but with a proper conception of what should be done and with very clear information as to how the material should be prepared, planted and looked after in the field.

b. The Rubber Board must take a deep interest in popularising this because, after all, if the Board is cool to the idea, it is not going to be accepted, particularly by the small holders.

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