

**The Rubber Research
Institute of
Sri Lanka**

**Annual
Review**

1991



THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW 1991

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Mr. M. A. L. Perera (upto 05.07.1991)
Mr. Denzil Peiris, Representative of the JEDB (from 05.07.1991)

Mr. Nihal Cooray (In attendance)
Dr. L. M. K. Tillekeratne, Director, RRI
Mr. V. M. Katugaha, Estate Superintendent, Dartonfield Group (In attendance)
Mr. J. A. A. S. Ranasinghe, Secretary

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Mr. S. W. Karunaratne, Deputy Director (Research), RRI (on leave abroad, 20.03.91 — 01.09.91)
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Dr. O. S. Peries, Chairman, Sri Lanka Standards Institution
Dr. N. E. M. Jayasekera, Head, Genetics & Plant Breeding Dept., RRI
Dr. A. Nugawela, Head, Plant Science Dept., RRI
Mr. C. K. Jayasinghe, Head, Plant Pathology & Microbiology Dept., RRI
Mrs. L. Samarappuli, Head, Soils & Plant Nutrition Dept., RRI
Dr. (Mrs) K. G. K. de Silva, Head, Polymer Chemistry Dept., RRI
Dr. (Miss) N. M. V. Kalyani, Head, Rubber Technology Dept., RRI
Dr. G. Seneviratne, Rubber Chemist, RRI
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Mr. L. Karunanayake, Asst. Specifications Officer, RRI
Mr. P. H. M. U. Herath, Asst. Agricultural Economist, RRI
Mr. K. Meegahawatta, Head/Development Division, ASD
Mr. L. Madawela, Director Marketing, SLSPC, Head Office
Mr. B. G. S. Gunathilake, Assistant Rubber Controller, RCD
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Mr. G. Amarasinghe, Chairman, JEDB IV, Avissawella
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Mr. B. M. S. Fernando, Superintendent, Yatawatta S.P.
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Dr. G. Seneviratne, Rubber Chemist
Dr. (Miss) N. M. V. Kalyani, Head, Rubber Technology Dept. (from 25.07.1991)
Mr. G. W. S. K. de Silva, Rubber Controller
Mr. D. E. C. Wijesinghe, Factory Advisor, SLSPC
Mr. L. Perera, Factory Advisor, JEDB
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Mr. Desmond Fernando, Marketing Specialist, JEDB
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Mr. A. Rajapakse, Deputy Director (Budget Division), Ministry of Finance (upto 07.10.1991)
Mrs. C. S. Kumarasinghe, Deputy Director (Budget Division), Ministry of Finance (from 07.10.1991)
Mr. G. W. S. K. de Silva, Rubber Controller
Mr. M. M. A. Naina Marikar, Planter
Mr. R. Wijegunaratne, Working Director
Dr. L. M. K. Tillekeratne, Director, RRISL (In attendance)
Mr. K. Ginige, Secretary (upto February 1991)
Mr. J. A. A. S. Ranasinghe (Secretary) (upto 25.02.1991)

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Dr. L. M. K. Tillekeratne - Director, RRISL
Mr. K. Ginige - Secretary, Provident Fund Committee (upto February 1991)
Mr. J. A. A. S. Ranasinghe - Secretary
Mr. W. C. Dayaratne - Elected Committee Member
Mr. A. L. Ratnayake - Elected Committee Member

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Mr. G. W. S. K. de Silva, Rubber Controller
Mr. M. M. A. Naina Marikar, Member, Rubber Research Board
Dr. L. M. K. Tillekeratne, Director, RRI
Mr. S. W. Karunaratne, Deputy Director (Research), RRI
Mr. A. Dahanayake, Acting Director, ASD
Dr. N. Yogaratnam, Assistant Director, RRI
Mr. L. K. Meegahawatte, Head, Development Division, ASD
Dr. (Mrs) A. C. I. Samaranyake, Head, Plant Science Department, RRI
(upto 31.01.91)
Dr. N. E. M. Jayasekera, Head Genetics & Plant Breeding Department, RRI
Mr. A. J. L. de Silva, Regional Advisory Officer (Colombo District)
Mr. P. Samaranyake, Regional Advisory Officer (Kalutara District)
Mr. M. C. Samarasekera, Regional Advisory Officer (Galle & Matara
District)
Mr. D. D. Dasanayake, Regional Advisory Officer (Kegalle District)
Mr. A. H. Kularatne, Regional Advisory Officer (Ratnapura District)
Dr. R. C. W. M. R. A. Nugawela, Head, Plant Science Department, RRI
(from 20.05.1991)

Secretary to the Board

Mr. K. Ginige (upto February 1991)
Mr. J. A. A. Ranasinghe (from 25.2.1991)

Lawyers

Attorney General,
Attorney General's Department,
(Government Institutions),
P.O. Box 502,
Colombo 12.

Auditors

M/s. Warusawitharana & Co.,
Chartered Accountants,
27/3, Pedris Road,
Colombo 3.

Bankers

**Bank of Ceylon,
Corporate Branch,
75, Janadhipathi Mawatha,
Colombo 01.**

**Bank of Ceylon,
Agalawatta.**

Registered Office and Laboratories

**Dartonfield,
Agalawatta.**

Telephone : 034 - 71426

Fax : 034 - 71426

Colombo Office and Laboratories consist of:

**Rubber Research Board Office,
Advisory Services Department,
Polymer Chemistry Department
Raw Rubber & Chemical Analysis Department
Raw Rubber Process Development Chemical Engineering Dept.
Rubber Technology & Development Department
Electronic Instruments Repair Unit**

**Telawala Road,
Ratmalana,
Mt. Lavinia.**

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Chairman, Rubber Research Board — 01 - 605171

General Office — 01 - 635851

01 - 635852

01 - 633351

**THE RUBBER RESEARCH INSTITUTE OF SRI LANKA
STAFF**

(As at 31st December 1991)

Chairman	..	Professor I. Balasooriya, BSc (Cey.), PhD (Liverpool)
Director	..	L. M. K. Tillekeratne, BSc (Cey.), MSc (Aston), PhD (Aston), F.I. Chem.C
Acting Director	..	N. Yogaratnam, BSc Agric (Alhabad) PhD (Lond.) (01.04.1991-31.07.1991)
Deputy Director (Research)	..	S. W. Karunaratne, BSc (Cey.), MSc (Aston) F. P. R. I., F. I. Chem. C
Assistant Director	..	N. Yogaratnam, BScAgric (Alhabad), PhD (Lond.)
Secretary to the Chairman	..	Mrs. L. J. C. Perera
Clerk/typist	..	Miss. S. N. Munasinghe

RESEARCH DEPARTMENT

Plant Science

Head of Department	..	Mrs. A.C.I. Samaranayake, BSc (Cey.), PhD (Lond.) (upto 31.01.1991) R.C.W.M.R.A. Nugawela, BSc (SL), MSc (Lond.), PhD (Essex) (from 20.05.1991)
Assistant Botanists	..	Mrs. G.P.W.P.P. Seneviratne, BSc (SL) PhD (University of Bath, U.K.) Miss. M. S. Ranasinghe, BSc (SL). L.S.S. Pathiratne, M.I. Biol., MPhil(SL)
Research Assistant (Intercropping)	..	V.H.L. Rodrigo, BScAgric (SL), MSc (Essex).
Experimental Officers	..	R. B. Gunaratne L. S. Kariyawasam
Senior Technical Officers	..	*K. A. G. B. Amaratunga R. P. Karunasena
Senior Experimental Assistant	..	S. Wilbert

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- .. Mrs. G. A. S. Wijesekera
- .. Mrs. R. K. Samarasekera
- .. U. S. Weerakoon
- .. T. U. K. Silva
- .. M. K. P. Perera
- .. S. M. A. Samarakoon
- .. W. D. M. N. de Alwis
- .. Miss. G. G. M. Soysa
- .. Mrs. H. D. D. E. Jayawardena

Clerk/typist

Genetics & Plant Breeding

Head of Department

- .. N.E.M. Jayasekera, BSc Agric (Cey.), PhD (Birm.)

Geneticist & Plant Breeder

- .. Mrs. S. C. Dharmaratne, BSc (SL), PhD (Scot.)

Assistant Geneticist & Plant Breeder

- .. *D.P.S.T.G. Attanayake, BSc Agric(SL)

Experimental Officer

- .. K. W. Rupertunga

Senior Experimental Assistants

- .. B. M. S. G. Peiris
- .. A. K. M. S. Senaratne

Technical Officers

- .. R. A. S. K. Ranatunga
- .. I. D. M. J. Sarath Kumara
- .. K. P. Sunethra Nilmini

Clerk/typist

- .. ***Mrs. K. D. R. Tissera

Plant Pathology & Microbiology

Head of Department

- .. C.K. Jayasinghe, BSc (SL), MSc (SL) MSc (Agric) (Aust.) (from 30.07.1991)

Assistant Plant Pathologists

- .. *A.H.R. Jayaratne, BSc (SL), MSc (SL), K. E. Jayasooriya, MSc (USSR)
- .. Miss. W.P.K. Silva, BSc (SL), MSc (SL)

Experimental Officers

- .. L. W. Amaratunga
- .. W. A. D. D. S. Wettasinghe
- .. E. B. Fernando

Senior Technical Officer

- .. Mrs. P. C. Wettasinghe

Technical Officers

- .. Miss. B I. Fernando
- .. Miss. T. H. P. S. Fernando

Clerk/typist

- .. Mrs. W. S. P. Amerasekera

Soils & Plant Nutrition

<i>Head of Department</i>	.. M.K.S.A. Samaraweera, BSc (SL), MSc (Bristol), PhD (Bristol) (upto 31.03.91) Mrs. M. L. A. Samarappuli, BScAgric (SL), MSc (Calif.) (from 20.05.1991)
<i>Assistant Soils Chemist</i>	.. D.M.A.P. Dissanayake, BScAgric (SL) P.I. Yapa, BScAgric (SL). R. S. Dharmakeerthi, BScAgric (SL)
<i>Experimental Officers</i>	.. A. M. A. Perera H. D. S. P. Perera, BSc (SL) J. G. de Mel Mrs. R. Hettiarachchi, BSc (SL)
<i>Senior Technical Officer</i>	.. Miss. S. D. C. K. Maheepala
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<i>Specification Assistant (special grade)</i>	.. T. M. Ahamadeen
<i>English Stenographer</i>	.. Mrs. K. A. D. L. Rupasinghe Perera

Biochemistry & Physiology, Polymer Chemistry, Raw Rubber & Chemical Analysis, Rubber Technology & Development, Raw Rubber Process Development Chemical Engineering, and Electronic Repair Unit

<i>Head of Raw rubber & Chemical Analysis</i>	.. L. M. K. Tillekeratne, BSc (Cey.), MSc (Aston) PhD (Aston); F.I.Chem.C.
<i>Head of Polymer Chemistry</i>	.. Mrs. K. G. K. de Silva, BSc (SL), MSc (SL), PhD (Aston)
<i>Head of Rubber Technology</i>	.. Miss. N.M.V. Kalyani, BSc (SL), PhD (Lond.)
<i>Rubber Chemists</i>	.. W. M. G. Seneviratne, BSc (SL), PhD (Sussex) S.A.P.P. Sirimanne, BSc (SL), PhD (Sussex)

Assistant Rubber Chemists

*B. P. Weeraratne, BSc (SL)
S. M. C. E. Silva, BSc (SL)
Miss. J.A.G.S.G. Gunawardena, BSc (SL), MSc (SL)
S. Siriwardena, BSc (SL)
Miss. H. M. M. de S. Rajapakse, BSc (SL), MSc (SL)
Mrs. D. G. Edirisinghe, BSc (SL), MSc (SL)

Assistant Biochemists

M. T. Warnakula, BSc (SL)
Miss. P. N. de Silva, BSc (SL)

Assistant Specifications Officer

L. Karunanayake, BSc (SL)

Experimental Officers

*H. N. K. K. Chandralal, BSc (SL), MSc (SL)
A. S. Dekumpitiya, NRP
I. H. S. L. Weerasinghe, DNRP
Mrs. D. I. R. Denawaka
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Senior Technical Officers

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Technical Officers

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Instrument Technician

L. G. P. Lelwala

Specification Assistant (Special Grade) ... W. A. S. Wijsekera

Specification Assistants .. G. Wanigatunge
P. D. J. Rodrigo
K. K. Austin
B. Gunasiri
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Senior Technical Officer .. Miss. J. D. Nandanie

Technical Officer .. T. I. Hettiarachchi

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Adaptive Research Unit**

Research Assistant/Agronomy .. S. M. M. Iqbal, BScAgric (SL), MPhil(SL)

Assistant Development Officers .. F. P. W. Silva
P. P. Jayasinghe, LPRI
W. C. Dayaratne
K. B. A. Karunasekera

Senior Technical Officer .. E. A. T. Senadeera

Agricultural Economic Units

Agricultural Economist .. I. N. Samarappuli, BScAgric (SL)
MSc (Reading)

Assistant Agricultural Economists .. *H. Talgaswatte, BScAgric (SL)
**P. H. M. U. Herath, BScAgric (SL)
Mrs. S. Amaratunge, BA (SL)

Library

Librarian & Publication Officer .. Mrs. Kamani Perera (ASLLA)

Library Assistant & Assistant Publications Officer .. Mrs. D. T. Dantanarayana

Clerk/typists .. Mrs. R. M. Amaratunge

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<i>Office Assistant</i>	..	J. D. Gunaratne
<i>Assistant Medical Practitioner</i>	..	K. V. de Silva
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<i>Telephone Operator</i>	..	Mrs. P. Edirimanne
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<i>Assistant Internal Auditor</i>	..	Neil C. de Silva
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<i>Transport Officer</i>	..	B. D. Ponnampereuma
<i>Building Foreman</i>	..	K. K. A. S. Kannangara
<i>Electrical Foreman</i>	..	W. D. Ratnasinghe
<i>Mechanical Foreman</i>	..	S. D. Gunawardena
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<i>Charge Hand (Building)</i>	..	H. A. Somasiri
<i>Charge Hand (Electrical)</i>	..	J. D. Sirisena

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<i>Assistant Accountant</i>	..	K. G. A. K. Dharmawardena (from 15.01.1991)
<i>Book-keeper</i>	..	D. A. Rajapakse
<i>Graduate Assistants</i>	..	Mrs. G. K. Somasiri, Mrs. K. Jagoda, BA (Cey.)
<i>Accounts Clerks (special grade)</i>	..	G. S. Doolwela G. A. Kannangara
<i>Accounts Clerks</i>	..	Mrs. C. C. Silva Miss. S. Irene Mrs. M. Gunawardena Mrs. K. Kapuge K. C. Fernando
<i>Clerk/typists</i>	..	Mrs. W. A. C. Weeramanthrie Mrs. R. Handungoda
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<i>Assistant Store Keepers</i>	..	P. D. Somadasa P. L. A. W. Cooray

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<i>Chief Clerk</i>	..	S. A. L. Chandrawansa
<i>Senior Assistant Clerk</i>	..	K. K. P. Gunawardena
<i>Junior Assistant Clerks</i>	..	K. D. Sumanasena Mrs. C. Dissanayake A. K. D. A. Wickremasinghe
<i>Rubber Factory Officer</i>	..	D. S. K. Ranaweera
<i>Rubber Factory Supervisor</i>	..	W. D. D. Senanayake
<i>Field Officers</i>	..	N. L. D. Piyadasa A. K. D. Hemapala H. M. J. Premalal S.K.S. de Silva (attending to Clerical Work)
<i>Assistant Field Officer</i>	..	J. A. Wimalasena

Field Supervisors

.. S. R. Vadivel
T. Somaratne
N. L. D. Reggie

Kuruwita Sub-Station

Visiting Superintendent

.. N. M. Cooray

Assistant Estate Superintendent

.. S. A. R. Samarasekera

- * On study leave overseas
- ** On study leave locally
- *** On no pay leave overseas

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

DIRECTOR'S REVIEW

By

L. M. K. TILLEKERATNE

The price of NR during 1991 was disappointing, being static within 175-185 US cents per kg, thereby keeping the producers who are mainly small holders, in a difficult situation. As a result most small holders stopped tapping their plantation so that rubber production dropped down to 103000 MT. Shortage of tappers in producing areas was another factor which has affected production. Unless correct measures are taken quickly to increase rubber production, all indications are that Sri Lanka will be down to about the 10th position amongst the rubber producing nations in the world in the near future.

The main global change that took place in 1991 was that Thailand overtook both Indonesia and Malaysia in rubber production producing over 1320000 MT. This is the 1st time since 1958, that Malaysia was beaten to the second place by another rubber producing nation in the world. However, the share of the total production by the above 3 big producers is slightly decreasing as a result of the production increase in other countries Like India & China.

All the major rubber producing nations have understood the need for quality enhancement by the elimination of contamination. In order to eliminate contamination caused by wooden crates shrink wrapping on wooden pallet bases has shown to be the best method of packing so far available for TSR. Extending the same method for our latex crepes too will be an important improvement. Malaysia is trying hard to implement ISO 9000 for rubber in the near future in order to gain more consistency for her product.

In 1990, the total natural rubber production in Sri Lanka was 113096 MT: which is a 2354 MT. increase over the production in 1989. But in 1991 the total rubber production came down to 103000MT.

This makes the situation more difficult for Sri Lanka to reach its peak production figure of 155500 MT. produced in 1978 even in another two decades. However, every year nearly 3000 acres of rubber land go out of rubber mainly due to diversifica-

tion into tea by the small holders in view of the more attractive tea prices prevailing in the market. A sudden drop of rubber production from the above peak figure to about 103000 MT. was mainly due to nationalisation of estates in 1973. Another little set back for rubber was the unexpected failure of the clone RRIC 103 in 1985. But now there is sufficient time for the plantation to recover from the above set backs and produce maximum crop according to the targets forecast some time ago. However the rate of recovery has been found to be very slow and the annual growth of rubber production is still very small

A survey carried out during the last quarter of 1991 has indicated that the main cause for the drop in the yield is the unexpectedly low stand and very high level of incidence of brown-bast. Areas subject to the above study have revealed that there are only about 250-270 trees per hectare in most of the plantations: hence to reach the required field norms, tapping is carried out on every dry day. As a result nearly 25% of the existing trees are affected by brown bast thereby lowering the actual number of yielding, healthy trees in a hectare to between 200 and 220. Hence if proper planting practices have been followed in such places the actual yields given by the RRIC 100 series clones could have reached an average figure of over 2000 kg/ha/yr: which is equivalent to yields recorded by those clones in African countries.

This is a serious situation and if at least the state sector plantations take necessary precautions in the future, the national yield average could be increased from about 750 kg/ha/yr: to at least 1500 kg/hr/yr: thereby doubling our annual production. Hence with privatisation and with the improved estate management practices expected to take place in the near future, doubling our national yield of rubber will not be a difficult task. If not with the present restrictions of the application of fertilizer for mature plantations, every possibility is there for the national rubber production to decrease further. However RRI was able to introduce a skirt type rainguard to carry out tapping on rainy days during this year.

The price of natural rubber has continued to decline throughout 1991. The indicator is now at the lowest level since May 1986. Hence in order to help the poor rubber producer, the Government of Sri Lanka reduced the export duty on rubber by Rs. 2.40 in September 1991. This reduction although it slightly improved the sheet rubber price, had no impact on latex crepe producers who make the best quality rubber in the world, at a higher cost of manufacture. The reason was that, the price of latex crepe rubber, at present produced only by Sri Lanka, is not quoted by an international body like Reuter and hence the shippers who are in the business of shipping latex crepe, can manipulate the price the way they wish, thereby absorbing all such concessions offered to the producer. Mainly due to this poor price the production of latex crepe is declining very fast and since 1983: the quantity produced has gone down to 50%.

However the inland rubber price has gone up by 2-3 rupees as a result of the duty reduction and hence the foreign investors who set up factories have to manu-

facture finished rubber goods purely because of the low rubber price inside Sri Lanka are now badly effected by this duty reduction. Further decrease in export duty of rubber will therefore be a discouragement of foreign investments.

Research Aspects

1. Biology

Breeding and testing of clones continued to receive high priority. Clone RRIC 121 continued to show its superiority in terms of vigour and yield in all the clone trials.

An accelerated testing programme of proven foreign clones was initiated with the objective of selecting promising foreign clones for large scale planting in Sri Lanka.

Screening of clones for esterases and alcohol dehydrogenases was also initiated using continuous electrophoresis.

Studies conducted to identify the causes for low yield in commercial plantations reveal that approximately 25% of the stand is lost during the immature period and a further 20-25% of the remaining trees are lost during exploitation due to panel dryness which amounts to an overall reduction of 50% from the original stand. This appears to be one of the reasons for the very low yields per unit area recorded in the recent past in commercial plantations.

Response to low frequency tapping with stimulation varies with clones. Clones that show such responses give yields comparable to the conventional $1/2 s d/2$ systems.

High yielding tapping systems have been observed to reduce the girthing of plants. Tapping time was found to be similar for both Jebong and push knives. Apron type pleated polythene rainguards were effective upto 12 months from fixing and has given 70 extra tapping days during this period.

Agroclimatic conditions do not appear to have any influence on the incidence of tapping panel dryness and although genetic differences exist, dryness is not necessarily high in high yielding clones. Under poor management conditions, the incidence of dryness increases significantly.

Although *Hevea brasiliensis* leaves developed under low light have a relatively low CO_2 assimilation rate, the optimum rates are maintained for a major part of the day giving a daily integral comparable to that of sun leaves.

Intercropping with banana and pineapple does not appear to retard the growth of immature rubber plants. As multicropping of Rubber lands with Tea continue to be popular both in the small holder and state sector estates more work is being done on this subject. Nevertheless, indications are that multicropping of Rubber with Tea on areas marginal for Tea would be advantageous to the grower.

Studies on fertilizer use continue to receive attention. Application of potassium at the currently recommended rate was seen to increase girthing of immature rubber irrespective of the soil type and clone used, suggesting that K requirement of the newly recommended clones are not different from the currently recommended rate in the first year.

Studies on mulching practices indicate that the rubber trees with mulching are superior to the trees under other management practices such as growing leguminous covers and naturals. As expected, better growth during immaturity resulted in early opening of trees under mulch. Mulching can reduce the non-productive period of *Hevea* by about 12 months. Yield was also higher in the mulched plots.

An important observation that emerged from the investigations on soil moisture and potassium is that application of K especially at double the recommended level might result in increased water use efficiency under stressed conditions through significant reduction in transpirational loss of water by rubber.

White root disease caused by *Rigidoporus lignosus* is still the main cause for crop loss in rubber plantation. Nevertheless, Penta Chloro Phenol could be used economically to control this disease provided the fungicide is applied at the early stages of infection: Dithane M 45 at a concentration of 3% ai was found to be effective as a prophylactic treatment in the management of bark rot.

Adaptive Research Programmes started on small holder fields in Kalutara, Galle, Kegalle, and Ratnapura regions in 1989 and 1990 were continued. More new programmes were also started in 1991. The objective of this programme is to evaluate and refine or modify if necessary, the technologies developed at the research stations and state owned plantations to fit better small holder resource and risk situation and to meet their needs. Several programmes on clone evaluation, intercropping, soil moisture and conservation practices, tapping systems, use of yield stimulants and rainguards were in progress.

2. Chemistry and Technology

Treatment of effluent from rubber factories : Small scale trials to reduce the BOD levels of effluent from rubber factories were very successful using the rotating bio belts made out of coir fibre. The engineering aspects of the model for scaling up purposes is still at the formative stages. Hence the successful operation of the technique on a commercial scale has still to be achieved.

During dry spells the problem is more acute and especially during this period the effluent could be spread on land. This will not only be an additional source of nutrient to the soil but will, also help to reduce the moisture stress in the soil due to prolonged dry spells.

A method was developed to cascade the effluent on coir fibre brushes fixed to a slanting base. This has also given some encouraging results. This method is simple and the flow of effluent through the system is by gravity. The efficiency of BOD reduction is related to the surface area of treatment surface to which the effluent is exposed and the rate of flow of effluent over this surface.

Conservation of energy : Power is an important item in the cost of manufacture. In order to reduce the power consumption we have repeatedly advised on the effectiveness of basic concepts in the use of electricity such as the use of power factor corrections, upkeep of power carriers, load rescheduling and the use of efficient motors.

A new grade of TSR : SLR LX is a new grade of TSR produced in Sri Lanka. This crepe lace prepared without removing a fraction and dried in normal drying towers are subjected to further drying at 100°C for 10 min and pressed into bales of standard size. SLR-LX is a light grade of rubber with a lovibond colour index less than three and a dirt content of less than 0.03%.

LNR : A centrally controlled factory is recommended for the manufacture of LNR to overcome some of the problems such as low P₀ caused mainly by the use of water containing certain contaminations at relatively high levels.

The necessity for TQC should be stressed in the manufacture of special grades of NR required for special markets. The demand for LNNR is good provided the quality is assured.

Resin coated coconut shells : For the collection of latex in the field coconut shells are the most popular due to the availability at a low cost. Use of plastic cups has ever been in question due to its cleanliness but the price is at least five times more than the coconut shell. Provided coconut shells of a standard size (large size is preferred to the medium size or small size) can be obtained and coated inside with Urea-Formaldehyde resin prepared at low cost by polymerisation of the two reacting chemicals it is possible to maintain a level of cleanliness far above the normal. A trial carried out recently showed a reduction of VFA by 33%, scrap percentage by 52% and the dirt content by as much as 80%.

Recycling discarded vulcanised gloves : With the increase in production of gloves mainly examination type there is also an increase in the accumulation of discarded gloves which do not meet export requirements. Efficient factories have a reject rate of less than 5%. This level of efficiency is not reached by all the glove manufactures. The resultant rejects are dumped in some way which tends to cause an environmental hazard. Reworking of the vulcanised material into crepe form is possible by milling. This can be used as an extender for rubber products manufacture. A relatively high percentage of this material can be incorporated into most rubber formulations without having any questionable influence on the physical properties.

OENR : The use of OENR in retreading of tyres has shown an alround improvement in the performance of the tyres. OENR is prepared at the latex stage by adding an emulsion of oil to the latex prior to coagulation. Retreading trials were carried out at a leading retreading factory.

Rubber Products centre at Agalawatta : A training centre to train Janasaviya recipients and others in the production of simple rubber goods based on latex as well as dry rubber was opened up at Dartonfield. It is encouraging to note that prospective enterprenures in the Agalawatta area are making use of the facility.

Irradiated Latex : A detailed evaluation of the suitability of two commercially available antioxidants for irradiated latex has been conducted. Suitability of irradiated latex in heat sensitive dipping applications has also been evaluated by using both PPS and Zinc/amine systems. It has been found that irradiated latex could be successfully used in PPS heat sensitive dipping systems.

Latex/cement mixtures : A novel water based cement with improved drying characteristics has been developed to be used in tyre retreading and repair industry. The bond strength characteristics of the new material have been found to be comparable to those of currently used solvent based cement.

Performance of Brown Crepe : Project on the evaluation of the performance of brown crepe rubber grades in tyre retread compounds has been initiated to gather data to prove the effectiveness of brown crepe rubber in retread compounds. Preliminary trials clearly demonstrated the unsuitability of poor quality brown crepe rubber in retread compounds.

Depolymerised NR : The major breakthrough by the Polymer Chemistry Department during the past year was the invention of a very practical method to produce economical and non toxic grades of depolymerised natural rubber and latex starting with natural rubber field latex. A method to manufacture depolymerised rubber is already known but the process involves the use of costly and highly toxic chemicals in a sophisticated reactor, under carefully controlled conditions. Our method does not need elaborate equipment to produce this highly vlaue added speciality rubber.

TPNR : Work on commercial implementation of Thermoplastic Natural Rubber was continued. *TPNR* coagulating pans were manufactured and distributed among the Group Processing Centres. About 200 coagulating pan (Rs. 45/-) each and 15,000 latex collecting cups (Rs. 2,50 each) were sold to rubber manufacturer who were satisfied with the trials. Further orders for coagulating pans have been undertaken.

A hand injection moulding machine of value Rs. 15,000 has been recommended to manufacture items like plug tops and bases, soap dishes, bowls, mirror holders etc.. out of *TPNR*. Due to the low cost, this technique can be implemented among

the Janasaviya recipients to turn out small items out of TPNR. The production of ceiling roses out of TPNR by using the above technique is in operation by a small scale industrialist.

Positex: Two large samples of positex have been dispatched overseas through Sherman Sons. Positex can now be produced at a cheaper price since a manufacturer of industrial grade cetrimide, the most expensive and important chemical used in the manufacture of positex, has been located. Positex can also be used as a binder for cement and to improve the bond strength between cement and metal.

STAFF

Overseas Visits

Miss M. S. Ranasinghe, Assistant Botanist resumed duties on 29 May after 24 months post-graduate studies. She is scheduled to leave the country again after 04 months to continue post-graduate studies for a period of 12 months.

Mr. V. H. L. Rodrigo, Research Assistant (Intercropping) resumed duties on 29 September after undergoing post-graduate studies in UK.

Dr. (Mrs.) G. P. W. P. P. Seneviratne, Assistant Botanist resumed duties on 1 March after completing her post-graduate studies in Tissue Culture at the University of Bath, England.

Dr. (Mrs.) K. G. K. de Silva, Head of Polymer Chemistry Department resumed duties on 6 May after her visit to McMaster University in Hamilton, Canada on sabbatical leave.

Mr. M. T. Warnakula, Assistant Bio-Chemist left for Australia to undergo a training course for a period of 27 months from 23 April. He resumed duties on 14 August. He is scheduled to leave the country again on 17 February to continue post-graduate studies.

Mr. K. B. A. Karunasekera, Experimental Officer visited UK to undergo a training under a UK Technical Assistance Co-operation Training Programme at the University of Birmingham and Reading during the period 25 July to 23 December.

Mr. H. N. K. K. Chandralal, Experimental Officer left for Japan for a period of one year to undergo a training in Nuclear Energy Research at the Takasaki Radiation Chemistry Research Establishment, Japan during the period 13.11.1991 to 12.11.1992.

Mr. K. A. G. B. Amaratunga, Senior Technical Officer left for UK for a period of 14 months to undergo a training under a UK Technical Assistance Training Programme at Luton College of Higher Education, UK, commencing 14 September.

Mr. A. H. R. Jayaratne, Assistant Plant Pathologist continued his post-graduate studies at the University of Sheffield, UK.

Mr. D. P. S. T. G. Attanayake, Assistant Geneticist and Plant Breeder continued his post-graduate studies at the University of Birmingham, U. K.

Mr. H. Talgaswatte, Assistant Agricultural Economist continued his post-graduate studies at the Lincoln University, New Zealand.

Mr. B. P. Weeraratne, Assistant Rubber Chemist continued his post-graduate studies at the University of Loughborough, UK.

Dr. L. M. K. Tillekeratne, Director attended the Annual Meeting of the International Rubber Research and Development Board followed by a Symposium on "Consistency in Rubber" held in Manilla, Philippines during the period 24 October to 2 November.

Dr. N. Yogaratnam, Assistant Director visited Indonesia to attend an Executive Meeting of the Association of Natural Rubber Producing Countries during the period 5 - 7 September.

Mr. C. K. Jayasinghe, Head of Plant Pathology and Microbiology Department visited Brazil to attend an ANRPC Workshop on South American Leaf Blight (SALB) and a Technical Committee Meeting during the period 29 July to 5 August.

Dr. N. E. M. Jayasekera, Head of Genetics and Plant Breeding Department visited Thailand to attend a meeting on Multilateral Clone Exchange Programme during the period 13 - 17 January.

Mr. L. Karunanayake, Assistant Specifications Officer visited Japan to undergo an UNDP/IAEA/RCA Regional Training Course on Radiation Chemistry during the period 13 to 24 May.

Local Training

Mr. P. H. M. U. Herath, Assistant Agricultural Economist is following a training course leading to the award of the MSc at the Post-graduate Institute of Agriculture Peradeniya for a period of one (01) year commencing 01 October.

Mrs. S. I. Yapa, Technical Officer, Mrs. W. C. M. Kuruppu, Senior Technical Officer Miss H. K. D. C. S. Jayawardena, Technical Officer and Mr. K. R. N. Karunatileke, Specification Assistant followed a Diploma Course in Rubber Technology at the Plastics and Rubber Institute for a period of ten (10) months commencing April 1991.

Mr. D. P. Wettasinghe, Technical Officer underwent an in-plant training at the CISIR, commencing 4 November.

No Pay Leave

Dr. L. M. K. Tillekeratne, Director left for Burma on no pay leave for an assignment for a period of 4 months commencing 1 April.

Mrs. E. W. Dhammika, Clerk/typist continued her no pay leave in New Zealand.

Mrs. P. R. Bogahawatta resumed duties on 4 December after completion of no pay leave.

Mrs. K. D. R. Tissera, Clerk/typist left for Australia on no pay leave for a period of 3 months from 14 October, to join her husband.

Mr. S. W. Karunaratne, Deputy Director (Research) resumed duties on 2 September after completion of no pay leave.

The salarised staff of the Institute at the end of year (1991) was as follows;—

Director	..	01
Deputy Director (Research)	..	01
Assistant Director	..	01
Officers in Grade I-VI	..	45
Officers in Grade VII-XIII	..	123
Officers in Grade XIV-XVI	..	96
		<hr/>
		267
		<hr/>

VISITORS

Visitors to the Institute included ;

Mr. Jean Campaignollo, Paris, France
Mr. Alan Green, Peterborough
Mr. Chen Elmven Lin, Beijing, China
Mr. Hans Bruins, Holland
Mr. Lno Misrgquwan, China
Mr. Patrick Corish, England
Dr. Johita Valentin, Romania
Mr. Joachim Groger, Germany
Miss Kristen Schioder, Germany
Miss Ilka Geerny, Germany
Mr. P. Rowwhite, England
Mr. J. A. Comyn, England
Mr. Joshim Mathens, Malaysia
Mr. Peter J. Bliss, Australia.

REVIEW OF THE PLANT SCIENCE DEPARTMENT

BY

A. NUGAWELA

SUMMARY

Studies conducted to investigate low yields in Rubber Plantations reveal that around 25 per cent of the stand is lost during the immature phase and a further 20–25 per cent of the remaining trees are lost during exploitation due to dryness. The original stand is therefore reduced by about 50 per cent and this is responsible for very poor yield per hectare.

The response to low frequency tapping with stimulation is different in different clones. Some clones give yields comparable to the conventional $\frac{1}{2}S$ d/2 system. High yielding tapping systems reduce the girdling of plants. Tapping time was found to be similar for both Jebong and Push knives. Apron type pleated polythene rainguards were effective upto a year from fixing and gave 70 extra tapping days during this period.

Agroclimatic conditions do not have an influence on the incidence of Tapping Panel Dryness. Though genotypic differences exist dryness is not necessarily high in high yielding clones. Under poor management conditions the incidence of dryness increases significantly.

Intercropping with banana and pineapple has not retarded the growth of rubber plants during the two years tested.

More than 20,000 budded stumps from 17 clones were issued to State Sector nurseries for the establishment of budwood nurseries.

Though *Hevea brasiliensis* leaves developed under low light have a relatively low CO₂ assimilation rate, the optimum rates are maintained for a major part of the day giving a daily integral comparable to that of sun leaves.

DETAILED REVIEW

Dr. (Mrs.) C. Samaranyake, Head of Plant Science Department resigned from the Rubber Research Institute with effect from 31st January 1991. Dr. A. Nugawela was appointed Head of Plant Science Department with effect from 20th May 1991. Mr. L. S. S. Pathiratna, Assistant Botanist was on duty throughout the year. Mr. R. B. Guneratne, Experimental Officer, Mr. L. S. Kariyawasam, Senior Technical Officer Messers R. P. Karunasena, U. S. Weerakoon, Mrs. C. W. Ranasinghe, Mrs. G. A. S. Wijesekera, Mrs. R. K. Samarasekera Technical Officers, Mr. S. Wilbert, Experimental Assistant were on duty throughout the year. Mrs. D. E. Jayawardena, Clerk/Typist was on maternity leave from 05.08.1992 to 03.12.1992.

Dr. (Mrs.) G. P. W. P. P. Seneviratne, Assistant Botanist, returned on the 1st March after successfully obtaining a PhD from University of Bath, England. She was promoted to Senior Staff grade II with effect from 1st March. Miss M. S. Ranasinghe, returned from University of New England, Australia on the 29th May, to continue her post graduate studies. Mr. V. H. L. Rodrigo, Assistant Botanist, returned on the 24th September after successfully completing his MSc at University of Essex, England.

Mr. K. A. G. B. Amaratunge, Senior Technical Officer, proceeded to UK for a training on instrumentation.

Mr. L. S. Kariyawasam was promoted to Experimental Officer with effect from 29th April. Mr. S. Wilbert was promoted to Senior Experimental Assistant and Mr. R. P. Karunasena to Senior Technical Officer with effect from 6th June and 9th July respectively.

Messers M. K. P. Perera, A. M. A. Samarakoon and T. U. K. Silva, were appointed Technical Officers with effect from 1st March. Miss G. M. M. de Soya and Mr. M. de Alwis Technical Officers appointed on the 4th March and 21st May respectively.

Messers S. L. G. Ranjith and R. S. Wijesundara, Technical Officers were transferred to the Rubber Chemistry Department, Ratmalana on their request, with effect from 8th March.

Research Students

Mr. P. M. Ariyawansa, under graduate student from Ruhuna University completed his final year project on the "Effect of shade on dry matter yield determinants of *Hevea brasiliensis* (Muell. Arg.) Plants" under the supervision of Dr. A. Nugawela. Mr. D. C. Abeysinghe, under-graduate student from Peradeniya University completed his final year project on the CO₂ assimilation rates and related parameters of Rubber (*Hevea brasiliensis*) plants grown under different light regimes under the supervision of Dr. A. Nugawela.

Visits

Department staff made advisory visits to Plantations and smallholdings and regular visits to experimental sites.

Meetings and Conferences

The Head of Department, Dr. A. Nugawela attended a workshop on "Agricultural Research Management" during 5th - 20th February at PGIA, Peradeniya.

The Head of Department addressed the Superintendents and Assistant Superintendents of the regions indicated on the following.

Planting material and management of nurseries	..	(Kegalle Region)
Replanting cycle	..	(" ")
Nursery management	..	(Kalutara ")
Exploitation	..	(" ")

Training Programmes

Department staff were involved with the following programmes.

1. Field day for the Planting Executives in Ratnapura and Galle regions.
2. Nursery management for Private Commercial Nursery owners.
3. Rubber Extension Officers on the Adaptive Research Programme.
4. Training of budders for PCN and State Plantations.

Publications

Pathiratne, L. S. S., Waidyanatha, U. P. de S. and Peries, O. S (1990.) Utilization of phosphorus from appetite and growth of plants inoculated with vesicular arbuscular mycorrhiza and phosphate dissolving bacteria. *Jl. Rubb. Res. Inst. (In Press)*.

Rodrigo, V. H. L. (1991). Temperature effects on parameters of the light response occurred from photosynthesis and canopy CO₂ assimilation in field grown maize. MSc Thesis, University of Essex, England.

Seneviratne, G. P. W. P. P. (1991), Micropropagation of juvenile and mature *Hevea brasiliensis*. PhD Thesis, University of Bath, England.

Sterling, C. M., Nie, G. Y., Aguilera, C., Nugawela A., Long, S. P. and Baker, N. R. (1991). Photosynthetic productivity of an immature maize crop: changes in quantum yield of CO₂ assimilation, conversion efficiency and thylakoid proteins. *Plant Cell and Environ.* 14, 947-954.

Reports

Samaranayake, Chandra (1990). *Ann. Rev. of the Plant Science Department.*

LABORATORY INVESTIGATIONS

Tissue Culture

Anther Culture

Good callus growth was observed in all clones tested. Anyhow, no somatic embryos were formed on transfer to embryoid formation medium. Studies on media composition are being continued.

Shoot Tip Culture

Contaminations of primary cultures continued to limit the progress of shoot tip culture of clonal material. Thus, use of antibiotics/fungicides to overcome this is being looked into.

Studies were commenced to multiply seedlings obtained through hand pollination programmes, i. e. new genotypes of the Plant Breeding Department. (P. Seneviratne, G. A. S. Wijesekera and G. M. M. de Soysa).

Latex Physiology

Hydrolic measurements

The diurnal variation in environmental factors and physiological parameters related to latex flow were studied in clone PB 86. Preliminary studies do not indicate any systematic diurnal pattern. However, the studies show turgour pressure, serum osmotic potential, leaf water potential, leaf sap osmotic potential to show significant correlations with each other. (M. S. Ranasinghe).

Latex Biochemistry

Latex of clones RRIC 100, RRIC 102, RRIC 101, RRIC 110 and PB 86 subjected to 5 different tapping intensities were analysed for dry rubber yield, dry rubber content and levels of sucrose and proline. Sucrose and proline levels were significantly correlated. (M. S. Ranasinghe).

Tapping Panel Dryness

Bark Anatomy

In trees fallen dry (TPD), as a result of few tappings after opening, a greatly reduced number of active latex vessel rings, i.e. 1 or 2 were found. (M.S. Ranasinghe).

Gas Exchange Studies

In canopies of mature plantations a significant percentage of leaves are found under limiting light levels. To investigate the contribution of these shade leaves

towards total dry matter production of the plant their gas exchange parameters were compared with those of sun leaves. Polybag plants of genotype RRIC 121 grown in different light environments were used for the study. In leaves developed at 40% incident light the maximum CO₂ assimilation rate and the total daily CO₂ assimilation are comparable to those of sun leaves. Under 25% of incident light the maximum CO₂ rate and the total daily CO₂ assimilation rate and the total daily CO₂ assimilation are only slightly less than in sun leaves. Shade leaves maintain their peak CO₂ assimilation rates for a major part of the day.

(A. Nugawela, P. Ariyawansa, C. Abayasinghe, R. K. Samarasekera).

FIELD EXPERIMENTS

Tapping

Interaction of Clones and Tapping Systems- St. George (CT/77/3).

Tapping systems are being tested on 13 genotypes to ascertain the most suitable tapping system for the clones tested.

No significant interaction of clones and tapping systems on yield was observed. The tapping system 2 x $\frac{1}{2}$ S d/3 gave significantly high yields per tree per tapping (g/t/t). Anyhow the estimated total annual yield per tree per annum (kg/t/year) is similar to that of $\frac{1}{2}$ S d/2 (Table 1).

Table 1. *The mean yields per tree per tapping (g/t/t) and estimated total annual yield per tree per tapping (kg/t/year) from different tapping systems.*

Tapping System	Yields	
	g/t/t	kg/t/year
2x $\frac{1}{2}$ S d/3	55.5	6.66
$\frac{1}{2}$ S d/3	40.3	4.84
$\frac{1}{2}$ S d/2	34.5	6.21
$\frac{1}{2}$ S d/2 + E*	31.4	5.65
PT** d/2	31.3	5.63

*E 5% ET, Ba 0.8(2.5) 4/y

PT**5% ET, Ga 0.8 (2.5)m

Girthing of the tree is significantly influenced by the tapping system. Generally, girthing is poor in tapping systems with stimulation and in high intensity tapping systems. (Table 2).

Table 2. The mean girth of plants tapped under different intensities

Tapping System	Girth
$\frac{1}{2}S$ d/3	69.2 A
$\frac{1}{2}S$ d/2	68.4 A B
PT** d/2	67.2 C B
$\frac{1}{2}S$ d/2 + E*	67.1 C B
2 x $\frac{1}{2}S$ d/3	65.9 C

(Mean with same letter are not significantly different)

(A. Nugawela, L. S. S. Pathiratne and C. W. Ranasinghe)

Low Frequency Tapping Systems and Clones – Eladuwa (F/76/5)

Three tapping systems are being tested on 3 genotypes, i. e. PB 86, RRIC 100 and RRIC 101 to identify the most cost effective exploitation system for the clones tested. Low frequency tapping systems with stimulation are being looked at to reduce tapping costs. (Table 3).

Table 3. The mean yields (g/t/t) for different clones and tapping systems. Given within the parenthesis are estimated yields per tree per annum (kg/t/year)

Clone	Tapping System		
	$\frac{1}{2}S$ d/2	$\frac{1}{2}S$ d/3	$\frac{1}{2}S$ d/4 + E*
PB 86	23.5 (4.23)	23.9 (2.87)	44.8 (4.03)
RRIC 100	34.2 (6.16)	39.3 (4.72)	50.9 (4.58)
RRIC 101	19.4 (3.49)	29.0 (3.48)	44.0 (3.96)

*E 5%ET, Ba 0.8(2.5) 4/y.

Clones PB 86 and RRIC 101 have given comparable yields from tapping systems $\frac{1}{2}S$ d/2 and $\frac{1}{2}S$ d/4 + E* (Table 3). The response to low frequency tapping with stimulation is poor in genotype RRIC 100. The girthing of trees tapped on systems $\frac{1}{2}S$ d/2 and $\frac{1}{2}S$ d/4 + E* are comparable (Table 4).

Table 4. Mean girth (cm) of trees tapped using different systems.

Clone	Tapping system		
	$\frac{1}{2}S$ d/2	$\frac{1}{2}S$ d/3	$\frac{1}{2}S$ d/4 + E
PB 86	63.4	61.1	62.5
RRIC 100	68.4	68.6	67.8
RRIC 101	64.9	61.8	62.0

(A. Nugawela, S. Wilbert and T. U. K. Silva)

Low Frequency Tapping (LFT)

The objective of the experiments conducted on this subject is to evaluate the response of newly recommended clones to low Frequency Tapping together with stimulation. Low Frequency Tapping with Stimulation may reduce tapping costs whilst increasing the tapping cycle.

RRIC 100, 1991 Replanting - Gallewatta (LTT/88/1)

The mean dry rubber yields per tree per tapping (g/t/t) and estimated total annual yield per tree (kg/t/year) based on the theoretical maximum possible tapping days per year are given in Table 5.

Table 5. *The mean g/t/t yields and estimated total annual yields tree, kg/t/year for different tapping systems tested in clone RRIC 100.*

Tapping System	Yields	
	g/t/t	Kg/t/year
$\frac{1}{2}$ S d/2	34.5	6.21
$\frac{1}{2}$ S d/3 +E*	45.2	5.42
$\frac{1}{2}$ S d/4 +E*	39.6	3.56
$\frac{1}{4}$ S d/2 +E*	25.7	4.63

*E 2.5% ET, Ba 0.8(2.5) 4/y.

$\frac{1}{2}$ S d/3+E and $\frac{1}{2}$ Sd/2 systems gives comparable yields per annum.

The mean girth of trees tapped on different systems and the girth increment during the year 1991 corresponds to the amount of dry rubber harvested from a plant. The girth and girth increment is generally low when amount of dry rubber harvested is high (Table 6).

Table 6. *The girth and girth increment during year 1991 of trees tapped on different tapping systems.*

Tapping System	Girth (cm)	Girth Increment (cm)
$\frac{1}{2}$ S d/2	65.8	2.95
$\frac{1}{2}$ S d/3 +E*	66.8	3.15
$\frac{1}{2}$ S d/4 +E*	67.8	3.45
$\frac{1}{4}$ S d/4 +E*	70.2	2.95

*E 2.5% ET Ba 0.8(2.5)4/y

(A. Nugawela, S. Wilbert and T. U. K. Silva)

RRIC 102, 1981 Replanting, Neuchatie (LFT/88/2)

The annual mean dry rubber yield per tree per tapping (g/t) and the estimated total annual yield per tree (kg/t/year) based on the theoretical maximum possible days of tapping per year are given in Table 7.

Table 7. The mean g/t yields and estimated total annual yields per tree kg/t/year for different tapping systems tested in clone RRIC 102.

<i>Tapping System</i>	<i>g/t</i>	<i>kgs/t/year</i>
$\frac{1}{2}$ S d/2	51.9	9.34
$\frac{1}{2}$ S d/3	52.7	6.32
$\frac{1}{2}$ S d/3 + E*	60.0	7.20
$\frac{1}{2}$ S d/4 + E*	55.0	5.5
$\frac{1}{2}$ S d/4 + E*	41.2	7.4

E* 2.5% ETH, Ba 0.8(2.5) 4/y.

$\frac{1}{2}$ S d/2 gives the highest total yields per tree per annum. Of the Low Frequency Tapping Systems tested, $\frac{1}{2}$ S d/3+E* and $\frac{1}{2}$ S d/4+E* gives fairly high yields (Table 7).

The girth and the girth increment during year 1991 is less in tapping systems giving relatively high yields (Table 8).

Table 8. The girth and girth increment during year 1991 of trees tapped on different tapping systems.

<i>Tapping System</i>	<i>Girth (cm)</i>	<i>Girth Increment</i>
$\frac{1}{2}$ Sd/2	64.0	1.73
$\frac{1}{2}$ Sd/3	65.4	2.22
$\frac{1}{2}$ Sd/2+E*	63.5	1.33
$\frac{1}{2}$ Sd/4+E*	66.5	4.91
$\frac{1}{2}$ Sd/2+E*	63.5	1.31

E* 2.5% ETH, Ba 0.8 (2.5) 4/y.

(A. Nugawela, K. A. G. B. Amaratunga, S. M. A. Samarakoon)

RRIC 121, 1985 Replanting - Kiriwanaketiya (LFT/91/1)

Low frequency tapping systems tested on LFT/88/1 and LFT/88/2 trials are being tested on RRIC 121, in this trial commenced in mid 1991.

(A. Nugawela, S. Wilbert and T. U. K. Silva)

Girth at Opening

The objective of this study is to find out the possibility of reducing the immature period by commencing tapping at lower girths than the presently recommended 50 cms.

The following trials on opening at lower girths were commenced during the year to find out whether economic yields could be obtained whilst no serious retardation of growth, bark renewal and increase in dry trees which will result in a decline in future yields.

RRIC 100, 1985 Replanting — Dalkeith (TG/91/1)

RRIC 100, 1985 Replanting — Kiriwanaketiya (TG /91/2)

RRIC 100, 1985 Replanting — Eladuwa (TG/91/3)

A tapping block was selected from each of the above clearings. Trees in each tapping block were grouped into the following girth classes.

T₁ — 40 — 44.9 cms

T₂ — 45 — 49.9 cms

T₃ — 50 — 54.9 cms

T₄ — 55 cms and above

Tapping was commenced in trees belonging to the different girth classes and the dry rubber yields, girthing, bark renewal and the number of dry trees are being monitored.

(A. Nugawela, S. Wilbert and T. U. K. Silva)

RRIC 121, 1984 Replanting — Perth (TG/91/4)

Three adjacent tapping blocks were selected and in each tapping block trees were grouped into the above girth classes and the same data are being gathered.

(A. Nugawela, S. Wilbert and T. U. K. Silva)

Low Yields in Rubber Plantations

Despite introducing technology to improve yields, the yield per hectare (YPH) is rather low in both private and public sector Estates. A study was undertaken in a few Estates managed by JEDB and SPC to identify possible reasons for poor yields. The information gathered from the study is summarised in Table 9.

Table 9. *Information related to poor yields gathered from a few Estates managed by SPC and JEDB'*

<i>Estate/ Plantation</i>	<i>Clearing</i>	<i>YPH(kgs)</i>	<i>Stand/Ha</i>	<i>Bark Consumption/Yr.</i>	<i>Dry Trees (%)</i>	<i>Healthy Stand/Ha</i>
1.	PB 86, 1975	673	390	11"	23	300
2.	RRIC 100, 1980	1200	270	10"	18	221
3.	PB 86, 1978	1495	328	8.1"	15	279
4.	RRIC 100, 1973	1428	318	10.2"	50	159
5.	RRIM 600, RRIC 45 1972	838	336	9.4"	28	242
6.	RRIC 100, RRIC 600 1971	1116	265	8.3"	28	191
7.	PB 86, 1976	944	226	8.8"	17	187
8.	RRIC 100, 1983	927	280	7.3"(d/3)	2	275
	Mean	1078	302	9.2"	23	232

In the clearings studied the stand (trees/ha.) ranges from 226 to 390. The mean stand for the clearings studied is 302. Even at 400 trees/ha. this is a 25% decrease in the stand which will result in a 25% decrease in the yield per hectare (YPH). Use of poor quality planting material non-adoption of proper planting technique may be responsible for this. The rate of bark consumption range from 8.1 to 11 inches a year (d/2 frequency). The incidence of dry trees ranges from 15-50%. These observations suggests that intensive exploitation probably to increase the YPH from a poor stand with rather low inputs. In the attempt to achieve this, ca. 23% of the trees in the existing stand have become unproductive due to dryness. Thus, the healthy stand is further reduced. The mean healthy stand of the clearings studied is ca. 232/ha. Tapping cycle of the trees may also be reduced from the recommended 24 years due to over exploitation and is indicated by high bark consumption rates. In the long run this will result in unsuitable mature to immature ratios in the Estates making them uneconomical units.

By adopting proper planting practices and using quality planting material 100% field establishment could be obtained, resulting in a complete stand. Tapping these trees as recommended with proper agronomic practices the incidence of dryness could be minimised. Thus, a much higher healthy stand giving economic yields could be maintained until uprooting. This will also lead to an ideal mature to immature ratio in the Estate.

(A. Nugawela and R.P. Karunasena)

Tapping Time

Jebong and Push Knife

Two adjacent tapping blocks in a clearing one tapped using the Jebong and the other using the Push knife for about 2 years were selected to study the above. The total time and the actual tapping time to exploit 100 trees in each block were determined (Table 10).

Table 10. *The total and actual time taken to exploit 100 trees using the Jebong and Push knife. The actual time expressed as a percentage of the total time is given within brackets.*

Knife	Observation	Total time(mts)	Actual time(mts)
Jebong	1	45	16
	2	41	15
	mean	43	15.5(36%)
Push	1	38	15
	2	44	16
	mean	41	15.5 (37%)

It is apparent that the actual tapping time is similar for both Jebong and Push knives, 36 and 37 percent of the total time respectively. The highest point of the tapping cut was 137 and 120 cms in blocks tapped with Jebong and Push knives respectively. The rest of the time, a major part is spent on removing tree lace, cleaning collecting cups and walking from tree to tree.

(A. Nugawela and R. P. Karunasena)

Square and Avenue Planting

In a separate study it was found that the time spent on walking from tree to tree during tapping is about 35 and 24 percent of the total time taken to tap a block in a square, i.e. 12' x 20' and avenue, i. e. 8' x 30' planted areas respectively. Thus tapping time could be slightly reduced by avenue planting. This is because the relatively short distance the tapper has to walk in avenue planted areas.

(A. Nugawela and R. P. Karunasena)

Tapping Panel Dryness (TPD)

A survey on the incidence of Tapping Panel Dryness (TPD) was conducted to find out the genotypic differences, the influence of environmental conditions and management practices on the development of this disorder. The genotypes RRIC 100, PB 86 and regions Kegalle (Dry), Kalutara (Wet) and Ratnapura (Wet) were selected

for the study. In each region, from a genotype clearings tapped for ca. 3 (Panel BO-1), 9 (Panel BO-2) and 15 (Panel BI-1) years were selected. In each clearing two adjacent tapping blocks were selected for the survey in an attempt to study the influence of the tapper. Information on incidence of dry trees, bark consumption rates and girth were collected from each clearing.

There is no evidence to suggest that TPD is high in either dry or wet regions (Table 11). Thus other factors influencing this disorder may exist.

Table 11. *The percentage incidence of dryness in genotypes PB 86 and RRIC 100 tapped on panels BO-1 BO-11 and BI-1 and grown in dry (D1) and wet (W1 and W2) regions. (Each value given is the mean of 6 observations).*

Genotype	Panel	Region and % incidence of dryness		
		Kegalle(D1)	Kalutara(W1)	Ratnapura(W1)
PB 86	BO-1	2.4	1.8	5.9
	BO-2	7.7	6.3	19.4
	BI -1	20.5	9.2	11.5
	Mean	10.2	5.8	12.3
RRIC 100	BO-1	7.7	1.0	0.8

Data available on genotype RRIC 100 is not sufficient compare the incidence of dryness of the two genotypes. Anyhow, information collected from Genotype Environment trials of Plant Breeding Department suggests that genotypic differences exist (Table 12).

Table 12. *The percentage incidence of dryness of different genotypes grown in dry (D1) and wet (W1 and W2) regions. (Each value is the mean of 10 observations)*

Genotype	Regions and percentage incidence of dryness			Means
	Kegalle(D1)	Kalutara(W1)	Ratnapura(W2)	
RRIC 36	17.9	33.3	7.1	19.4
RRIC 52	22.6	33.3	16.7	24.2
RRIC 100	20.0	14.3	20.6	18.3
RRIC 101	41.4	25.9	13.3	26.9
RRIC 102	37.5	14.3	21.6	24.5
RRIM 600	33.3	17.7	13.8	21.6
RRIM 623	30.3	33.3	16.7	26.8
IAN 47/710	12.1	12.5	31.3	18.6
PB 86	21.4	18.5	11.4	17.1
(Mean	26.3	22.6	16.9)	

(Data gathered from G & E Trials of Plant Breeding Dept.)

It appears that incidence of dryness is not necessarily high in high yielding genotypes.

Within a region either dry or wet, a marked variation in the incidence of dryness exist even though the genotype, age are similar. (Table 13).

Table 13. *The variation in the percentage incidence of dryness in PB 86 clearings tapped on panels BO-1 BO-2 and BI-1 within the different regions i. e. D1, W1 and W2*

Region	Panel and Variation in incidence of TPD		
	BO-1	BO-2	BI-1
Kegalle (D1)	1.3-3.3	1.4-17.3	14-30
Kalutara (W1)	0-4.0	4.9-10.0	2.4-14.7
Ratnapura (W2)	2.2-7.5	4.3-31.2	5.2-21.7

Difference in management practices soil conditions may be responsible. Case studies show clearings with exceptionally high bark consumption to have high percentage of dry trees.

Within a clearing between 2 adjacent tapping blocks the incidence of dryness could be either similar or highly variable (Table 14).

Table 14. *The variation in TPD in adjacent tasks of same clearing tapped by different tappers.*

Panel	Variation in TPD
BO-1	2.8- 3.9
BO-2	9.4-12.3
BI-1	11.4-16.6

Further, within a task some trees fall dry where as others remain healthy. It is clear that the occurrence of this disorder is highly unpredictable and are randomly distributed within a clearing.

Tapping significantly retards vegetative growth as dry matter produced is partitioned towards latex biosynthesis. Serious retardation of vegetative growth of the plant may cause dryness by a mechanism in the plant to stop latex biosynthesis. Poor management practices, i.e. no fertilizer application, over exploitation can make trees more vulnerable to this disorder. In a clearing there is variation amongst the individual plants when the growth and yields are concerned. In a clearing trees in which relatively more dry matter is partitioned towards latex production or trees in which the total dry matter production is less may succumb to dryness.

(A. Nugawela, R. P. Karunasena and S. Wilbert.)

Rainguards

Apron Type

Apron type pleated polythene rainguards were fixed in a 10 ha. field at Gallewatta Division, Dartonfield Estate. The rainguards lasted one year. During this period 70 extra tapping days were recorded. The material and labour cost per rainguard was Rs. 5.00. At 30 g. of dry rubber per tree per tapping the additional tapping days (70) because of rainguards would yield ca. 2.1 kgs of dry rubber per tree.

Gutter Type

Two gutter type rainguards, one rubber based developed by the Raw Rubber Department and the other made of polythene are being tested using the same sealant.

(A. Nugawela, R. P. Karunasena and S. Wilbert)

Planting Material and Techniques

Young buddings

Studies were initiated in August–September 1991 to find out whether the maturity of top whorl of the seedlings grown in polybags for young budding has an effect on the grafting success. The grafting success of scale buds and axillary buds of 7–8 week old shoots are also compared. The young buddings obtained from this study will be used to investigate whether growth of scion could be improved by using a larger polybag, having a long snag and by leaving a few snag leaves.

(P. Seneviratne, A. Nugawela, A. M. A. Samarakoon and G. de Soysa)

Planting Techniques — Padukka (PT/91/1)

The following planting material of clone RRIC 121 were planted according to a randomized block design during the south west monsoon in 1991 in a 3 ha. block.

1. Two whorled young buddings
2. Two whorled brown buddings
3. Bareroot brown buddings
4. Bareroot green buddings

The establishment success of two whorled young buddings and brown buddings were 100 percent. That of bare root brown and green buddings were 88 and 96 percent respectively. Their growth rates are being monitored.

A similar experiment is planned to be established during the South West in 1992. The following planting material will be tested in this experiment.

1. Two whorled young buddings
2. Two whorled green buddings
3. Two whorled brown buddings

4. Bare root brown budded stumps
5. Bare root green budded stumps

Nurseries have been established to obtain the above material.

(A. Nugawela and S. M. A. Samarakoon)

Intercropping

Coffee and Pepper—Padukka (IC/87/1)

The objective of this experiment is to study the feasibility of growing coffee and pepper among rubber in the low country wet zone. Experimental details are given in Ann. Rev. 1987. The establishment rate of Coffee and Pepper is ca. 95 and 60 percent respectively. The establishment rate is markedly low for Pepper. Both crops were in bearing during the year. Anyhow, yields could not be recorded due to theiving.

(V. H. L. Rodrigo and L. S. Kariyawasam)

Grass—Legume Systems—Neuchatel (IC/GL/91/1)

The objective of this experiment is to study the feasibility of growing forage grass—tree legume systems among rubber during its immature phase. Clone RRIC 100 was planted at a spacing of 2.4m X 9m. Two grass species, i. e. *Panicum maximum* var Guniea B and *Bracharia brizantha* and two tree legume species, i.e. *Leucenia leucocephala* and *Gliricidia* were planted in rubber interrow as follows:

1. Rubber X *Pueraria* (Control)
2. Rubber X *Panicum*
3. Rubber X *Bracharia*
4. Rubber X *Gliricidia*
5. Rubber X *Leucenia*
6. Rubber X *Panicum* X *Gliricidia*
7. Rubber X *Panicum* X *Leucenia*
8. Rubber X *Bracharia* X *Gliricidia*
9. Rubber X *Bracharia* X *Leucenia*

The experimental design is randomised blocks with four replicates. Planting was done during SW 1991. Establishment of *Bracharia brizantha* was superior to *Panicum maximum* var Guniea B. The establishment and initial growth of tree legumes and *Pueraria* were poor.

(L. S. S. Pathiratne and M. K. P. Perera)

Cocoa and Cinnamon — Dartonfield (IC/CC/91/2)

The objective of this experiment is to study the feasibility of growing Cocoa and Cinnamon as intercrops among rubber in the low country wet zone. Clone RRIC 121 was planted at a spacing of 2.4m X 9.0m. Cocoa and Cinnamon will be planted in rubber interrow as follows:

1. Rubber only
2. Rubber x Cinnamon (Cinnamon 5' away from rubber, spacing 4' x 2')
3. Rubber x Cinnamon (Cinnamon 7' away from rubber, spacing 4' x 2')
4. Rubber x Cinnamon (Cinnamon 9' away from rubber, spacing 4' x 2')
5. Rubber x Cocoa (Spacing of Cocoa 30' x 8')
6. Rubber x Cocoa (Spacing of Cocoa 30' x 12')
7. Rubber x Cocoa (Spacing of Cocoa 30' x 16')

Shade trees required for Cocoa were established during SW in 1991. Planting of Cocoa and Cinnamon will be undertaken during SW in 1992.

(L. S. S. Pathiratne, M. K. P. Perera).

Intercropping Systems, Demonstration Plots—Dartonfield (IC/DP/91/1)

The following different intercropping systems were established during the NE in 1991. Cocoa, Cinnamon, Cardomons and Pepper of these systems will be planted in SW monsoon in 1992.

1. Rubber x Banana x Cocoa
2. Rubber x Coffee x Gliricidia x Wingbean
3. Rubber x Passionfruit x Pineapple
4. Rubber x Gliricidia x Pepper x Cardemon
5. Rubber x Banana x Papaw
6. Rubber x Banana x Cinnamon
7. Rubber x Grass x Ipil-Ipil
8. Rubber x Vegetables

(V. H. L. Rodrigo, L. S. S. Pathiratne, L. S. Kariyawasam and M.K.P. Perera)

Nursery Inspection Unit

Budwood multiplication nurseries of private commercial nursery owners were inspected for the issue of permits by the Rubber Control Department. During the year hundred nurseries were inspected and inspection reports were submitted to the Rubber Control Department.

During the early part of the year Budwood nurseries of the State Plantations in Kalutara Region were inspected to check the authenticity of clones and to advice on the upkeep.

The nucleus material to all Budwood nurseries in the country is now being supplied by the Institute as budded stumps.

During the SW 1991 budded stumps of the following clones were issued to the JEDB and SPC managed Estates.

RRIC 100	RRIC 121
RRIC 102	RR:C 130
RRIC 110	PB 28/59
RRIC 117	PB 217

The number of plants issued to each region are given below.

<i>Region</i>	<i>No of plants</i>
Kegalle	1285
Avissawella	3675
Galle	820
Ratnapura	2331
Kalutara	1450
Total	<u>9561</u>

During the NE in 1991 budded stumps of the following clones were issued to estates managed by the JEDB and SPC.

PB 217	PR 255
PB 235	PR 261
PB 255	PR 305
PB 260	BPM 24
RRIM 712	RRI 105

The number of budded stumps issued to each region are given below.

<i>Region</i>	<i>No of plants</i>
Kegalle	1800
Avissawella	1200
Galle	1200
Ratnapura	1550
Kalutara	1255
Total	<u>7305</u>

Private commercial nursery owners were issued with 2750 RRIC 100 and 700 RRIC 102 budded stumps during the year to establish Budwood Nurseries.

(A. Nugawela, R. B. Gunaratne, U. S. Weerakoon and M de Alwis)

Adaptive Research Programme

Work done by this Department on this programme is reported under the Review of the Adaptive Research Unit.

REVIEW OF THE PLANT PATHOLOGY AND MICROBIOLOGY DEPARTMENT

By

C. K. JAYASINGHE

SUMMARY

Wintering and refoliation protracted over a few months. The wet weather experienced during this period resulted an attack of *Oidium* leaf disease especially at higher elevations. The diseases caused by *Phytophthora* spp. were negligible. Several polybag nurseries were severely affected with *Corynespora cassiicola* regardless of the type of the clone. However, no new clones were reported to be affected with *C. cassiicola* in the field.

White Root disease caused by *Rigidoporus lignosus* is still the main cause of crop loss in rubber plantations. This situation was aggravated with the withdrawal of the recommended fungicide PCNB in 1989 due its carcinogenic properties. Results of the experiments carried out during this year revealed that Penta Chloro Phenol (PCP) could be used economically to control WRD provided that fungicide is applied at early stages of infection.

The operation on eradication of CLF in smallholdings was reassumed on 1st of June 1991 and 54 new permits were issued to cover around 75 acres after inspecting 90 clearings.

Dithane M 45 (new formulation) at a concentration of 3% ai was found to be effective as a prophylactic treatment in the management of Bark Rot.

The Collar Rot of *Hevea* seedlings, first reported in 1987 was spread again during this year. Two fungicides namely Formalin (0.12% ai) and Folicur (0.06% ai) were recommended to control the disease. Moist heat was also proved to be very effective as a prophylactic measure.

Eight *Hevea* clones viz. HP 74-194, HP 74-213, PB 28/59, RRIM 600, PR 255 PR 235, PB 260 and RR11 105 were established at 13 sites to screen for leaf and panel diseases.

Hevea seedlings showed the highest susceptibility to Bird's Eye Spot disease when different clones were screened using the crude toxin produced by *Drechslera heveae*.

A similar condition to Target Leaf Spot disease of *Hevea*, a serious leaf disease in South America was discovered in *Hevea* seedlings in Sri Lanka and disease causing organism was authenticated as *Thanatephorus cucumeris*

DETAILED REVIEW

Staff

Mr. C. K. Jayasinghe, Acting Head of Plant Pathology and Microbiology Department was appointed as the Head of Plant Pathology and Microbiology Department with effect from 30th July 1991.

Asst. Plant Pathologist, Mr. R. Jayaratne continued working for his post-graduate work at the University of Sheffield in U.K. Mr. K. E. Jayasuriya and Miss. W. P. K. Silva, Asst. Plant Pathologists continued to work in the Department.

Technical Officers, Messrs. S. S. Warnapura and E. A. T. Senadheera were transferred to the Rubber Technology Department and Advisory Services Department with effect from 11th March 1991 and 6th March 1991 respectively.

Experimental Officers, Messrs. W. Amaratunga, S. Wettasinghe and E. B. Fernando, Technical Officer Mrs. J. L. P. C. Wettasinghe, who was promoted as Senior Technical Officer on 9th July 1991. Technical Officers Miss B. I. Fernando and Miss T. H. P. S. Fernando who assumed duties on the 1st of March and Clerk Typist Mrs. P. Amarasékera were on duty throughout the year.

Research students

Miss. W. R. M. Karunaratne from the Ruhuna University worked for five months under C. K. Jayasinghe's supervision for the final year research project entitled "Toxin production by *Drechslera heveae*".

Overseas visits

Mr. C. K. Jayasinghe attended ANRPC Workshop on South American Leaf Blight (SALB) disease and 8th Meeting of the ANRPC Technical Committee on SALB held in Brazil from 29th July to 6th August 1991.

Training

Messrs. C. K. Jayasinghe, K. E. Jayasooriya and Miss. W. P. K. Silva involved in training students from Hardy Technical College, Ampara.

Lectures/Seminars

Mr. C. K. Jayasinghe, continued to be an external lecturer in the Ruhuna University.

Messrs. C. K. Jayasinghe, K. E. Jayasooriya and Miss. W. P. K. Silva involved in training Superintendents and Asst. Superintendents of JEDB and SLSPC for the Diploma in Plantation Management.

Committee

Mr. C. K. Jayasinghe served as a member of Pesticide Formulary Committee.

Visits

The following visits were undertaken by the staff of the Department.

Experimental	186
Advisory	120
Miscellaneous	106
Total	412

GENERAL

Wintering was protracted over a few months due to the wet weather conditions that prevailed during early months of 1991. Consequently, refoliation was also staggered and a mild attack of *Oidium* was evident in many areas, especially at higher elevations. Several polybag nurseries were found to be severely affected with *Corynespora cassiicola* regardless of the type of the clone. Hence, an interim circular entitled "Control of Nursery Diseases" was sent to JEDB, SLSPC, ASD and RCD in January, 1991 requesting them to be vigilant of nursery diseases and to follow our recommendations strictly.

The incidence of secondary leaf fall caused by *Phytophthora* spp. and of Bark Rot caused by the same fungus was very light during the monsoon period, presumably due to the low pod set in *Hevea* plantations during the period under review.

Eventhough, an interim circular was sent to public sector estates in the first quarter requesting them to be vigilant of nursery diseases, considerable number of polybag nurseries from Kalutara, Ratnapura and Galle Districts were reported to be severely affected with CLF disease. All the affected nurseries were visited and necessary advice were given.

The operation on eradication of CLF disease in smallholdings which was terminated in May 1989 was reassumed on 1st of June 1991 as a response to a request made

by the Review Committee. All the Public Sector Estates which requested for advice on CLF disease were visited and methods adopted to overcome this problem were explained.

The collar Rot of *Hevea* seedlings caused by *Sclerotium rolfsii*, first reported in 1987 was brought to our notice again during this year. Necessary action was taken immediately to eradicate the problem wherever the disease was detected.

A similar condition to Target Leaf Spot disease of *Hevea* a serious leaf disease in South America was discovered in *Hevea* nurseries in Sri Lanka and disease causing organism was authenticated as *Thanatephorus cucumeris* with the kind assistance of IMI, U.K.

LABORATORY AND FIELD INVESTIGATIONS

Chemical Control of Economically Important Diseases of *Hevea* (CC/89/1)

(A) New fungicides for control of Bark Rot.

New formulations of two fungicides namely Dithane M 45 and Folpet which were found to be potential fungicides to control Bark Rot during trials conducted in 1990 were screened at Ambanpitiya Estate, Kegalle. New formulations were obtained incorporating organic compounds and talc with the collaboration of Specifications and Analysis Department.

Field experiments were performed using virgin panels of the clone PB 86 and experiments were designed to find both prophylactic as well as the curative effects of the chemicals. The recommended fungicides Brunolinum plantarium and Sandofan paste and common wound dressing Candarson were also used as controls.

The results of the experiments conducted to evaluate the prophylactic activity revealed that Dithane M 45 at a concentration of 3% ai can prevent the disease incidence significantly ($P=0.05$) compared to the control. But no conclusion was made from the results of the curative treatments as observations of these experiments varied markedly. However, results of the both curative and prophylactic experiments reaffirmed the effectivity of Sandofan Paste in controlling the Bark Rot. (C.K. Jayasinghe and E. B. Fernando).

B) Screening of fungicides against *Rigidoporus lignosus*

Penta Chloro Nitro Benzene (PCNB) the recommended chemical for White Root disease was suspended during the year 1989 with the discovery of its carcinogenic properties. Hence a series of experiments was conducted with three fungicides namely Bayfidan, Bayleton and Penta Chloro Phenol (PCP) to find an alternative for PCNB. The results of *in vitro* experiments revealed that all these fungicides can check the growth of the fungus very effectively.

Observations of the *in vivo* trials indicated that treatment success totally depended on severity of infection at the time of fungicide application and rate and frequency of fungicide applied. The degree of infection at the collar appeared critical to treatment success. None of the chemicals proved to be effective on plants with severe foliar symptoms.

Results of the field experiments carried out with PCP the most economical fungicide revealed that a concentration of 1.0 — 2.0% ai is effective in controlling White Root disease provided that fungicide is applied at early stages of infection. Eventhough another 9-12 months observations are necessary to make firm conclusions, steps have been already taken to distribute PCP among the affected holdings considering the severity of the problem. The approval of the Pesticide Formulary Committee was also obtained to recommend PCP in a bituminous base as a collar protectant. (C.K. Jayasinghe, K. E. Jayasuriya and T. H. P. S. Fernando)

(C) Screening of fungicides against Collar Rot.

Collar Rot of *Hevea* seedlings caused by *Sclerotium rolfsii* was spread again in the years 1990 and 1991 devastating a considerable amount of seedling in affected germination beds.

On the light of this situation a series of new experiments was conducted to find suitable fungicides to control Collar Rot of rubber seedlings.

In vivo fungicides were screened as soil drenching chemicals on artificially inoculated *Hevea* seedlings. Fungus was multiplied in 150 g. of Cornmeal-sand medium for 12 days and used for the inoculation purposes. In one set of experiments inoculum was added before the germination of seeds while in the other set of seeds just about to germinate were used. Soil drenching was done with different fungicides namely Anthracol (0.2% ai), Benlate (0.2% a.i.), Captan (0.2% a.i.), Cobox (0.2% a.i.) Thiram (0.2% a.i.), Formalin (0.5% a.i.) and Folicur (0.25% a.i.) in water suspensions at the rate of 200 ml. per pot. A traditional burning of soil using a mixture of paddy husk and straw was included as another treatment in the second set of experiments and seeds were sown only after 24 h. from burning.

The results of these experiments showed that among the fungicides tried, only Formalin and Folicur were effective in controlling the pathogen *in vivo*. None of the other chemicals gave significantly better control of the disease than the untreated check. The burning of soil completely checked the incidence of the disease indicating that it is the most economical way of controlling this disease.

A series of experiments was later conducted using lower concentrations of Formalin and Folicur as the concentrations tried were found to be phytotoxic. Observations of these trials showed that 0.12% a.i. Formalin and Folicur at concentrations below 0.06% a. i. as a soil drench can check the growth of the pathogen completely without

causing any harmful effect to young rubber seedlings. Furthermore it was observed that Formalin enhances the growth of antagonistic flora in the soil where as other fungicides checked the growth of antagonistic flora.

Finally a survey was conducted to find the factors contributed to this sudden outbreak of the collar rot disease in our nurseries. It was revealed that a sand-soil mixture with organic matter has been used to prepare the seed germination beds in the localities where the disease was detected. Hence, attention of the nursery owners was drawn to the correct cultural practices such as use of pure sand without any organic matter during the establishment of seed germination beds as a prophylactic measure. (C.K. Jayasinghe and I. Fernando)

Screening of Clones of Rubber for Leaf and Panel Diseases (SC/89/1)

Eight *Hevea* clones viz. HP 74-194, HP 74-213, PB 28/59, RRIM 600, PR 255, PR 235, PB 260 and RR11 105 were established at thirteen sites during this year for the utilization in future clonal evaluation programmes. Furthermore, arrangements have been made to fill the vacancies of the previously established clones at all sites.

The nurseries are located at

- | | | |
|---------------------------------------|----|-----------------|
| 1. Dartonfield Estate, Agalawatta | .. | |
| 2. Frocester Estate, Govinna | .. | |
| 3. Culloden Estate, Neboda | .. | Kalutara Region |
| 4. Padukka Estate, Padukka | .. | |
| 5. Elston Estate, Puwakpitiya | .. | |
| 6. Meralioya Estate, Ruwanwella | .. | K.V. |
| 7. Muwankanda Estate, Mawanella | .. | |
| 8. Newlands Estate, Aluthnuwara | .. | Kegalle |
| 9. Pallegama Estate, Niyadurupola | .. | |
| 10. Bentota Estate, Elpitiya | .. | |
| 11. Nakiyadeniya Estate, Nakiyadeniya | .. | Galle |
| 12. Doloswela Estate, Nivitigala | .. | |
| 13. Rilhena Estate, Pelmadulla | .. | Ratnapura |

Sixteen RRIC clones namely 100, 101, 102, 109, 110, 111, 112, 113, 114, 115, 116, 117, 119, 120, 121 and 130 were screened against Bark Rot using plug method at five localities viz. Frocester S.P., Govinna, Bentota S.P., Elpitiya, Rilhena S.P., Pelmadulla, Padukka S.P., Madeniya Estate, Warakapola during this year.

Eventhough the reaction of the clones at different sites varied markedly results of the statistical analysis revealed that clones RRIC 112, RRIC 114, RRIC 130 and RRIC 119 are highly susceptible while clones RRIC 100, RRIC 116, RRIC 102 are resistant to Bark Rot. (C.K. Jayasinghe and S. Wettasinghe)

Micro-organisms and Pests Associated with Rubber Plantations (MP/89/1)

1. Studies on potential pathogens of *Hevea* (MP/89/1A)

Biology of *Cylindrocladum* Sp., a potential pathogen *Hevea* in Sri Lanka.

A series of experiments was conducted to find whether the *Hevea* clones present in Sri Lanka are susceptible to *Cylindrocladum* Sp. The results of these experiments revealed that some clones (eg. IAN 873) are highly resistant while clones such as PB 86, RRIC 121 and Tjir 1 are highly susceptible for the disease. (C. K. Jayasinghe and I. Fernando)

11. New records/uncommon pathogens of *Hevea* (MP/89/1B)

(a) Symptoms similar to Web Blight disease were noticed on the leaves of seedlings in seed germination beds of Dartonfield Estate, Agalawatta, and Rubber Control Dept. nursery at Ratnapura. Plants in the seed germination beds as well as in the seedling nursery were found to be affected with the same disease at Urupola nursery, Attanagalla. The causal organism was authenticated as *Thanatephorus cucumeris* (Frank) Donk (*Rhizoctonia solanii* Kuhn anamorph) with the collaboration of IMI, U.K. and pathogenicity was confirmed by fulfilling the Koch's postulates.

Further studies revealed that *Thanatephorus cucumeris* is the pathogen responsible for the Target Leaf spot disease of *Hevea* in South American countries such as Brazil, Peru, Bolivia, Colombia, Guatemala, Costa Rica and French Guyana. The most conspicuous symptoms on the affected leaves was a net work of silvery fungal thread which appears as a thin tissue. The infected leaves may defoliate after few days. Translucent irregular patches on the affected leaves are also appeared during the prolonged wet weather. Studies are in progress. (C. K. Jayasinghe)

(b) The fungal isolate obtained from the lesions of *Hevea* leaves of the clone LCB 1320 was confirmed as *Cochliobolus eragrostidis* (Tsuda and Ueyama) Siven (*Curvularia eragrostidis*) previously not recorded pathogen on *Hevea* in Sri Lanka. (C. K. Jayasinghe and J. L. P. C. Wettasinghe)

(c) An uncommon fungal culture was obtained from the lesions of *Hevea* leaves at Bentota S.P. and further studies on this isolate confirmed that the fungus is *Phomopsis heveae* (Patch) Boedijn. (IMI No. 342169). (C. K. Jayasinghe and J. L. P. C. Wettasinghe)

Biology of Common Pathogens of *Hevea* (BCP/90/1)

1. Studies on the toxin production of *Drechslera heveae*

One of the species of the genus of the *Drechslera*, *D. heveae* produces toxic substances and causes a serious leaf spot disease on *Hevea* seedlings in many rubber

growing areas of the world including Sri Lanka. Present study was undertaken to investigate the toxin production by *D. heveae* in particular to study the reaction of different clones of *Hevea brasiliensis* towards the toxin.

Crude toxin was obtained from six day old cultures of *D. heveae* after incubating in two different media namely Modified Fries medium and Modified *Alternaria* medium. When the fungus was grown on Modified Fries medium markedly higher concentration of the toxin was obtained.

Studies carried out on the toxin clearly showed that the toxin produced by *D. heveae* isolate is thermolabile. When crude toxin was used after autoclaving the lesion areas produce on all the test clones were reduced markedly.

Leaves of the different *Hevea* clones gave varying lesion sizes when treated with the crude toxin. Seedlings showed the highest susceptibility by producing significantly ($p = 0.001$) higher lesion areas compared to all the clones tested. Clones PB 86, RRIC 105, RRIC 104 and RRIC 52 showed a moderate susceptibility while the clones PB 217 and RRIC 121 exhibited a high degree of tolerance. Studies are in progress with different genetic materials of *Hevea brasiliensis*. (C. K. Jayasinghe and W. R. M. Karunaratne).

Biology of Common Pathogens of *Hevea* (BCP/90/1)

(A) Susceptibility of *Hevea* clones to different isolates of *C. cassiicola*.

Fifteen clones of *Hevea* are being tested against 10 isolates of *Corynespora cassiicola*. Marked differences were observed in the reaction of different clones towards the different isolates. The progress of these experiments was extremely slow as the test organism does not produce spores freely under *in vitro* conditions. However, during the latter part of year 1991 a new technique was developed to obtain spores readily by using a dark treatment. (C. K. Jayasinghe, W. P. K. Silva and J. L. P. C. Wettasinghe)

(B) Reaction of different clones towards the toxin produced by *C. cassiicola*.

Different isolates of *C. cassiicola* were grown in modified *Alternaria* Medium and the crude toxin produced by those isolates were tested on apple green leaves of various clones of *Hevea*. A visual rating was given to the reaction (lesion area) produced by each toxin on different clones. Experiments are in progress. (C. K. Jayasinghe and W. P. K. Silva)

Miscellaneous

1. Utilization of bare patches caused by *Rigidoporus lignosus*.

R. lignosus inoculum was prepared *in vitro* and seven plant species namely *Alstonia* sp., *Albizia* spp., *Tephrosia* Sp., *Calliandra* Sp. and *Cinamomum* Sp. were screened against *R. lignosus*. Experiment is in progress (W. P. K. Silva and C. K. Jayasinghe)

2. Operation on eradication of *Corynespora* Leaf Fall disease in smallholdings.

Issuing of the certificates to smallholders to obtain relief payments by RRI staff was reassumed on 1st of June 1991 as a response to a request made by the Review Committee. This operation was launched in all rubber growing areas and at the termination of the programme 54 permits have been issued to cover around 75 acres after inspecting around 90 clearings (Table 1) (C. K. Jayasinghe, K.E.Jayasuriya, W. P. K. Silva, S. Wettasinghe, E.B. Fernando, J. L. P. C. Wettasinghe, S. Fernando and I. Fernando)

Table 1. *Incidence of CLF in Smallholdings*

District	No. of holdings visited	No. of permits issued	Acreage to be uprooted		
			Ac	R	P
Galle/Matara	16	8	20	01	15
Kalutara	23	15	14	03	38
Ratnapura	16	11	09	00	09
Kegalle	12	7	12	00	30
Colombo/Gampaha	19	13	18	01	16
Total	86	54	74	03	28

CLF disease survey in State Plantations

Eventhough this programme was terminated in the year 1987 several new requests have been made during this year. Necessary advice were given and certificates were issued to uproot the affected clearings. (C. K. Jayasinghe, S. Wettasinghe and E.B. Fernando).

REVIEW OF THE SOILS AND PLANT NUTRITION DEPARTMENT

By

LALANI SAMARAPPULI

SUMMARY

Research on improvement of soil fertility, increasing efficiency of nutrient uptake economizing on fertilizer use, improved methods of soil, water and nutrient conservation and weeds and weed control have been the main objective of this Department. Research on analytical methods is another important subject that has been handled by this Department.

Application of potassium at the currently recommended level was seen to increase girthing, irrespective of soil type and clone used, suggesting that the potassium requirement of young immature plants is still not different from the currently recommended rate of 33g/ plant/ year for immature rubber during the first 12 months.

The pattern of occurrence of visual magnesium deficiency symptoms appears to vary between clones. In clone RRIC 102, the yellowing was not contiguous with leaf margin whereas in clone RRIC 121, the development of the interveinal yellowing commenced from the leaf margin.

Girth increment data showed that the rubber trees with mulching were superior to the trees under other management practices such as growing leguminous covers and naturals. As expected, better growth during immaturity resulted in early opening of trees under mulch. Mulching can reduce the non-productive period of *Hevea* by about 12 months in comparison with other management practices. Yield was also higher in the mulched plots.

An important observation that emerged from the investigations on soil moisture and potassium is that application of K especially at double the recommended level might result in increased water use efficiency under stressed condition through significant reduction in transpirational loss of water by rubber.

The foliar survey programme which commenced in July provided data for fertilizer recommendations to 2000 hectares. Fertilizer programme has been computerised and recommendations for a period of 3 years (1992, 1993, 1994) were sent, based on the survey done in 1991.

DETAILED REVIEW

Staff

Mrs. Lalani Samarappuli, Agronomist was appointed as the Acting Head of the Department from April 1st 1991 and then as the Head of the Department in May 1991. She was on duty throughout the year and continued with her studies for the PhD degree of the University of Peradeniya under the supervision of Dr. N. Yogaratnam, Mr. D. M. A. P. Dissanayake, Assistant Soils Chemist was on duty throughout the year and continued with his post graduate studies on a split programme basis leading to a PhD degree of the University of Aberdeen under the supervision of Dr. N. Yogaratnam (in Sri Lanka). Messrs. P. I. Yapa and S. Dharmakeerthi joined the Department in June as Asst. Soils Chemists.

The Experimental Officers Messrs. A. M. A. Perera and H. D. S. P. Perera were on duty throughout the year. Senior Technical Officer Mr. G. de Mel was promoted as an Experimental Officer with effect from April. Miss R. Hettiarachchi joined the Department in June as an Experimental Officer.

Miss C. Maheepala was promoted as a Senior Technical Officer and Mr. T. B. Dissanayake and Mr. A. Yakandawela were promoted as Technical Officers higher grade.

Technical Officers Messrs. S. N. Silva, P. Karunadasa, U. Mitrasena, Mrs. M. K. Mahanama, the specification Assistant T. M. Ahamadeen and the English stenographer Mrs. L. Perera were on duty throughout the year. Miss. S. Jayasekera and Mr. R. Gunasekera joined the Department as Technical Officers in March and May respectively.

Mr. Thomas Tilakaratna, Field Attendant passed away in July.

Research Students

Mr. S. M. M. Iqbal completed his studies for the MPhil degree of the University of Peradeniya under a CIDA funded programme supervised by Dr. N. Yogaratnam. Mr. U. Senarath, a temporary research student who was attached to this Dept. discontinued his studies and another student Mr. K. G. S. Jayawardena continued with his studies until end of the year.

Research students from the Faculty of Agriculture, University of Peradeniya worked on the following projects, in partial fulfilment of the requirements of the specialization course in soil and crop science under the supervision of L. Samarappuli.

KANNANGARA, K. N. : Influence of different soil management practices on soil physical properties and their effect on growth of immature rubber.

SHYAMALI, G. G. V. : Influence of potassium nutrition and soil moisture stress on water relations and growth of rubber seedlings.

Temporary workers

Miss Chandani Jayalath and Miss Daivi Senaratna continued to work in the Department as temporary Technical Assistants in CIDA Funded Programme. Miss. Thushara Peries worked in the Department as a temporary Technical Assistant from February. Miss. R. Hettiarachchi resigned to rejoin the RRI as an Experimental Officer.

Visits

The Departmental staff paid advisory visits to plantations and routine visits to experimental areas where necessary.

Meetings

Head of the Department participated in the following seminars, field days and committee meetings:

- Progress Review Seminar of the CIDA Fertilizer Research Programmes
- Central Scientific Committee Meeting of the RRI
- Field day for Planting Executives of Ratnapura District
- Field day for Planting Executives of Galle District.

Training Programmes

- Diploma in Plantation Management organised by the National Institute of Plantation Management.
- Training of Rubber extension Officers of the Advisory Services Department
- Training of Factory Officers of SLSPC and JEDB.

Mr. D. M. A. P. Dissanayake, Asst, Soils Chemist also participated in some of these seminars and programmes.

Publications

Iqbal, S. M. M. (1991). Effects of potassium and magnesium nutrition on growth yield and mineral composition of *Hevea brasiliensis*. MPhil thesis submitted to the University of Peradeniya.

Iqbal, S. M. M. and Yogaratnam, N. (1991), Effects of potassium and magnesium fertilizers on growth, yield and mineral composition of *Hevea brasiliensis*. Progress Review Seminar CIDA Fertilizer Research Programme, February 1991.

Samarappuli, L. and Yogaratnam, N. (1991) some aspects of soil moisture stress in *Hevea brasiliensis* grown under Sri Lankan condition. Progress Review Seminar CIDA Fertilizer Research Programme, February 1991.

Yogaratnam, N., Samarappuli, L. and Dissanayake, D. M. A. P. (1991), Weed control in rubber plantation. Bull. Rubb. Res. Inst. of Sri Lanka, Vol. 28.

RESEARCH

Evaluation of fertilizer mixtures for young budding

Three experiments were started to identify suitable fertilizer programmes which would be more economical than the current recommendation for young budding.

Following treatments were allocated to single plant plots in randomized complete block designs with 25 replicates for each treatment in all three experiments :

- | | |
|-----------------|---|
| T ₁ | Control (Nil fertilizer + watering) |
| T ₂ | Control (Nil fertilizer + without watering) |
| T ₃ | Sulphate of ammonia, muriate of potash and kiserite (conventional mixture) + rock phosphate as a basal dressing + watering. |
| T ₄ | Current recommendation for polybags (urea based) + watering |
| T ₅ | Current recommendation for polybags (sulphate of ammonia based) + watering. |
| T ₆ | Current recommendation for young budding + watering |
| T ₇ | CIC foliar application (Wuxal) + watering |
| T ₈ | Mackwood foliar application (Nitrophoska) + watering |
| T ₉ | Sulphate of ammonia, tripple super phosphate, muriate of potash and kiserite (conventional mixture) + watering |
| T ₁₀ | Latex effluent + watering. |

Germinated seeds of clone PB 86 were planted in polybags. Different fertilizer treatments were given two weeks after planting and plant diameter (girth) was measured at monthly intervals (Table 1), (S. Dharmakeerthi, P. Yapa, L. Samarappuli and S. N. Silva in collaboration with N. Yogaratnam)

Table 1 *Effect of different fertilizer treatments on plant diameter (mm) at the end of three months'*

Treatment	Plant Diameter (mm)		
	EXP I	EXP II	EXP III
1	5.45	5.43	5.42
2	5.92	5.63	6.11
3	6.04	5.91	6.17
4	5.08	5.41	6.55
5	5.88	6.51	5.23
6	6.73	7.28	6.81
7	5.80	5.86	5.85
8	5.80	5.84	5.85
9	7.06	6.93	6.81
10	6.13	5.93	6.42

Fertilizer requirements of new clones

New high yielding and vigourously growing clones may differ in their nutrient requirements. Moreover a proper and well balanced fertilizer mixture (clone specific) is likely to give higher growth rate and yield. Two experiments, field and pot, were therefore started to study the fertilizer requirement of some new clones viz. RRIC 110 RRIC 121, RRIM 712, 74—193 and PB 260.

Treatments :

- T₁ .. No fertilizer
- T₂ .. 1/2 the current recommendation
- T₃ .. Full current recommendation
- T₄ .. 1 1/2 times the current recommendation

A site was selected for field experiment in Kalutara District and the pot experiment will be conducted at Dartonfield. Both experiments will be started with the onset of South west monsoon in 1992. (S. Dharmakeerthi, L. Samarappuli and S. N. Silva in collaboration with N. Yogarajnam).

Economics of fertilizer use in mature rubber.

An experiment was planned to study the economics of fertilizer utilization by mature rubber.

Following treatments were allocated to each plots in a randomized block design with five replicates.

T ₁	..	No fertilizer from the 1st year of panel C
T ₂	..	No fertilizer from the 2nd year of panel C
T ₃	..	No fertilizer from the 3rd year of panel C
T ₄	..	No fertilizer from the 4th year of panel C
T ₅	..	Fertilizing throughout the panel C

Blocking was done according to the design in the site selected for this experiment in Kalutara District. (P. Yapa, L. Samarappuli and N. Yogaratham).

K/Mg. Nutrition

Several pot and field experiments were carried out to study the K/Mg. nutrition of *Hevea*.

The pattern of occurrence of visual magnesium deficiency symptoms appear to vary between clones. In clone RRIC 102, the yellowing was not contiguous with leaf margin whereas in clone RRIC 121, the development of the interveinal yellowing commenced from the leaf margin. Deficiency symptoms of potassium characterised by marginal yellowing followed by scorching.

Although, Parambe soils are inherently high in potassium in comparison with the other soil series, there were no differences in response to applied K on growth during the first year. Nevertheless plants growing in Parambe series exhibited the highest rate of growth in the first year but this effect was not related to levels of applied potassium. All clones tested viz. PB 86, RRIC 100, RRIC 102, RRIC 110, RRIC 121 when grown on PB 86 root stock, were found to exhibit normal growth in the absence of applied K fertilizers when the exchangeable soil K value was found to be in the region of 0.05 me./100 g. soil.

Application of potassium, at K₁ level of application (equivalent to 33 g./ tree/year) significantly increased girthing but no further increase was obtained with increase in potassium to K₂ level (equivalent to 66 g/ tree/ year). Moreover, there were no clonal differences with regard to response to application of K. Potassium application was found to significantly depress the foliar and bark Mg contents in all the clones tested except in clone RRIC 102. Similar antagonistic effect was shown by Mg when applied in the form of dolomite, decreasing the K content of leaves. Dolomite application was however found to increase the leaf calcium content also. Application of Mg in the form of kieserite however increased the leaf Mg content in comparison with dolomite. Application of potassium was also found to increase the K/Mg, K/ Ca and K/ (Ca + Mg) ratios in the leaves.

Application of potassium at K_2 level (66 g/ tree/ ar) was found to prevent the occurrence of a shoot die back disease caused by *Botryodeploidea theobroma* which attacked developing shoots in the control plots.

All the pot experiments and field experiments; F/76/05, C/77/08 and F/84/02 were terminated. (S. M. M. Iqbal, N. Yogaratnam G. de Mel and A. Yakandawela).

In experiment F/84/1, methods of improving soil fertility and fertilizer use efficiency in rubber plantations by mulching and different levels of K and Mg fertilizers were studied on 5 sites. Leaf samples were collected. (N. Yogaratnam, S. M. M. Iqbal, A. M. A. Perera, S. N. Silva, C. K. Maheepala and C. Jayalath)

Phosphate Nutrition

Experiment started at Eladuwa State Plantation to study the effects of different sources and levels of phosphate on the performance of clone PB 86 was continued. (D. M. A. P. Dissanayake, T. B. Dissanayake, R. Gunasekera and S. Jayasekera in collaboration with N. Yogaratnam).

Extention trials on fertilizer use

Use of fertilizer in plantations is being investigated in experiments on Salawa, Mahaoya, Densworth, Dewalakanda and Atale JEDB estates. Fertilizer treatment consists of no fertilizer control, fertilizer on the basis of soil and leaf analysis and standard fertilizer mixture. Yield data obtained are being analysed. (L. Samarappuli, H. D. S. P. Perera and T. B. Dissanayake in collaboration with N. Yogaratnam).

Soil - Plant - Water - Relation Studies

Effects of soil management practices on moisture stress, mineral composition growth and latex production of *Hevea* were studied in experiments SM/82/5, SM/83/1 and SM/88/1.

When paddy straw is used for mulching the performance of young *Hevea* may be improved, possibly due to the absence of competition for moisture and nutrients. It appears possible to eliminate or at least minimize the adverse effects of moisture stress by mulching which also would enhance nutrient uptake by rubber eventually improving growth as well as yield of rubber. This study also seems to suggest that when rice straw is used for mulching it is possible that the performance of young *Hevea* plants may be improved as a result of improvement in the potassium status. (L. Samarappuli, Rasika Hettiarachchi, P. Karunadasa and U. Mitrasena in collaboration with N. Yogaratnam).

Investigations on soil moisture and potassium (SM/88/4) indicated that application of K especially at K₂ level might result in increased water use efficiency under stressed condition through significant reduction in transpirational loss of water by rubber. (L. Samarappuli, Rasika Hettiarachchi P. Karunadasa and U. Mitrasena in collaboration with N. Yogaratnam).

Organic Manures

The use of organic manures in immature *Hevea* plantations is being studied at Elston estate, Puwakpitiya (OM/86/1) Paiyagala State Plantation (OM/86/2) and Hewagama estate, (OM/88/1). (N. Yogaratnam and J. G. de Mel).

Nutrient cycling in rubber plantation

This experiment was continued. Experimental data are being analysed. (I. A. U. N. Gunatileka – Dept. of Botany, University of Peradeniya, K. G. S. Jayawardena in collaboration with J. M. Anderson, Dept. of Biological Science, University of Exeter U.K.).

Use of leguminous trees

Two experiments were started in Agalawatta and Kegalle to study the use of leguminous trees as hedges and their effects on soil and moisture conservation and on the mineral composition and growth of *Hevea* plants. (L. Samarappuli, A. T. Senadeera and U. Mitrasena)

Adaptive Research Programme

Experiments were started to compare the effectiveness of growing bush tree legumes with the current practice of growing creeping legumes on soil and moisture conservation in small holdings, in Kalutara and Kegalle Districts. Experimental details are discussed in the Review of the Adaptive Research Unit. (L. Samarappuli, F. P. W. Silva, W. C. Dayaratna and A. T. Senadeera).

Use of poultry manure as a substitute for inorganic fertilizers in immature and mature rubber small holdings is also being studied under the Adaptive Research Programme. It is too early to make any conclusions from this study. (L. Samarappuli and F. P. W. Silva).

Chemical Analysis

Routine chemical analysis of soil leaf and latex samples collected for experimental and advisory purposes were carried out. Samples from other Departments and organizations were also analysed. Nearly 12 000 serum water samples were

analysed for the Bio chemistry Dept. during November – December period. (P. I. Yapa, A. M. A. Perera, Rasika Hettiarachchi, Chitra Maheepala, Manel Mahanama and S. Jayasekera).

Soil and Foliar Survey

The foliar survey programme for 1991 commenced in July and 2000 hectares were covered this year. Computerised fertilizer programme for the next 3 years (1992, 1993, 1994) based on this survey were sent to all the estates. (L. Samarappuli P. I. Yapa, H. D. S. P. Perera, A. M. A. Perera, C. Maheepala, Manel Mahanama, A. Yakandawela and T. M. Ahamadeen).

REVIEW OF THE GENETICS AND PLANT BREEDING DEPARTMENT

By

N. E. M. JAYASEKARA

SUMMARY

A series of trials was established to evaluate promising foreign clones.

A Higher Education Link between Rubber Research Institute of Sri Lanka and University of Birmingham was accepted by the British Council. Analysis of data collected from genotype - environment interaction studies was initiated under this link programme.

RRIC 121 continued to be the highest yielding clone in clone trials where RRIC 121 was used as a control clone.

Screening of clones for esterases and alcohol dehydrogenases was initiated using continuous electrophoresis.

DETAILED REVIEW

General

Staff

Dr. N. E. M. Jayasekera, Head of the Department, Dr. (Mrs.) S. C. Dharmaratna, Geneticist and Plant Breeder, Mr. K. W. Rupatunga, Experimental Officer, Mr. B. M. S. G. Peiris, Senior Experimental Assistant, Mr. A. K. M. S. Senaratna, Experimental Assistant, Messrs. I. D. M. J. Sarath Kumara, and R. A. S. K. Ranatunga, Technical Officers were on duty throughout the year.

Mr. D. P. S. T. G. Attanayaka, Assistant Geneticist and Plant Breeder, continued his postgraduate studies in the School of Biological Sciences of Birmingham University, U.K.

Mr. K. B. Karunasekara, Experimental Officer who was under-going a training in Genetics and Plant Breeding was promoted as Assistant Development Officer of the Adaptive Research Unit with effect from 1 Sept. 1991. He returned to the Island on 23rd December 1991 after completing his training at the School of Biological Sciences of University of Birmingham, U.K. and University of Reading and continues to work in the Department while helping the adaptive research trials.

Dr. (Mrs.) S. C. Dharmaratna was promoted to the senior staff grade I and designated Geneticist and Plant Breeder.

Mr. K. W. Rупatunga was promoted as an Experimental officer with effect from 29 April 1991.

Miss. K. P. Sunethra Nilmini was appointed as a technical officer and assumed duties on 1st March 1991.

Mrs. Ranjane Tissera, Clerk/Typist, was granted no pay leave for the period of 14 October 1991 to 13 January 1992.

Meetings, Seminars and Workshops

Head of the Department attended the following seminars and meetings.

1. Adaptive Research Seminars for Advisory staff.
2. Planters' Meeting, Kegalle region.
3. Workshop on plant breeding held at the Postgraduate Institute Agriculture
4. Planters Meeting Kalutara Region.
5. Expert Consultation on importation of Coconut Germplasm.
6. Central Scientific Committee meeting.

Training and Field days

NDT students were trained.

Head of the Department addressed the planters, who participated in two field day programmes conducted on Pussella State Plantation (S.P.) and Elpitiya S.P.

Head of the department gave a lecture on "Clone recommendations and *Hevea* breeding" to those who followed the 6th Diploma course in Plantation Management conducted by the National Institute of Plantation Management.

Miss. W. N. P. Katuwawala was assigned to the Department with effect from 5th December 1991 as a trainee typist.

Visitors

Dr. M. J. Lawrence, Senior Lecturer in Genetics, School of Biological Sciences, University of Birmingham visited the Department.

Publications

Attanayaka, D. P. S. T. G. Kekwick, R. G. O. and Franklin F. C. H. (1991). Molecular cloning and nucleotide sequencing of the rubber elongation factor gene from *Hevea brasiliensis*. *Plant Molecular Biology*, 16, 1079-1081.

Thattil, R. O., S. Samitha and Jayasekera, N. E. M. (1991) Statistical relationships affecting yields of rubber. Proceedings of Ssecond Regional workshop of multipurpose trees. 61—65.

Reports

Jayasekera, N. E. M. (1991) Annual Review of the Genetics and Plant Breeding Department.

LABORATORY AND FIELD INVESTIGATIONS

Clone identification

Screening for esterases and alcohol dehydrogenase

Extracts were made from 1 cm discs, cut from leaves of different *Hevea* clones and continuous electrophoresis was carried out on 12.5% starch gel slab using Tris-citrate running buffer. Current was applied at 120V for 5 hours. The gel was then washed and stained for esterases and acid phosphatase. The band resolution in both is insufficient to interpret the variation. Therefore further experiments are necessary using discontinuous polyacrylamide gel electrophoresis. (S. C. Dharmaratna and K. P. Sunethra Nilmini).

Breeding selection and clone evaluation

Hand pollination programme for 1991 (BST/HPS/91/1)

Hand pollination programme for 1991 was carried out in Neuchatel State Plantation. Crosses attempted, number of pollinations done in each cross, pods harvested are given in Table 1. (S. C. Dharmaratna and K. W. Rupatunge).

Table 1. *Details of 1991 hand pollination programme.*

Cross	No. of Pollinations	No. of fruits harvested
RRIC 100 x GP 24/137	300	10
RRIC 121 x RRIM 600	350	30
RRIC 102 x RRIC 121	600	15
RRIC 121 x GP 24/137	50	10
RRIC 102 x PB 86	352	03

Cross	No. of Pollinations	No. of fruits harvested
RRIC 102 x RRIM 600	484	10
RRIC 130 x PB 86	250	08
RRIC 130 x RRIM 600	43	15
RRIC 100 x RRIM 600	322	27
RRIC 100 x RRIC 121	305	15
RRIC 121 x RRIC 100	207	0
RRIC 130 x RRIC 100	445	15
RRIC 130 x RRIC 102	181	21
RRIC 102 x RRIC 130	810	20
RRIC 100 x RRIC 130	215	15
RRIC 130 x GP 24/37	21	15
Total	4725	229

Clone evaluation.

Evaluation of selections from 1974, 1975 and 1978 hand pollinated seedlings. (BST/HPS/74, 75, 78/1).

A girth measurement was recorded in the small scale trial on Moraliyoa Estate where some of the promising selections made from 1974 H. P. seedlings are evaluated.

Out of the three control clones, RRIC 121 had the highest mean girth (88.6 cm.) while the other two control clones, RRIC 100 and RRIM 600 had mean girth of 60.2 cm and 67.3 cm respectively. Non of the new selections exceeded the mean girth of RRIC 121. Among new selections 74-166, recorded the highest mean girth 81.8 cm while 74-144 and 74-17 recorded mean girth of of 79.8 cm and 78.3 cm respectively.

With respect to yield RRIC 121 had the highest mean yield of 74.9 grams per tree per tapping (g/t/t). New selection 74-217 had the second highest yield of 50.1 g/t/t while the third highest yielder was 74-174 with a mean yield of 46.8 g/t/t. Mean yield of control clones and some new selections are presented in Table 2 (N. E. M. Jayasekera and K. W. Rupaunga).

Table 2. Mean yield of control clones and promising new selections.

Selection/clone	Mean yield (g/t/t)	
	1992	
74-6	42.1	
74-173	46.8	
74-213	50.1	
RRIC 100	27.5	} Control clones
RRIC 121	74.9	
RRIM 600	40.8	

A girth measurement was recorded in the small scale trial (BST/HPS/74/3) at Kuruwita Sub-station. In this trial also some selections from 1974 H.P. seedlings are evaluated.

According to girth measurements presented in Table 3 one of the control clones, RRIC 121, and a new selection 74-41 recorded the highest girth (74.9 cm). while another new selection 74-135 had a mean girth of 70.3 cm.

With respect to yield, RRIC 121 was the highest yielder followed by the new selections 73-193, 74-41 and 74-135. All these selection yielded more or less the same.

It can be seen from the Table 3 that RRIC 121, 74-41, 74-135 and 74-12 recorded fairly significant yield increases in 1991 when compared to 1990 (N. E. M. Jayasekera and B. M. S. G. Peries)

Table 3. *Mean girth and yield of clones evaluated in small scale clone trial at Kuruwita Sub-station (BST/HPS/74/3).*

Clone	Girth at 150 cm	Yield in g/t/t		1991	dry trees
		1989	1990		
74-193	59.6	74.09	65.8	66.4	2
74-135	70.3	57.11	52.0	65.4	2
74-41	74.9	54.94	54.4	65.4	2
74-12	69.7	39.09	38.3	58.4	3
74-180	61.8	55.45	51.3	56.4	2
74-205	61.9	55.60	48.1	50.2	1
74-198	68.0		42.9	49.0	3
74-162	61.1	42.68	41.4	45.1	1
74-139	56.3		33.2	44.7	2
74-199	54.9	40.24	35.8	34.8	2
74-221	53.0		29.0	32.9	2
RRIC 121	74.9	40.53	34.4	80.6	2
RRIM 600	55.9	33.91	33.2	45.2	1
RRIC 100	55.3	37.20	36.3	41.7	—
PB 86	53.1	25.00	23.8	26.3	—

In the small scale trial (BST/HPS/74, 75, 78/1) on Paiyagala S.P., 15 new selections, 7 each from 1975 and 1973 and one from 1974 H.P. seedlings, are tested.

A girth measurement was recorded and mean girth of promising new selections as well as three control clones are presented in Table 4.

Table 4. *Mean girth of new selections and control clones in small scale trial (BST/HPS/74,75,78,1) on Paiyagala S.P.*

Clone	Mean girth cm
75-55	52.0
78-33	50.3
75-268	49.2
78-85	49.0
74-181	48.9
RRIC 100	47.4
RRIC 102	51.5
RRIC 121	50.4

Twenty four selections from 1975 H. P. seedlings are tested in the small scale trial (BST/HPS/75/1,2) planted on Clyde S.P. In this trial RRIC 121 recorded the highest mean girth (67.5 cm.). Only one new selection 75-143 exceeded this value though there are new selections which exceeded the mean girth of other control clones, RRIC 100, and RRIC 130.

With respect to yield non of the new selections exceeded the yield of the highest yielding control clone, RRIC 121. Again there are new selections which out yield other control clones.

Mean yield and girth of promising new selections and the three control clones are presented in Table 5 (N.E.M. Jayasekera and I.D.M.J. Sarath Kumara).

Table 5. *Mean girth and yield of promising new selections and control clones in small scale trial (BST/HPS/75/2) on Clyde S.P.*

Clone	Mean girth (cm)	Yield g/t/t
75-33	64.7	40.3
75-71	55.8	29.7
75-79	66.1	28.8
75-104	60.5	30.6
75-143	79.5	38.9
RRIC 100	57.4	26.5
RRIC 121	67.5	48.4
RRIC 130	51.1	36.5

In the other trial (BST/HPS/75/1) where new selections from 1975 H.P. seedlings are evaluated on Sorana S. P. highest mean girth among control clones was recorded by RRIC 121 with 69.3 cm. Only one new selection 75-79 exceeded this girth. The mean girth of 75-79 was 76.6.

With respect to yield highest yielding control clone was RRIC 130 and 75-4 was the only new selection that out yielded the best control clone.

1979 H.P. Seedlings (BST/HPS/79/2) on Eladuwa SP.

Average girth and yield of families which constitute the 1979 H.P seedling population are given in Table 6.

As in the last year highest girth was recorded by the family derived by crossing RRIC 103 with RRIM 623.

The highest yielding family was derived by crossing RRIC 103 with RRIC 101.

From this population 12 genotypes were selected for further testing. Hand pollination number and the parentage of selected genotypes are given in Table 7 (N. E. M. Jayasekera and K. W. Rупatunga).

Table 6. *Mean girth and yield of 1979 H. P. Seedling families (BST/HP/79/2) planted on Eladuwa S.P.*

<i>Family</i>	<i>Family size</i>	<i>Mean girth cm</i>	<i>Yield g/t/t</i>
RRIC 101 x RRIM 600	234	58.41	24.47
RRIC 100 x RRIM 600	18	67.00	26.60
RRIC 100 x RRIC 101	10	61.95	22.56
RRIC 102 x RRIM 600	20	55.86	17.80
RRIC 102 x RRIM 623	02	59.00	20.25
RRIC 103 x RRIM 600	04	57.57	22.00
RRIC 103 x RRIM 623	13	70.75	33.64
RRIC 103 x RRIC 101	05	65.41	36.51

Table 7. *Selected genotypes from 1979 H. P. Seedlings and their parentage.*

<i>Genotype</i>	<i>Parentage</i>
79-80	RRIC 101 x RRIM 600
79-87	RRIC 101 x RRIM 600
79-145	RRIC 101 x RRIM 600
79-159	RRIC 103 x RRIM 623
79-281	RRIC 103 x RRIM 600
79-286	illegimate
79-337	RRIM 101 x RRIM 600
79-347	RRIC 103 x RRIM 623
79-375	RRIC 101 x RRIM 600
79-394	RRIC 103 x RRIM 623
79-399	RRIC 101 x RRIM 600
79-457	RRIM 101 x RRIM 600

1981 H.P. Seedlings (BST/HPS/81/2) on Malaboda Division of Eladuwa S.P.

Mean girth and yield of 1981 H. P. Seedling families are given Table 8. Highest girth was recorded by the family derived by crossing RRIC 52 with IAN 45-710.

With respect to yield just one seedling obtained from the cross between RRIC 102 and IAN 45/710 gave a very high yield of 87.09./t/t. (N. E. M. Jayasekera and K. W. Rупatunga).

Table 8. *Mean girth and yield of H.P. seedling families planted on Malaboda division of Eladuwa S.P.*

<i>Family</i>	<i>No. of trees</i>	<i>Mean girth (cm)</i>	<i>Mean yield (g/t/t)</i>
PB 28/59 x RRIC 102	21	58.7	34.8
PB 28/59 x IAN 45/710	30	64.5	33.0
PB 28/59 x RRIC 121	13	59.7	35.8
PB 28/59 x RRIC 52	07	61.6	30.7
RRIC 52 x IAN 45/710	04	75.0	36.8
RRIC 102 x IAN 45/710	01	70.5	87.0
RRIC 102 x PB 28/59	07	65.8	38.2
RRIC 52 x PB 28/59	17	73.0	36.2

Clone trial (BST/V/73/37) on Bibile Estate

Yield and girth are summarized in Table 9. RRIC 110 had the highest yield and girth followed by RRIC 117. Unregistered clone which was the second highest yielding clone in 1991 was the 3rd best clone, according to 1992 mean yield. (N.E.M. Jayasekera and R. A. S. K. Ranatunge)

Table 9. *Mean girth and yield of clones in BST/V/73/37 on Bibile estate.*

<i>Clone</i>	<i>Mean girth (cm)</i>	<i>Yield (g/t/t)</i>
RRIC 110	80.1	42.3
RRIC 117	75.9	41.4
1461	79.2	37.2
RRIC 112	72.8	28.8
RRIC 102	69.6	27.8

Evaluation of Ivory Coast clones (BST/ICC/85/2) on Paiyagala S.P.

A girth measurement was recorded in this trial and mean girth are presented in Table 10.

RRIC 121 had the highest mean girth (53.7 cm) followed by RRIC 100 (48.3 cm.) Among the test clones P 122 and RO 46 had the highest mean girth of 43.7 cm and 43.3 cm respectively (N.E.M. Jayasekera and K. W. Rupatunga).

Table 10. Mean girth of clones tested in BST/ICC/85/2 planted on Paiyagala S.P.

Clone	Mean girth (cm)
RRIC 121	53.7
RRIC 100	48.3
P 122	43.7
RO 46	43.3
RO 51	43.0
RO 55	42.7
GU 86	41.0
GU 1296	40.6
AC 54	39.7
PFB 5	38.5
AC 57	32.7
AC 55	30.7
RRIC 102	48.3

Evaluation of 100 germplasm clones BST/GP/85/2 at Kuruwita Sub-station

A girth measurement was recorded in these trials. In one trial the highest girth 58.6 cm was recorded by RRIC 121 while in the other trial RRIC 102 had the highest mean girth (59.0 cm) followed by RRIC 121 which had a mean of 58.8 cm.

With respect to germplasm clones the highest mean 56.2 cm was reached by MT-C-1 18-95 in both trials.

Arrangements have been made to test tap this trial in 1992. (N.E.M. Jayasekera and R.A.S.K. Ranatunge).

Genotype-environment interaction studies (PB/GE/75/1).

A Girth measurement and yield data were collected during 1991. Girth data is summarized in Table 12 as mean girth for each clone in each test site. The highest mean over all sites was recorded by RRIC 52 followed by RRIC 600 and RRIC 623. RRIC 100 registered the lowest girth. RRIC 100 though had a very good vigour prior to tapping, its vigour or growth slows down after tapping. This has been observed in other trials too.

Mean yield is given in Table 13. Tapping panel was changed at the beginning of 1991. RRIC 600 was the highest yielding clone, when test tapping data were averaged over all sites.

Testing of proven foreign clones.

Budgrafting of these clones commenced in early April and completed by the end of May. Budgrafting was done in seedling nurseries at Nivitigalakele and Kuruwita Sub-stations and at Neuchâtel S.P.

Table 12. *Mean girth 1991 of PB/GE/75/1.*

Clone	Kanana	Bentota	Monrovia	Densworth	Hunuwella	Golinda	Bibile	Mean
RRIC 36	63.6	73.4	72.5	78.0	59.5	70.2	70.4	69.66
RRIC 52	87.6	89.4	77.3	92.8	87.9	80.0	87.4	86.05
RRIC 100	69.4	72.2	73.2	67.1	59.0	67.4	65.5	67.68
RRIC 101	71.6	66.9	66.3	75.4	67.6	60.5	66.9	67.88
RRIC 102	77.0	73.7	67.9	74.5	74.5	53.1	70.4	70.15
RRIC 600	80.9	87.3	82.2	79.0	84.2	75.4	73.7	80.38
RRIC 623	76.6	87.0	76.2	87.0	81.3	79.1	78.2	80.77
PB 86	91.2	73.9	69.7	77.8	70.3	78.2	66.7	75.40
IAN 45/710	76.2	88.1	82.5	81.4	82.7	74.3	82.8	81.14

Table 13 *Mean yield 1991 of PB/GE/75/1.*

Clone	Kanana	Bentota	Monrovia	Densworth	Hunuwella	Golinda	Bibile	Mean
RRIC 36	19.9	33.1	25.9	43.0	22.0	32.1	26.0	28.8
RRIC 52	18.7	18.0	22.8	28.4	23.7	14.6	19.9	20.8
RRIC 100	33.0	29.2	29.7	24.8	17.2	27.0	21.4	26.0
RRIC 101	40.0	23.8	20.3	30.3	32.9	23.0	25.3	27.9
RRIC 102	28.9	28.7	13.9	24.0	26.6	17.0	25.5	23.5
RRIC 600	46.9	41.3	26.4	36.3	54.0	33.3	32.3	38.6
RRIC 623	43.8	33.1	27.1	33.2	31.6	12.6	33.2	30.6
PB 86	57.4	28.6	21.5	35.3	25.0	23.0	27.2	31.1
IAN 45/710	40.7	40.1	31.1	29.2	29.8	17.7	38.3	32.4

Two large trials were planted on Eladuwa S. P. and Salawa Estate to test seven foreign clones. Three local clones were planted as controls.

Clones planted and their countries of origin are given in Table 14.

Table 14. *Clones planted and their countries of origin.*

<i>Clone</i>	<i>Country of origin</i>
PB 217	Malaysia
PB 269	Malaysia
PB 235	Malaysia
RRIM 712	Malaysia
PR 255	Indonesia
PR 261	Indonesia
BPM 24	Indonesia
RRIC 100	Sri Lanka
RRIC 110	Sri Lanka
RRIC 121	Sri Lanka

In addition to these two trials, five small scale trials were planted at Kuruwita sub-station, Bentota S.P., Atala Estate, Bibile Estate and Yatawatta S.P. Trials on Bibile Estate and Yatawatta S.P. were planted during N.E. season and others were planted during S.W. monsoon. In these trials all foreign clones appearing in Table 14 except PB 217 were planted along with RRIC 121.

Details of trials established under this project are given in Table 15.

Table 15. *Details of trials established in 1991 to evaluate proven foreign clones.*

<i>Site</i>	<i>District</i>	<i>No of plots per clone per site</i>	<i>Aprox: No of plants per plot</i>
Salawa	Keleni Vally	2	300
Eladuwa	Kalutara	1	300
Kuruwita	Ratnapura	3	25
Bentota S. P.	Galle	3	25
Atala Estate	Kegalle	3	25
Bibile Estate	Bibile	3	25
Yatawatta S.P.	Matale	3	25

Germplasm nursery

Routine maintenance was carried out during 1991.

Miscellaneous:

Higher educational Link between Birmingham University and R.R.I. in Plant Breeding.

Link programme proposed by the Head of the Department was accepted by the British Council.

Under this project, sponsored by the British Council, Dr. M. J. Lawrence, a Senior Lecture in Genetics and Plant Breeding visited the Department and had a discussion on the analysis of data collected from genotype-environment interaction trials.

As a result of this, data from genotype-environment interaction trial were sent to the Birmingham University. Mr. K. B. Karunasekera, Assistant Development Officer who was undergoing a training in U.K. analysed part of this data.

REVIEW OF THE BIOCHEMISTRY AND PHYSIOLOGY DEPARTMENT

By

NEELAMANIE DE SILVA

SUMMARY

Research work of the Department was concerned mainly with investigation of methods to overcome environmental pollution caused by rubber factory effluent.

Trials were continued at Culloden Estate to study the possibility of using rubber factory effluent as a fertilizer to rubber with special reference to N, P. and K.

A modified rubber waste treatment system was evolved. A research scale model of the rotating activated belt system for effluent treatment was also constructed.

DETAILED REVIEW

Staff :

Mr. M. T. Warnakula, Assistant Biochemist left for Australia on April 1991 to read for his postgraduate degree at the University of New South Wales and returned to Sri Lanka on 14th August 1991 to continue the research work on a split - programme basis. Miss Neelamanie de Silva assumed duties on 15th August 1991 as an Assistant Biochemist, Mr. M. D. C. Seneviratne, Technical Officer, Mr. P. D. J. Rodrigo, Specification Assistant, Mr. D. Ramawickrama, Laboratory Attendent, and G.W. Guna-sena, Factory Attendent were on duty throughout the year.

Mr. T. Hettiarachchi, assumed duties as a Technical Officer on 1st March 1991 and was transferred to the Biometry Section from 15th August 1991. Miss. S. Kudaligama, Technical Officer was transferred from the Biometry Section to this Department with effect from 15th August 1991.

FIELD AND LABORATORY INVESTIGATIONS

Effluent Treatment :

Sri Lanka produces about 1,00,000 metric tonnes of factory effluent in rubber plantations every year causing environmental pollution in rubber growing areas. In recent years pollution problem has become very serious in these areas. There was therefore an immediate necessity to establish waste water treatment system which should be effective under Sri Lankan conditions. Research scale model was installed at Dartonfield to study the feasibility of using biological processes in the treatment of rubber effluent. Such rotating activated belt system facilitate the growth of aerobic bacteria on rotating coir brushes. Feeding tank of the diluted serum provides nutrients to such aerobic bacteria while rotating, thus digesting the rubber waste aerobically. This aerobic digestion of rubber waste minimizes the environmental pollution. Enrichment cultures of aerobic bacteria with the predominant species being determined by the characteristics of the rubber waste and the environmental conditions created through process design and operation were used. Series of trials were carried out by changing the experimental variables. More trials were carried out to obtain data to improve the above system for large scale implementation. (M. T. Warnakula, M. D. C. Seneviratne, S. Kudaligama, P. D. J. Rodrigo, D. Ramawickrama).

Effluent utilization :

Rubber factory effluent has been reported to be rich in several important nutrients. The amount of nutrients contained in the effluent under Sri Lankan conditions are 336 ppm sodium, 745 potassium, 140 ppm magnesium, 83 ppm calcium, 625 ppm nitrogen and 646 ppm phosphorous. Because of its high nutrient content rubber factory effluent can be used as a fertilizer on a wide range of crops including rubber. The objective of this study is to investigate the possibility of using rubber factory effluent as a source of N, P, and K for rubber plants.

Experiments :

Crepe rubber factory effluent on mature rubber.

Effect of rubber factory effluent as a fertilizer and as a source of water for mature rubber trees are being tested at the Culloden State Plantation, Nevada. This trial is being conducted in an area of about 6 acres on clone PB 86 in a 1986 replanting. The area was blocked according to the experimental design and land scape to minimize surface run off effects of applied effluent.

Design : Randomized Block (03 blocks with 5 replicates)

Clone : PB 86.

- Treatments** ; T₁ — Normal dose of recommended dose of mature rubber fertilizer mixture (12 ; 14 ; 14)
- T₂ — Half of normal fertilizer rate + 1 ; 1 diluted serum
- T₃ — 1 ; 1 diluted serum.
- T₄ — Undiluted serum (from coagulation tank)
- T₅ — Control (water)

Fertilizer used ; Urea—46% N
Rock phosphate—28.5% P₂ O₅
Muriate of Potash — 60% K₂ O
Kieserite — 24% MgO

Field layout ; Block 1 — 01 to 05 plots.
Block 2 — 06 to 10 plots
Block 3 — 11 to 15 plots

Latex yield per tree and dry rubber content (DRC) per 50 ml. of latex were recorded at fortnightly intervals. N, P, K, Mg and Ca contents of soil and plot samples were determined. (N. Yogaratnam, Neelamanie de Silva, M. D. C. Seneviratne, P. D. J. Rodrigo)

Enzyme Deproteinization of Natural Rubber

Preliminary studies were carried out with the intention of testing bacterial enzymes for deproteinization of natural rubber. Proteolytic activity of bacterial enzyme preparation was compared with papain enzyme action by conducting simple experiments. However, extraction and purification procedures of bacterial enzymes has to be improved. Further experiments were in progress (M. T. Warnakula and Neelamanie de Silva).

New Programmes

- Following new programmes have been planned.
01. Studies on latex physiology and biochemistry (M. T. Warnakula, Neelamanie de Silva and A. Nugawela).
 02. The influence of physiological and biochemical conditions of the tree on the development of Tapping panel Dryness (Brown Bast) of *Hevea*. (Neelamanie de Silva and A. Nugawela.)

03. Studies on some biochemical aspects of latex production created by different moisture stress conditions (Neelamanie de Silva and Lalani Samarappuli).
04. Effect of rubber factory effluent on availability of phosphate from Eppawela rock phosphate. (Neelamanie de Silva and D. M. A. P. Dissanayake).

Centrifuge Unit

The centrifuge unit functioned under biochemistry department and was involved in the production of centrifuge latex for Specification, Rubber Technology, Raw Rubber Development and Polymer Chemistry Departments.

REVIEW OF THE RUBBER TECHNOLOGY AND DEVELOPMENT DEPARTMENT

By

N. M. V. KALYANI

SUMMARY

A detailed evaluation of the suitability of two commercially available antioxidants for irradiated latex has been conducted. Suitability of irradiated latex in heat sensitive dipping applications has also been evaluated by using both PPG and Zinc/amine systems. It has been found that irradiated latex could successfully be used in PPG heat sensitive dipping systems.

A large scale trial on the preparation of a blend of latex/bitumen emulsions was successfully performed.

A novel latex based cement with improved drying characteristics has been developed to be used in tyre retreading and repair industry. The bond strength characteristics of the new material have been found to be comparable to those of currently used solvent based cement.

A project on the evaluation of the performance of brown crepe rubber grades in tyre retread compounds has been initiated to gather data to prove the unsuitability of poor quality rubber in retread compounds. Preliminary trials clearly demonstrated the unsuitability of poor quality rubber in retread compounds.

Use of oil-extended natural rubber in tread compounds was further studied. Possibilities of replacing rubber processing oils by other locally available oils were also looked into.

Novel applications for skim rubber and RSS/skim rubber blends were studied in detail.

DETAILED REVIEW

Staff

Dr. (Miss) N. M. V. Kalyani was promoted as the Head, Rubber Technology and Development Department with effect from 25th June 1991.

Mr. B. P. Weeraratne, Assistant Rubber Chemist continued his postgraduate studies at the University of Loughborough, U.K.

Miss. D. G. Edirisinghe and Miss. M. M. Rajapakse assumed duties as Assistant Rubber Chemists on the 15 th of November, 1991.

Mr. D. D. Medagama, Experimental Officer, was on duty throughout the year.

Technical Officers, Mr. K. M. U. Mithrananda and Mrs. Sriyani I. Yapa were on duty throughout the year.

Technical Officer, Mr. D. P. Wettasinghe, continued his studies for Diploma in Technology at University of Moratuwa.

Miss. N. Edirisooriya assumed duties as a Technical Officer on 4th March 1991

Publications

Kalyani, N. M. V. Use of Natural Rubber in Tyres J. Plas & Rubb. Inst. Sri Lanka (in press).

Seminars

1. Dr. N. M. V. Kalyani organised a seminar on "Tyre retreading" at the request of Hon. M. L. M. Abosally, Minister of Plantation Services. At the seminar which was held on 11th September, 1991, at Sausiripaya Dr. N. M. V. Kalyani made two presentations on the following:
 - a. General Aspects of Tyre Retreading.
 - b. Precured Retreading.
2. Dr. N. M. V. Kalyani participated in two seminars organised by the Plastics & Rubber Institute.

Courses, Meetings & Lectures

Dr. N. M. V. Kalyani attended the following meetings during the year;

1. Four committee meetings of RVNRL group held at Atomic Energy Authority.
2. Meetings of the "Advisory Committee on Manufactured Rubber Products" held at Export Development Board.

3. The Annual General Meeting of Plastics and Rubber Institute held on 26th April, 1991.
4. The fourth Central Scientific Committee meeting held at SLAAS on 5th July, 1991. Dr. N. M. V. Kalyani made a presentation on the research projects of Rubber Technology and Development Department.
5. The progress control meetings of Road Development Authority to discuss the project on latex/bitumen emulsions.
6. The meetings of Industrial panel for "Manufactured Rubber Goods" held at Ministry of Rural Industrial Development and Tourism.

Dr. N. M. V. Kalyani served as a lecturer for the following courses during the year;

1. M. Sc. course on Polymer Science & Technology conducted by the Sri Jayawardenepura University.
2. Training course organised by SLSPC for factory officers and factory superintendents on 25th April at Galle.
3. Training course for factory officers organised by NIPM on 24th May at Nivitalakelle Training Centre.
4. Training course for planters organised by NIPM in August.

LABORATORY INVESTIGATIONS

Latex Technology

1. Developments in radiation prevulcanisation of NR latex.

The results of the technical evaluation of a large batch of special latex developed by research group of RVNRL committee, were received from Japan. According to the comments of the Japanese experts in the field our latex exhibits the best stability observed so far towards the sensitizers. A sample of 50 kg. of the same batch of latex was received after irradiation and was used for following investigations.

- (a) Development of a suitable antioxidant system to be used with irradiated latex.

A detailed evaluation of the suitability of two commercially available antioxidants to be used with irradiated latex has been conducted. Techniques were developed to incorporate antioxidants into the latex to ensure that antioxidant/antioxidants were properly dispersed within the latex with no coagulation. Various combinations of the two antioxidants were tested and an optimum combination, i. e. combination which shows the maximum retention of tensile properties, was obtained. Further the effects of leaching solvent upon the retention of tensile properties were also investigated.

(N. M. V. Kalyani, L. Karunanayake and P. H. Sarath Kumara).

(b) Irradiated latex in heat sensitive dipping applications.

Suitability of irradiated latex in heat-sensitive dipping applications was evaluated using two heat sensitising systems, namely, PPG and Zinc/amine system.

It has been found that our irradiated latex could successfully be used in PPG heat-sensitive dipping system. Variables such as pH of the latex, former temperature, maturation period and concentration of PPG etc. . . greatly influence the heat-sensitivity of latex.

As for heat sensitisation by Zinc/amine system it has been found that the addition of a fatty acid soap which is normally done to enhance the heat sensitivity of latex was not a requisite for our latex. However, like in all the other types of latex. the Storage stability of the latex compound used in Zinc/amine system was poor.

(N. M. V. Kalyani, N. Edirisooriya and S. I. Yapa).

2. Latex bitumen emulsions in road construction

A large scale trial on the in-situ preparation of a blend of latex/bitumen emulsion was successfully performed. A road stretch of about 500m long was laid on Etul-kotte-Mirihana road for evaluation.

Potential application of field latex and centrifuged positex prepared using different cationic soaps in the preparation of latex/ bitumen blends are being investigated.

(N. M. V. Kalyani, M. M. Rajapakse, D. P. Wettasinghe, Sriyani Yapa, Nisha Edirisooriya and Sriyanthi Weeramen)

3. Latex based cement with improved drying characteristics for tyre retreading industry.

Today, a solvent based adhesive is used in tyre retreading and repair industry for the process called cementing. A few years ago Rubber Technology and Development Department developed a latex based cement of comparable bond strength

properties. It has been found that with the latex based cement the process control becomes easier as the accurate visual estimation of drying is possible. The main obstacle for its commercial implementation is its long drying time.

Recently a novel latex based cement with improved drying characteristics has been developed. The drying time of the new latex-based cement is found to be almost the half of the earlier latex cement. Furthermore, lab scale trials have revealed that the bond strength characteristics are comparable to those of the solvent cement. Factory scale trials are being carried out.

(N. M. V. Kalyani, L. Karunanayake and S. Weeramen).

4. Thickening behaviour of NR latex.

The effects of non rubbers upon the ZnO thickening of NR latex were further investigated. As it has been established that the proteins play a significant role in determining the extent of thickening the effects of added proteins such as casein were taken into consideration. The results obtained so far however, have not indicated any appreciable effects of casein upon ZnO thickening of NR latex. Further work is in progress. (N. M. V. Kalyani, Sriyani Yapa and N. Edirisooriya)

5. Rubberised coir belts.

The use of pre-vulcanised latex in the preparation of rubberised coir belts which are to be used in rice hulling and coir processing mills has been studied. Further experiments are to be conducted to improve the diffusion of latex into the coir belts to ensure better adhesion between the individual coir fibres.

(N. M. V. Kalyani, T. Warnakula, Sriyani Yapa and N. Edirisooriya)

6. Latex covered coir dust-based flower pots.

A request for development of a suitable latex compound to be used as a coating for coir dust based flower pots was made by Tropical Seed Co. (Pvt.) Ltd. A latex based compound based on a room temperature curing system was developed and its suitability in this application was found to be good. Nearly 125 flower pots were coated in this manner and handed over to Tropical Seed Co. (Pvt.) Ltd. to send for an exhibition in Germany. (N. M. V. Kalyani and Anoma Gunawardena)

Dry Rubber Technology

1. Evaluation of the performance of brown crepe rubber in retread compounds.

Since the advent of radial tyre, usage of NR in tyre components has increased markedly where its high green strength, tack and cohesive properties serve to maintain green tyre uniformity during building and shaping operations. However, with the advent of precured retreading techniques the usage of NR in truck tyre retreading

industry has declined in the Europe as well as in the USA. Many commercial precured retreads for heavy duty truck tyres are based primarily on SBR or SBR/BR blends. However, being a NR producer, the retreading industry in Sri Lanka is totally dependant on NR. Majority of the retreaders use various poor quality grades of rubber in the preparation of tread compounds. As such a project was initiated to evaluate the performance of brown crepe rubber relative to RSS in tyre retreads.

Preliminary trials conducted using three grades of brown crepe rubber collected from C. W. Mackies showed that certain important technological properties of tread compounds such as abrasion resistance and rebound resilience are highly dependant on the dirt content and nitrogen content. A factory scale trial conducted using flat bark crepe clearly demonstrated its unsuitability as a retread material. Plans are in hand to conduct fleet trial in collaboration with Associated Motorways Ltd. (N. M. V. Kalyani, Anoma Gunawardena, K. M. U. Mithrananda and D. D. Medagama).

2. Oil-extended natural rubber in tyre tread compounds.

The extension of rubber by cheap processing oils permits rubber manufacturers to produce low cost compounds which have good performance as tyre treads and which may even wear better than unextended compounds under certain conditions. However, it has been reported that the wear performance of tyres made of OENR reduces at temperatures above 15 c. A study on the development of OENR based tread compounds which would show better wear properties at high temperatures was initiated. Also the possibilities of using oils other than rubber processing oils in this regard are being investigated.

(N. M. V. Kalyani, D. G. Edirisinghe, D. D. Medagama and K. M. U. Mithrananda).

3. Novel applications for skim rubber.

An evaluation of technological properties of RSS/skim rubber blends in various compounding formulas has been initiated. Preliminary trials carried out using a tyre tread formula indicated that the blending of RSS with skim upto a certain limit enhanced some technological properties such as hardness and moulds without too much sacrifice in resilience properties. Suitability of such blends in some other selected items such as extruded goods has also been evaluated. (N. M. V. Kalyani, Anoma Gunawardena, L. Karunanayake, K. M. U. Mithrananda and D. D. Medagama).

Industrial Extension

The following industries have requested the services of the Rubber Technology and Development Department in product development and testing:

Associated Motorways Ltd.	testing solvents and compounds.
Richard Peiris & Co. Ltd.	testing compounds.

Don Somapala Company	..	development of tread and cushion gum compounds.
Kandy Tyre Rebuilders	..	development and quality improvement of tread and cushion gum compounds.
Lanka Tyre Retreaders	..	testing compounds
Bata Shoe Company	..	testing samples
Trent Manufacturing Co. (Pvt.) Ltd.	..	development of compounds for grease boots mud flaps, and car mats.
Sarvodaya Economic Enterprises & Development Services		development of rubber seals of low water absorption characteristics.
Various small individual industrialists	..	castings, rubberised coir, dipped products, etc.

REVIEW OF THE POLYMER CHEMISTRY DEPARTMENT

By

K. G. KARNIKA DE SILVA

SUMMARY

The major break through by the Polymer Chemistry Department during the past year was the invention of a very practical method to produce economical and non toxic grades of depolymerised natural rubber and latex starting with natural rubber field latex. A method to manufacture depolymerised rubber is already known but the process involves the use of costly and highly toxic chemicals in a sophisticated reactor, under carefully controlled conditions. Our method does not need elaborate equipment to produce this highly value added speciality rubber.

A certain number of major rubber industrialists abroad have shown an active interest in depolymerised rubber, provided sufficient and consistent supplies can be guaranteed. This means that an economically and commercially profitable market should be built up. It should have a capacity of about 1500 t per annum in the field of adhesive industry, ebonite manufacture and as a non extractable, co-vulcanisable processing aid which could replace costly processing oils that do not involve in the vulcanisation process. Also there is a significant potential market for products such as epoxidised and chlorinated natural rubber and other chemically modified rubbers that were not possible to develop with available grades of natural rubber to date mainly due to its high molecular weight.

The report by the Lendell Mills Commodity Studies (Published in June 1991 and submitted to the EDB) states that the future market for depolymerised rubber could increase even to about 5000 t per annum if a non toxic light coloured grade can be developed. Since the material developed by the Polymer Chemistry Department satisfies these features there is a high possibility that our product could capture a considerable percentage of the market in the future.

A German collaborative GCEC approved project is about to start at Associated Speciality Rubber, Yatideriya to manufacture depolymerised natural rubber for export.

Experiments on depolymerised natural rubber latex have also been successful and a sample has been dispatched to Germany on request.

The depolymerised rubber has been introduced to the industry as an adhesive and a factory in the FTZ, Katunayake is using this material at present in semi commercial scale. Initial arrangements have been made to introduce depolymerised natural rubber in the tyre industry as a non extractable vulcanisable processing aid and as a base for cushion gum in the retreading industry.

Work on commercial implementation of Thermoplastic Natural Rubber (TPNR) was continued. TPNR coagulating pans were manufactured and distributed among the Group Processing Centres. About 200 coagulating pans (Rs. 45/- each) and 15,000 latex collecting cups (Rs. 2.50 each) were sold to rubber manufacturers who were satisfied with the trials. Further orders for coagulating pans have been undertaken.

A hand injection moulding machine of value Rs. 15,000 has been recommended to manufacture items like plug tops and bases, soap dishes, bowls, mirror holders etc. out of TPNR. Due to the low cost, this technique can be implemented among the Janasaviya recipients to turn out small items out of TPNR. The production of ceiling roses out of TPNR by using the above technique is in operation by a small scale industrialist in Lunuwila.

Sample of newly developed Heat Resistant Rubber and Superior Processing Rubber have been sent overseas for possible market promotion. A request to advise on production of these rubbers in commercial scale at Associated Speciality Rubbers Yatideriya on consultancy basis has been accepted.

Formulation based on natural rubber latex to get a protective coating for steel frames has been introduced to the industry. Inter Coir (Pvt.) Limited has done promotional work on this product and had undertaken to export rubber coated pot holders to Japan. A development fee has been agreed upon for the process developed by the Polymer Chemistry Department.

A soluble form of cyclised rubber has been prepared successfully from natural rubber latex. This will be a better substitute for the imported costly resins used in the paint industry. Several paint manufacturers have shown interest in this new product. The suitability of this paint as a road marking paint is to be tested in the near future.

Experiments carried out on the preparation of epoxidised natural rubber (ENR) were promising. Oil resistance of ENR has been found to be better with increasing level of epoxidation.

A formulation based on highly stabilized natural rubber latex has been introduced to a small scale industrialist to produce canvas shoe cleaning fluid.

Two large samples of positex have been dispatched overseas through Sherman Sons. Positex can now be produced at a cheaper price since a manufacturer of industrial grade cetrimide, the most expensive and important chemical used in the manufacture of positex, has been located.

Polymer Chemistry Department was actively involved in getting an attractive promotional brochure done on "Natural Rubber and Products" during November, 1991.

Polymer Chemistry Department was also responsible in getting a leaflet 'What We Can Do For You' printed. These leaflets were distributed among the public to show the services offered to the industry by the RRISL.

Two exhibitions have been organised by the Polymer Chemistry Department with co-operation of the other departments to mark SAARC conference (Expo Crop 1991) and SLAAS Annual sessions at Mahaweli Centre and BMICH respectively. The outcome of these exhibitions has been successful and as a result a lot of inquiries have been made on different aspects including information about certain speciality rubbers and latices. The percentage of trouble shooting problems, inquiries and information about small scale rubber industries forwarded to the RRISL by the public have been increased considerably after holding these exhibitions. Also four new small scale industries have started during the past six months as a result of valuable advice and technical know how provided by the Polymer Chemistry Department.

DETAILED REVIEW

Staff:—

Dr. K. G. Karnika de Silva returned to the country on 6th May 1991 after completing 9 months sabbatical leave at McMaster University in Canada. She was appointed as the Acting Head of the Polymer Chemistry Department with effect from 6th May 1991 and promoted to the Head of Polymer Chemistry Department on the 25th June 1991.

Dr. Pushpa P. Sirimanne was promoted as a Research Officer (Grade I and II) with effect from 15th October 1989. She was on duty throughout the year.

Mr. S. M. C. E. Silva, Assistant Rubber Chemist was on duty throughout the year.

Mr. H. N. K. K. Chandralal left for Japan on no pay leave on a Japanese Government Scientist Exchange Programme in November 1991 to work on a project on Radiation Vulcanisation.

Mrs. Indra Denawaka was promoted to Experimental Officer with effect from 29th April, 1991.

Three Technical Officers Messrs. S.S. Warnapura, S.L.G. Ranjith and L.P. Witharana were transferred to the Polymer Chemistry Department from Dartonfield with effect from 11th March, 1991.

Mrs. Chithra Kuruppu and Mr. S. S. Warnapura were promoted to Senior Technical Officers with effect from 9th July 1991.

Mrs. Lakshmi Dissanayake, Technical Officer, was on Maternity Leave until 1st September, 1991.

Miss. Vindya Kudaligama assumed duties as a Technical Officer on 1st March 1991 and resigned on 12th August to continue her higher studies.

Mrs. Manel Nilaweera resigned from duties with effect from 10th January 1991 and migrated to Australia with her family.

Mrs. Renuka Wijeratne, Typist/Clerk was on duty throughout the year.

Messrs. S. Weerasiri and P. G. Sigera, Laboratory Attendants and Mr.L. Piyasena, Laboratory Labourer were on duty throughout the year.

Two labourers Messrs. W. D. S. Dharmawardena and J. A. Dayaratne were transferred to the Polymer Chemistry Department with effect from 15th April, 1991.

Research Students:—

Miss. Samantha Premachandra, N.D.T. student from the University of Moratuwa carried out a 3 months project on cyclised rubber.

Mr. W. P. M. Abeysekera, MSc student from the University of Moratuwa has undertaken to carry out his project on the processing behaviour of thermoplastic natural rubber.

Overseas visits:—

Dr. K. G. Karnika de Silva was on sabbatical leave for 9 months and returned to work on 6th May, 1991. Mr. H. N. K. K. Chandralal left for Japan to work on a project on "Radiation vulcanization of NR latex".

Reports:—

Graft copolymerisation of vinyl monomers onto natural rubber—K. G. Karnika de Silva – work carried out on sabbatical leave at McMaster University in Canada.

Lectures/Seminars/Exhibitions/Meetings:—

Dr. K. G. Karnika de Silva, Dr. Pushpa P. Sirimanne and Mr. S. M. C. E. Silva served as lecturers for the 6th Diploma courses in Plantation Management organised by the NIPM.

Dr. K. G. Karnika de Silva served as a lecturer for the Diploma course in Rubber Technology organised by the Plastics and Rubber Institute.

Dr. K. G. Karnika de Silva and Dr. Pushpa Sirimanne served as Visiting Lecturers for the MSc in Polymer Science at the University of Sri Jayawardenapura. Dr. K. G. Karnika de Silva, Dr. Pushpa P. Sirimanne and Mr. S. M. C. E. Silva served as supervisors for their practicals conducted in the Polymer Chemistry Department and the staff assisted them.

Dr. K. G. Karnika de Silva participated on a field day organised by SPC Ratnapura and talked about the introduction of TPNR latex collecting cups and coagulating pans and the possibilities of manufacturing speciality rubbers in factories using existing facilities.

Dr. K. G. Karnika de Silva conducted two lectures on TRNR and modified speciality rubbers and Dr. Pushpa P. Sirimanne conducted a lecture on Anticoagulants for factory officers organised by NIPM.

Mr. S. M. C. E. Silva delivered a lecture on "Rubber Products Manufacture from latex" to small scale industrialists in Ratnapura area. This was organised by the IDB.

Dr. K. G. Karnika de Silva attended 4 committee meetings on "Survey of Industries" held at the Standard Institution.

Dr. K. G. Karnika de Silva participated at the Central Scientific Committee Meeting and reviewed the services offered to the rubber manufacturers and industrialists by the Polymer Chemistry Department.

Dr. K. G. Karnika de Silva, Dr. Pushpa P. Sirimanne and Mr. H. N. K. K. Chandralal participated at a discussion with JEDB IV, Chairman, Director and six Superintendents regarding the advantages in using TPNR latex collecting cups.

Department staff was actively involved in organising two exhibitions held at the Mahaweli Centre and BMICH to mark the occasions of the SAARC conference and the annual sessions of the SLAAS respectively.

Department staff participated at seminars on Tyre Retreading, Non staining Phenolic antioxidants and Elastomeric Architecture.

Mr. H. N. K. K. Chandralal attended 3 committee meetings of RVNRL group held at the Atomic Energy Authority.

Industrial Extension:—

Polymer Chemistry Department assisted the following organisations in product development testing and improving the quality of the existing products and formulations.

Intercoir Limited	..	Rubber Coated Metal Frames and foam carpet backings.
T. K. Precisions Industries (Pvt.) Limited		Adhesives.
Vincit Estate, Waharaka	..	LATZ latex.
Silver Rays Industries	..	Can Sealant.
Jayalath Electricals	..	Electrical components out of TPNR.
Nawaloka Polysacks Ltd.	..	Mirror holders, latex collecting cups.
Hirani Industries	..	TPNR coagulating pans.
Sherman Sons Limited	..	Positex, compounded latex.
Associated Speciality Rubbers	..	SP rubber, depolymerised rubber and coagulating pans.
Bata Shop Co. Ltd.,	..	Blooming of antioxidants in shoe soles.
Trent manufacturing Co., (Pvt.) Limited.		Factory development and product development.
Synchro (pvt) Limited	..	Shoe reconditioner.
ChemaneX Limited	..	Road marking paint.
Road Development Authority	..	Road marking paints.

Field and laboratory investigations:—

Depolymerised Natural Rubber

A very economical procedure has been developed by the Polymer Chemistry department to produce depolymerised natural rubber and latex starting from field latex on industrial scale.

A certain number of major rubber industrialists abroad, have shown an active interest in depolymerised rubber, provided sufficient and consistent supplies can be guaranteed. Although other countries had studied the possibility of producing depolymerised rubber from natural rubber latex the process involve the use of costly, toxic chemicals, Apart from this the material has to be produced in a sophisticated reactor under carefully controlled conditions. The technique developed by us is a very practical way of producing non toxic grades of depolymerised rubber in commercial scale.

Therefore an economically and commercially profitable market should build up rapidly. It should have a capacity of about 1500 t per annum in the field of adhesive industry, ebonite manufacture and as a non extractable and vulcanisable processing aid to give better performance.

Further there is a significant potential market for modifications such as epoxidation and chlorination which were difficult to produce upto date due to the high molecular weight of the natural rubber. Experiments on these modifications in laboratory scale have been commenced.

An introduction of depolymerised natural rubber to possible local consumers was also carried out. As a result a local consumer T. K. Precision Industries (Pvt) Limited in the FTZ Katunayake has started using the product developed by us as an adhesive in their industry. This has saved them 2/3 of their expenses spent on imported adhesives. The material will also be introduced in the local tyre industries as a non extractable, co-vulcanisable processing aid to improve the performance of tyres and as a base for cushion gum used in tyre retreading.

The development of a non toxic grade of depolymerised latex have also been carried out during the past year. This product will be of interest among German consumers in the latex products manufacturing industry. The initial evaluation of the product has been successful. Further work on the project is in progress.

(K.G. Karnika de Silva, S. M. C. E. Silva, L. P. Witharana).

(2) Ebonite manufacture:—

Hard ebonite compounds are used in lining of various metallic containers and pipe lines used in chemical industries. It has been experienced that the depolymerised natural rubber is the best raw material for the manufacture of ebonite.

Initial trials commenced in the laboratory to produce ebonite have been encouraging. Different proportions of depolymerised rubber have been used in the formulation to see the most suitable combination to obtain ebonite.

(K.G. Karnika de Silva, S. M. C. E. Silva, A. S. Dekumpitiya).

(3) Thermoplastic Natural Rubber

Commercial scale implementation of items out of TPNR has been carried out. Samples for initial trials have been provided free of charge by the RRISL. Latex collecting cups (about 15,000 Nos.) and coagulating pans (about 200 Nos.) have been manufactured during the past year and sold to the interested parties. A royalty payment of Re. 1/- per kg. of TPNR manufactured had been paid to RRISL. JEDB has bought 10000 latex collecting cups for Rs. 25000/- for Elston estate and private estates have paid over Rs. 4000.00 for TPNR coagulating pans. New orders for pans and cups have been placed.

A hand injection moulding machine to turn out ceiling roses and plug tops has been introduced to a private party at a lower cost. This machine will cost Rs. 12000—15000 and the mould to turn out small items will cost only about Rs. 1500/-. Therefore this could be a project that is suitable for the Janasaviya recipients. The production of small items using hand injection moulding machine is in operation at the moment in Lunuwila.

Mirror holders for motor cycles and cars have been turned out at Nawaloka Polysacks Ltd. The demand for these items is very high and UV resistance of the samples is being tested before introducing them to the consumer market. (K. G. Karnika de Silva, H. N. K. K. Chandralal, S. L. G. Ranjith, S. S. Warnapura)

(4) Cyclised rubber

(a) *Cyclised rubber for paints*

Work on this project has been continued. The nitrogen content and the molecular weight of the rubber in latex was found to effect the efficiency of cyclisation significantly. Also the use of various non-ionic soaps such as vulcastab LW, Triton X 100 and Wettam, in preparing the low nitrogen latex for cyclisation has been tested. It has been found that the vulcastab LW is the most suitable stabiliser in the manufacture of low nitrogen latex used in the process of cyclisation. In addition to the nitrogen content, and molecular weight of NR, maturation period of low nitrogen latex also has a marked effect on the solubility of cyclised rubber.

Several batches of latex were prepared in order to find out the consistency of the cyclisation process. Analysis of the samples were carried out at Institute of Fundamental Studies and University of Colombo using their available facilities.

Cyclised rubber based road marking paints were prepared using different formulations at CIC and Chemanex. One of the drawbacks in this process is the poor grinding facilities available to incorporate the pigments to cyclised rubber solution. To perfect the paints obtained it is necessary to improve the formulation. Also a large scale trial of manufacture of cyclised rubber is planned to be carried out at Chemanex Ltd.

(Pushpa P. Sirimanne, S. M. C. E. Silva, K.G. Karnika de Silva, Indra Denewaka, L. P. Witharana).

(b) *Cyclised rubber as hardening resin.*

Use of cyclised rubber in articles where improved hardness, light weight and light colour are important, is of interest due to the rising cost of important substi-

tutes. Preliminary work has shown that cyclised rubber when properly mixed with rubber and rubber compounding ingredients impart good physical properties by its reinforcing action.

(Pushpa P. Sirimanne, S. M. C. E. Silva, S. S. Warnapura, S. L. G. Ranjith)

(c) Compounding Latex with cyclised rubber.

Cyclised rubber was blended with latex using different dispersion systems. The dispersibility of CR using a non ionic surfactant; sodium salt of disulphonic acid (Dispersol LR) and a cationic surfactant, cetrimide was compared. Formulations were tested with centrifuged latex and positex. Film forming properties of the latter system were found to be satisfactory. Incorporation of different levels of cyclised rubber were made with positex. Experiments are underway to determine optimum level of incorporation of cyclised rubber in latex to give the best physical properties.

(Pushpa P. Sirimanne, S. S. Warnapura, Indra Denewaka).

(5) Epoxidation of Natural Rubber

Epoxidised natural rubber was prepared by using peracetic acid as the epoxidizing agent. The extent of epoxidation was found to be 16% as analysed by NMR and IR spectroscopy. Experimental trials, carried out to prepare ENR 50 was not successful, as the latex coagulated before the completion of the addition of per acid. Therefore further experiments were carried out to overcome the problem of the coagulation of latex. Also several experiments were carried out to determine the optimum concentration of the cationic soap to be used for making positex, as the raw material for epoxidation.

ENR Latex

A successful trial on the preparation of epoxidised natural rubber latex was done and the TS of the resultant latex was found to be around 15%. In order to concentrate the latex, Sodium Alaginate was added. It has been found that the TS of ENR latex can be increased upto 40%.

It was found that an increase in the epoxidation level give rise to an increase in the oil resistance of ENR in a semi-EV type formulation.

(Pushpa P. Sirimanne, Anoma Gunawardena, Chithra Kuruppu, S. L. G. Ranjith)

Positex

Several samples of positex were prepared for epoxidation, prevulcanisation and creaming.

(a) Creaming:—

Three types of cationic soaps were compared on the efficiency of creaming. The optimum concentration and the optimum time taken to complete the creaming were obtained.

(b) Prevulcanisation:—

The effect of concentration of cetrimide on prevulcanisation was studied. The problem of excessive stickiness of the latex films was rectified. Further experiments are underway to perfect the physical properties of the vulcanised films.

(Pushpa P. Sirimanne, Chithra Kuruppu, Lakshmi Dissanayake)

(c) Export order for yellow and white positex:—

Two large batches of positex 100 litres each of yellow and white positex were prepared and dispatched overseas through Sherman Sons Ltd.

It was found that it is very much cheaper to use industrial grade cetrimide available from Disham Chemicals (Pvt) Ltd. in India and arrangements have been made to order cetrimide through them. Another order for 25 litres each from yellow and white positex has been placed by the same consumer through Sherman Sons Ltd. The total requirement of positex by this particular consumer is about 200 t per annum. If the order is reconfirmed arrangements will be made to manufacture this quantity at Vincit Estate, Waharaka.

(K. G. Karnika de Silva, Pushpa P. Sirimanne, Chithra Kuruppu)

7. Coir based carpet backing

Trials have been conducted to produce coir based carpets with latex foam backing and rubberised edges on a request made by Inter Coir Ltd. The formulation in operation currently has been evaluated to be uneconomical and a new formulation have been carried out in our laboratories. Initial trials have been successful and further work on the project is in progress.

(K. G. Karnika de Silva, Indra Denawaka).

8. White/blue/red shoe polish for canvas shoes.

A formulation based on a highly established modified natural rubber latex has been recommended to be used as shoe cleaning fluid to an interested party. The trials have been very successful and a new industry is to be registered to commence

industrial scale manufacture of this product. The product could be sold at a cheaper price than the existing synthetic products since the cost of manufacture of natural rubber based material is very low and there is no capital investment involved.

(K. G. Karnika de Silva, Indra Denewaka)

9. Rubber Coated metal frames

A new formula was developed to coat metal frames with natural rubber latex based material. Eight sets of rubber coated metal flower pot holders were sent to Japan through Inter Coir (Pvt) Ltd.

The method involved is a simple dipping process which needs drying the dipped frames in an hot oven. The final coating is nonpeelable smooth and glossy in appearance. The firm has to pay a development fee to out right purchase of this process from the RRISL.

Further developments on this process are in progress.

(K. G. Karnika de Silva, Indra Denawaka)

10. MR Rubber

A detailed study of graft copolymerisation of vinyl monomers on to natural rubber latex had been studied and from the kinetics of the reaction a computer model had been developed. The best experimental curve that fits on to the model gives the ideal conditions for the copolymerisation reactions. This facilitates to select the exact temperature, concentration of the initiators and the composition of the reactants for efficient polymerisation.

The technological properties of the reaction products are to be tested.

(K. G. Karnika de Silva, A. E. Hamilelec (Mc Master University, Canada)

11. Superior Processing Rubber/Heat Resistant Rubbers.

SP 30 and SP 20 rubber, both superior processing and heat resistant, have been prepared and dispatched to Germany on request. The testing of the samples have been carried out and large scale production of the rubber is to be carried out in the future.

(K. G. Karnika de Silva, Chithra Kuruppu, Lakshmi Dissanayake).

12. Blooming of compounding ingredients

Bata Shoe Company has faced a problem of blooming of some compounding ingredients from shoe soles, during the past year. A study has been undertaken at the RRISL to identify these blooms. It has been found that at high cure temperature blooming is significantly high. Our experiments show that the bloom contains MBT. One possibility is that the MBTS which is present in the compound decomposes into MBT and hence increase the concentration which will be above the equilibrium solubility of MBT in NR at room temperature. UV spectroscopic analysis of the washings of the blooms also supported this observation.

(Pushpa P. Sirimanne, K. G. Karnika de Silva, S. M. C. E. Silva, S. L. G. Ranjith, Daya de Silva (Bata Shoe Co.)

REVIEW OF THE RAW RUBBER AND CHEMICAL ANALYSIS DEPARTMENT

By

L. M. K. TILLEKERATNE

The Raw Rubber and Chemical Analysis Department has been engaged in the following duties during the last year.

- (a) Analysis, grading and issuing shipping certificates for all TSR produced in the country.
- (b) Analysis and quality checking of rubber chemicals and water used in the industry.
- (c) Analysis and certification of concentrated latex manufactured in the country for local industries and for export.
- (d) Conducting research to improve the ageing properties of Radiation Vulcanized Natural Rubber Latex.
- (e) Presentation of latex crepes in TSR form to ensure consistency in quality

A survey was carried out to standardise the metrolac ready reckoner chart in collaboration with SLSI.

Experiments and surveys were carried out to check the magnesium levels of Sri Lankan field latex in the various rubber growing areas of the country. An experiment was carried out to check the effect of antioxidants 2,2' - Methylene - bis - (4-methyl-6-t-butyl phenol) and dialcaryl thio dipropionate on Radiation Vulcanized Natural Rubber Latex. Another important project started this year was the study of raw rubber and vulcanizing properties of skim rubber & blends of skim rubber with RSS.

Presentation of latex crepes in TSR form has been introduced to the rubber industry.

DETAILED REVIEW

Staff

Dr. L. M. K. Tillekeratne, Director, served as an UN expert in Miennam. The Director attended the IRRDB meeting held in Manila. Mr. L. Karunanayake, Asst. Specifications Officer participated in the UNDP/IEAE/RCA workshop on Radiation Chemistry held in Japan Atomic Energy Research Institute, Takasaki, Japan.

Miss. Anoma Gunawardene assumed duties as Asst. Rubber Chemist with effect from 1st March 1991. Mr. A. S. Dekumpitiya, Experimental Officer was on duty throughout the year. Mrs. H. S. Weeramen, Senior Technical Officer was promoted to the post of Experimental Officer with effect from 29th April, 1991. Mrs. L. Wanigatunga, Mrs. V. Gamage, Mrs. N. Baduge, Mr. P. H. Sarath Kumara and Mrs. C. S. Lokuge were on duty throughout the year.

Mr. R. S. Wijesundera was transferred to this Department from Plant Science Department. Mr. W. A. S. Wijesekara, Specifications Assistant (Special Grade), Messrs. G. Wanigatunga, K. K. Austin, B. Gunasiri, W. W. Nandasena and P. L. Perera, Specifications Assistants were on duty throughout the year. Mr. P. G. Lelwela, Instrument Technician was on duty throughout the year.

Seminars

Dr. L. M. K. Tillekeratne attended the IRRDB meeting held in Manila and presented a paper on "Presentation of Latex Crepe in TSR form".

Committees

Mr. L. Karunanayake attended a committee meeting of RVNRL group held at Atomic Energy Authority.

Training

Dr. L. M. K. Tillekeratne, Mr. L. Karunanayake and Miss. Anoma Gunawardene delivered lectures to the trainee planters and Factory Officers from SLSPC and JEDB, preparing for the Diploma course organised by the NIPM.

Laboratory Investigation and Field Experiments

DRC Determination of Latex

In order to eliminate the problem of under estimation of the DRC of small holders latex by using various ready reckoner charts, a project has been carried out to standardize the metrolac ready reckoner chart in collaboration with Sri Lanaka Standards Institute.

Collection of samples was completed. Analysis of the data collected is in progress

Objective of this project is to introduce a new standardized metrolac chart with the SLS mark. This will solve most of the problems which are created by the use of various versions of metrolac ready reckoner charts.

(L. M. K. Tillekeratne, L. Karunanayake, Mrs. S. Devendra, & P. H. Sarath Kumara).

Magnesium levels in Natural Rubber Latex

This investigation was started to probe the magnesium levels in centrifuged latex and field latex. The study was extended to analyse the variation of magnesium levels in field latex samples collected from different rubber growing areas of the country. Collection and analysis of samples were done throughout the year.

(L. M. K. Tillekeratne, L. Karunanayake, W. W. Nandasena & P. H. Sarath Kumara)

Evaluation of Skim Rubber

Skim rubber was blended with RSS in different ratios. The raw rubber properties, vulcanization characteristics and physical properties were tested and compared with other grades such as Low Nitrogen Natural Rubber (LNNR) and Superior Processing rubber (SP). An increase in hardness and the role of vulcanization were observed. At the moment we are studying extrusion characteristics and processability of skim and its blends with RSS which showed promising results so far.

(L. M. K. Tillekeratne, N. M. V. Kalyani, L. Karunanayake, Anoma Gunawardene, W. Nandasena & Nimal Karunatilaka).

Binder for Coir Dust

A binder for coir dust was developed using centrifuged latex. With this binder coir dust can be moulded into any shape for easier handling. Bound coir dust pressed into the form of miniature flower pots were specially prepared for a client as an export sample.

(N. M. V. Kalyani, Anoma Gunawardene, Champa Lokuge and Wasantha Gamage)

Evaluation of properties of different grades of scrap crepe

Raw rubber and physical properties of 3 types of scrap crepes were studied, as these grades are usually used widely in the tyre retreading industry.

(N. M. V. Kalyani, Anoma Gunawardene & D. P. Wettasinghe).

Presentation of latex crepes in block form as TSR

Latex crepe is presented in block form as TSR. By careful selection of laces a consistency in quality can be maintained. Differences in Plasticity, PRI and Colour are due to the fractionation and bleaching of latex prior to making of crepe. The laces are heated to about 100°C for half an hour prior to blocking. Traces of moisture in the laces are removed by this process and the average VM is less than 0.3%.

(L. M. K. Tillekeratne, L. Karunanayake, Anoma Gunawardene, and Wasantha Gamage).

Rainguards and sealent for rainguards

A new gutter type rainguard was developed. About 50 samples of this new rainguard were fixed in the Dartonfield estate using the sealent which was developed earlier for skirt type polythene rainguards.

Large scale production of sealent for skirt type rainguard was carried out throughout the year. Fixing of skirt type rainguard was done in the Kalutara & Kegalle areas.

(L. M. K. Tillekeratne, L. K. Karunanayake, A. S. Dekumpitiya, K. K. Austin with the staff of the Plant Science Dept.)

Antioxidant study on RVNRL latex

Vulcanization of natural rubber latex can be done by using radiation or electron beam. But the product made out of this latex does not have good ageing properties. Hence, the objective of this project was to find out a suitable antioxidant or antioxidants combination to improve the ageing properties.

It was observed that the combination of antioxidants BKF & LTDP gave some improvements.

(N. M. V. Kalyani, H. N. K. K. Chandralal, L. Karunanayake & P. H. Sarath Kumara)

Inspection Visits

Inspection visits were made to all the TSR factories. Special visits were made to some of the TSR factories to calibrate their testing equipments such as Wallace Rapid Plastimeter and Mooney Viscometers. Visits were also made to several factories for experimental and advisory purposes.

Miscellaneous

Table 1 * *Number of samples tested from each TSR factory during 1991.*

<i>Code</i>	<i>Producer</i>	<i>No of samples</i>
AA	Sri Lanka Rubber Manufacturing Co. Ltd., Mawanella.	694
AD	Statcon Block Rubber Factory, Getahetta	847
AF	Ceymac Block Rubber Factory, Horana.	8374
AE	Shermans Block Rubber Factory, Ingiriya.	2044
AI	Associated Traders Co. Ltd., Colombo.	111
Total		12070

Table 2 ; *Miscellaneous samples tested during the year.*

Rubber samples	1517
Latex samples	123
Water samples	4
Chemical samples	29
Carbon Black	—
Master batch samples	367
Fertilizer samples	2
Polythene samples	7
Total	2249

REVIEW OF THE RAW RUBBER PROCESSING AND CHEMICAL ENGINEERING DEPARTMENT

By

W. M. G. SENEVIRATNE

SUMMARY

Construction of an effluent treatment plant is now underway at Neuchatal Estate, Neboda to reduce the pollution levels in the area to acceptable standards. The method of treatment adopted here is the aeration activated sludge system and it is expected that the extent of treatment could be greatly enhanced if growth of micro organisms to that of supply of food is carefully controlled by supplying required amount of air into the system. Other methods of treatment systems are also discussed here and out of them effluent cascading technique would be of great interest and value if suitably developed since it is less expensive to construct when compared to other systems. Efficient utilization of energy in rubber factories is being evaluated and analysis shows that maximum power demand could be reduced vastly by improving the poor power factor. This could be achieved by fixing power factor capacitors to each rubber processing machine/mill.

Manufacture of Low Nitrogen Natural Rubber (LNNR) for export continued successfully and the establishment of a central processing factory is highlighted in the review to maintain the consistency of quality of LNNR.

The use of oil extended NR (OENR) in tyre retreads is now under evaluation in collaboration with Messrs AMW Ltd with a view to upgrade the quality and performance of retreaded tyres in Sri Lanka.

It is estimated that nearly 5 metric tonnes of glove cutting and rejected go as waste per month from glove manufacturing firms in Sri Lanka. Hence a project was started to recycle this material and the initial experiment indicated that this material could be developed into a special type of rubber if blended with unvulcanised NR.

The synthesis of urea formaldehyde resin is now perfected and latex collected in shells coated with this resin is found to be superior in quality to that of latex collected in uncoated shells.

A rubber products centre was set up at Dartonfield to train the unemployed youths in the area with a view to encourage them to set up their own business enterprises.

DETAILED REVIEW

Staff

Dr. W. M. G. Seneviratne, Rubber Chemist was transferred to this department from the Rubber Technology & Development Department as the Officer in Charge and made its acting head subsequently.

Mr. Susantha Siriwardene, Assistant Rubber Chemist assumed duties on 2nd May 1991 and was on duty throughout the year. One cadre vacancy for Research Officer was not filled during the year.

Experimental Officer, Mr. S. L. Weerasinghe, Technical Officers, Messrs. T. A. S. Siriwardene, C. Senanayake and Miss. C. K. Nalini were on duty throughout the year.

Technical Officer Miss. C. Jayawardene was transferred to the Rubber Technology & Development Department with effect from July 1991. Mr. Sarath Kumara was seconded to this department from Raw Rubber & Chemical Analysis Department with effect from July 1991 and he was assigned to the Janasaviya Training Programme organised by the department.

Mr. U. Dharmasena, was on duty throughout the year. Mr. Ariyaratne was transferred to this department from Raw Rubber and Chemical Analysis department with effect from 1992. The department functioned with a depleted staff.

Reports

Dr. W. M. G. Seneviratne served as the Chairman of the Committee appointed by the Ministry of State Plantation Services to look into some operations at the Mawanella Natural Rubber Complex and a comprehensive report was submitted.

Meetings/Seminars/Lectures

Dr. W. M. G. Seneviratne, Rubber Chemist visited India to attend the International Rubber Conference held at Bangalore from 5th February to 8th February and presented a paper on 'Some studies on TPNR blends'.

Dr. W. M. G. Seneviratne and Mr. Susantha Siriwardene, participated in the "Awareness Programme on Energy Management and Conservation" organised by the NERD centre, Ekala on 31 October 1991.

Mr. Sunil Weerasinghe attended a programme on Energy Management organised by the National Institute of Business Management in collaboration with the Sri Lanka Energy Managers Association held at CEB from 4 June to 8 June 1991.

Dr. W. M. G. Seneviratne attended the field work days for superintendents held at Pussella SP and Elpitiya SP and delivered lectures on rubber manufacture.

Dr. W. M. G. Seneviratne conducted lectures on Polymer Science and Technology for both General and Special students in the University of Colombo and University of Sri Jayawardenepura. He also conducted lectures for Polymer MSc course at the University of Sri Jayawardenepura.

Dr. W. M. G. Seneviratne and Mr. Sunil Weerasinghe delivered lectures to the training course for the factory officers and superintendents separately organised by the NIPM with the help of RRISL.

Dr. W. M. G. Seneviratne also attended the following meetings/seminars RRI Scientific committee meeting, Rubber Council meeting.

FIELD AND LABORATORY INVESTIGATIONS

Treatment of effluent from rubber factories

A survey to list out factories, for which the treatment of effluent is necessary, was carried out in the Kalutara region with a view to take remedial action to solve the prevailing problems in these factories. RRI recommends a few treatments systems and these can be listed out as follows;

(a) Treatment of effluent by aeration

This technique is widely used to treat a variety of effluents such as milk, waste, sewage and effluent from tanneries etc. Basically the treatment system should consist of the following ;

1. Rubber trap tank
2. Aeration (treatment) tank
3. Sedimentation (setting) tank

Rubber trap tank

Purpose of this tank is mainly to trap the small rubber particles in the effluent. It is desirable to construct the tank to accommodate half days effluent and should be partitioned into at least four compartments. Syphoning method should be adopted when passing effluent from one partition to the other in order to facilitate the trapping of rubber.

Aeration tank

This tank should at least accommodate one days effluent. Effluent from the rubber trap tank should be aerated using suitable aerators. Aeration has to be carried out until sludge forms and this is entirely dependent on the quality and the condition of the effluent.

Settling tank

The treated effluent from the aeration tank should be allowed to overflow to this settling tank where the sludge will be allowed to settle down when kept undisturbed.

In this type of treatment process it is desirable to recirculate part of the sludge formed in the settling tank to the aeration tank in order to activate the microbial activity on the raw effluent.

Construction of a pilot plant of this model is now underway at Neuchatal Estate, Neboda. Sri Lanka State Engineering Corporation (SEC) with the technical collaboration with the consultancy consortium and Rubber Research Institute is doing the construction and will be commissioned soon.

(b) Disposal of effluent — land application

This method of disposing effluent is being highly recognised in Malaysia and could easily be adopted in Sri Lanka too. Initial experiments carried out at Culloden Estate gave vital indication that not only the effluent can be disposed by way of distribution on soil but also it acts as a fertiliser if properly diluted to adjust the PH. It is also desirable first to trap the rubber by having suitable rubber traps as indicated in the aeration method prior to application on land.

(c) Effluent cascading system

The technique adopted here is same as the after cooling process by cascading. Plant should be constructed in such a way that the effluent is allowed to cascade intermittently through several wooden plates on which either natural or synthetic fibres are mounted in order to facilitate the growth of micro organisms. Initial experiments carried out at Yatadola SP are satisfactory and further studies are being carried out in order to perfect the system. Messrs Lalan Rubbers, kindly agreed to assist us in developing of this technique and have already set up a plant in its premises at Warakapola. (W. M. G. Seneviratne, S. Siriwardene, T. A. S. Siriwardene and C. K. Nalini).

Conservation of energy of rubber factories

It was observed in many factories that the energy is not utilised in a proper way and therefore have to pay the penalty by paying higher electricity bills.

Conservation of energy never attempts to limit the usage of energy by way of cutting down the production and reducing services offered, but by increasing energy, productivity through reducing wastage and increasing efficiency. Conservation of energy can be at two levels in a technological process.

1. Eliminating wastage and minimising losses
2. Improving or introducing modification in the existing technological process in order to obtain better energy utilization.

Suggestions to maximise the conservation of energy

(i) Power factor correction capacitors

Analysis of the measurements collected shows that the maximum power demand level could be reduced to a greater extent by improving the poor power factor. In most factories the KVA value lies in the range of 100-150 where as in factories where the power is utilised properly the KVA value is as low as 60. Hence it is recommended to fix individual power factor capacitors to each rubber processing machinery. According to a survey carried out at Doloswala SP, Niyithigala anticipated saving is given below:

Anticipated reduction in maximum demand	..	30 KVA
Anticipated annual saving	..	30 x 130 x 12
		<u>Rs. 46,800</u>

(ii) Power carriers

Conducting wires should be properly insulated in order to prevent electrical energy being lost as heat.

(iii) Load rescheduling

In most factories there is a considerable fluctuation of the maximum power demand and there is room to reduce the actual maximum power demand by operating the factory electrical loads according to proper scheduling. For example starting the machinery could be done by keeping sufficient interval after starting another machine.

(iv) Motors

The defective phase winding due to bad insulation of the motor will lead to higher consumption of electricity. Inbalance of current of the 3 phase of the motor is an indication for such bad insulation. In addition proper maintenance of the machinery and motors have to be carried out regularly to minimise the energy consumption.

(W. M. G. Seneviratne, S. Siriwardena, S. L. Weerasinghe & C. Senanayake).

Manufacture of SLR-LX block rubber and low nitrogen natural rubber (LNNR)

SLR-LX block rubber

Latex collected from selected clones from Atale, Perth and Urumewala were converted into latex crepe without bleaching or fractioning and later these were pressed into 33.3 kg bales. The standards required by the buyer were achieved by adjusting the manufacturing conditions. This particular grade of rubber was recognised as a premium grade and sold at 5 rupees higher than that of the crepe price. (W. M. G. Seneviratne, S. L. Weerasinghe).

Low nitrogen Natural Rubber LNNR

Manufacture of LNNR at Yatadola SP is being continued successfully with our direct guidance and assistance for export, through Messrs Alma Trading Co. and John Keels Ltd. Some inconsistency of the properties of LNNR was encountered initially. However by adopting exactly the same manufacturing procedure through out this variation of consistency could be eliminated to a greater extent.

Since LNNR is recognized as a premium grade of rubber and fetches a good price, it is advisable to set up a factory to manufacture LNNR to maintain its consistency, quality and also meet higher amounts of foreign demands which is a very important aspect in any kind of trading.

(W. M. G. Seneviratne, S. L. Weerasinghe, T. A. S. Siriwardena, C. Senanayake).

Resin coated coconut shells for latex collection

Synthesis of the thermosetting resin urea-formaldehyde is perfected and a fairly large number of shells were coated with it successfully. The initial experiments were carried out at Dartonfield over a period of time.

Definite improvements of the quality of latex was observed when compared with ordinary shells and they are given below*

- (a) Development of volatile fatty acid content is reduced by 33%.
- (b) Scrap content is reduced by about 52%.
- (c) In the bacterial count test, development of colonies is reduced by about 80% over a period of eight days.

Further work on this project is in progress with a view to implement it commercially. (W. M. G. Seneviratne, S. Siriwardena, C. Munasinghe, C. Senanayake, & T. A. S. Siriwardena.)

Use of Oil Extended Natural Rubber (OENR) in tyre retreading

It is established that the tyres made out of OENR are good for all seasons due to its superior physical properties than unextended natural rubber. It is even comparable or in some properties superior to that of oil extended styrene butadiene rubber (OESBR) which is one of the main types of rubber, used by the tyre industry other than NR.

Few tyres were retreaded using OENR by Messrs AMW Ltd who are jointly working with RRI with a view to upgrade the quality of retreads in Sri Lanka. These samples were prepared by incorporating 20 parts of rubber processing oil at Dartonfield and the performance of these retreaded tyres are yet to be analysed.

(W. M. G. Seneviratne, C. K. Nalini).

Chlorination of NR latex

Preparation of CR samples were interrupted intermittently mainly due to its gas leaks from the chlorine cylinders. Ceylon German Technical Training Institute is helping us to turn out a special adapter for this purpose and we hope to be able to resume further work on the project soon.

(W. M. G. Seneviratne, S. Siriwardene.)

Recycling of Gloves cuttings

Nearly 500 kg of latex glove rejects were kindly supplied by Messrs Hanwella Rubber Products Ltd and were processed at Dartonfield factory to be blended with natural rubber. Although the first set of experiments was found to be satisfactory according to ACS 1 formulation another set should be tested before submission to rubber product manufacturing companies. This particular grade of rubber will find application such as in the manufacture of rubber slippers and particularly in tyre retreading either as the main rubber component, or as a blend, or filler.

(W. M. G. Seneviratne, S. L. Weerasinghe & C. K. Nalini).

Effluent treatment and disposal

Sketches of plans were provided to the following estates on their request to construct effluent disposal systems.

<i>Factory</i>	<i>Type of system</i>
1. Neuchatal State Plantation	.. Aeration pond system
2. Elston Estate	.. Aeration pond system
3. Clyde State Plantation	.. Aeration pond system
4. Ellakande State Plantation	.. Aeration pond system
5. Culloden State Plantation	.. Aeration pond system
6. Padukka State Plantation	.. Aeration pond system
7. Kiriloppone Estate	.. Aeration pond system
8. Pelmadulla State Plantation	.. Aeration pond system

Indication of 1 BOQ was also provided.

Advisory visits on crepe rubber, RSS and block rubber

The following estates were visited on their request and advise was given to improve the manufacture.

Elston Estate	}	Discolouration
Sirinivasa Estate		
Halpe Estate		
Udabage Estate		
Panawatte Estate		
Talduwa Estate		
Salawa Estate		

Mirishena State Plantation	}	Drying tower
Eladuwa State Plantation		

Dolfeswella State Plantation	}	power consumption Trial in utilisation of solar energy
Sorana State Plantation		

Advisory visits on low nitrogen Natural Rubber (LNNR)

The following estates were visited and advised on how to prepare better quality LNNR

1. Yatadola State Plantation
2. Poronuwa State Plantation

(W. M. G. Seneviratne, S. Siriwardena, S. L. Weerasinghe, T. A. S. Siriwardena, C. Senanayake).

REVIEW OF THE ADAPTIVE RESEARCH UNIT

By

N. YOGARATNAM

SUMMARY

Implementing Adaptive Research Programmes on smallholder fields and research on Multicropping of Rubber with Tea in state and smallholder sectors are the main functions of this unit. Use of rainguards and leguminous trees as hedges were implemented during the year under review. Few of the adaptive research trials of the 1989 programmes were terminated due to poor smallholder management practices. Girth of rubber plants were recorded in the 1989 intercropped fields which indicated better growth in the intercropped plots than in the control. Yield increases were recorded with Ethrel stimulation and increase in the number of tapping days was also seen in rainguard trials. Tea was brought into plucking in the unrehabilitated plots of an experiment on multicropping of Rubber with Tea after 12 months of planting.

DETAILED REVIEW

Dr. N. Yogaratnam, Assistant Director, coordinated the activities of this programme. Mr. S. M. M. Iqbal was appointed as the Research Assistant in Agronomy with effect from 01st of August 1991. Three Assistant Development Officers, viz. Messers. F. P. W. Silva, P. P. Jayasinghe and W. C. Dayaratne were on duty throughout the year. Mr. K. B. A. Karunasekera also assumed duties as an Assistant Development Officer on 01-02-1991 but continued with his training programme in U. K. until 24.12.1991. Mr. E. A. T. Senadeera, Technical Officer of the Plant Pathology and Microbiology Department was transferred to the Adaptive Research Unit and was stationed in Kegalle. Other scientists and extension personnel involved in this programme are ;

- (a) Scientists ; Dr. N. E. M. Jayasekera, Head/Genetics and Plant Breeding Department ; Dr. A. Nugawela, Head/Plant Science Department ; Mrs. Lalani Samarappuli, Head/Soils and Plant Nutrition Department ; Mtr Luxman Rodrigo, Research Assistant ; Mr. L. S. S. Pathiratne, Assistan. Botanist and Mr. Lalith Kariyawasam, Experimental Officer.

- (b) Extension personnel; Mr. K. Meegahawatta, Head/Development Division, Advisory Services Department; Mr. P. Samarananayake, R. A. O., Kalutara; Mr. M. C. Samarasekera, R. A. O., Galle; Mr. A. J. H. Silva R. A. O., Colombo; Mr. A. H. Kularatne, R. A. O., Ratnapura; Mr. D. D., Dasanayake, R. A. O., Kegalle.

Meetings and Conferences

Assistant Development Officers attended the following:

- .. Field days
- .. Monthly conferences
- .. Seminars with REO's and smallholders.

Adaptive Research Programme in Rubber Smallholdings

The following programmes were in progress on Rubber smallholder fields in the Kalutara, Galle, Colombo, Kegalle and Ratnapura Regions:

1989 Programme :

1. Field establishment practices
2. Clones
3. Planting Density
4. Intercropping

Some results from the 1989 programme are given in Table 1 ;

Table 1 ; Average girth of rubber-1989 programme. (cm)

Programme (1989)	Kalutara	Colombo	Galle	Kegalle	Ratnapura
1. Establishment Practice					
Bare root	17.45	17.83	17.44	14.89	14.52
Poly bag	16.97	18.16	16.48	17.55	16.50
Young budding	15.56	—	—	16.15	—
2. Clones					
PB 86	16.35	15.46	—	17.81	19.90
RRIC 100	16.82	18.66	21.29	16.01	14.76
RRIC 102	18.74	—	16.80	—	—
RRIC 121	17.63	—	12.80	—	—

3. Spacing

12' x 18'	16.04	18.29	—	17.02	15.14
8' x 27'	16.09	17.48	—	16.20	13.84

(F. P. W. Silva and W. C. Dayaratne)

1990 Programme :

Clone Evaluation

These trials are in progress. Girth measurements have not been recorded, as the plants are too young for measurement.

Intercropping

The effect of intercropping on growth of rubber plants were studied by measuring girth as the growth indicator. Table 2 and 4 gives the mean girth of the trees in the intercropped and control plots at different sites and regions.

Table 2* *Mean girth of trees in the plots intercropped with Banana and in the non-intercropped plots at different sites and regions. The standard error of the mean is given within the brackets.*

Region	Site	(Mean girth (cms))	
		Non-intercropped	Intcropped
Kalutara	1	12.49 + (0.30)	13.77 (+ 0.37)
	2	12.30 (+ 0.48)	17.18 (+ 0.44)
	3	12.03 (+ 0.64)	17.04 (+ 0.64)
	4	19.57 (+ 0.64)	16.66 (+ 9.58)
	5	19.66 (+ 0.66)	22.71 (+ 0.56)
	6	21.06 (+ 0.65)	21.98 (+ 0.86)
	7	20.07 (+ 0.40)	20.58 (+ 0.60)
	8	19.00 (+ 0.40)	19.43 (+ 0.52)
	9	18.45 (+ 0.56)	17.79 (+ 0.39)
	10	19.99 (+ 0.56)	17.69 (+ 0.51)
	11	19.15 (+ 0.44)	17.03 (+ 0.43)
	12	17.52 (+ 0.46)	18.76 (+ 0.35)
	13	16.33 (+ 0.23)	17.85 (+ 0.37)
	14	17.86 (+ 0.48)	17.18 (+ 0.40)
	15	16.63 (+ 0.35)	17.72 (+ 0.40)

Region	Site	Mean girth (cms)	
		Non-intercropped	Intercropped
Kegalle	1	19.79 (+ 0.33)	20.58 (+ 0.32)
	2	15.69 (+ 0.38)	16.26 (+ 0.97)
	3	8.39 (+ 0.25)	10.09 (+ 0.30)
	4	15.83 (+ 0.23)	17.38 (+ 0.35)
Colombo	1	17.00 (+ 0.69)	19.7 (+ 0.39)
	2	22.57 (+ 0.36)	23.15 (+ 0.40)

Table 3 : *The mean girth of trees in the intercropped (with pineapple) and non-intercropped plots at different sites and regions. The standard error of the mean is given within the brackets.*

Region	Site	Mean girth (cms)	
		Non-intercropped	Intercropped
Kalutara	1	15.53 (+ 0.48)	17.77 (+ 0.41)
	2	15.73 (+ 0.50)	14.96 (+ 0.35)
	3	14.42 (+ 0.42)	16.90 (+ 0.41)
Colombo	1	15.76 (+ 0.29)	22.07 (+ 0.50)
	2	19.21 (+ 1.92)	18.80 (+ 0.48)
	3	15.20 (+ 0.54)	24.78 (+ 0.85)

Data given in Table 2 and 3 indicate that intercropping with either banana or pineapple would not have any adverse effect on the growth of rubber plants. Apparently, the growth of rubber plants are superior in a few intercropped plots. This could be attributed to the general improvement in upkeep of the intercropped areas. (V. H. L. Rodrigo, L. S. Kariyawasam, F. P. W. Silva, W. C. Dayaratne and E. A. T. Senadeera).

The possibility of using poultry litter to supplement fertilizer to pineapple is being tested in collaboration with soils and Plant Nutrition Department (V. H. L. Rodrigo, L. S. Kariyawasam and F. P. W. Silva).

Yield Stimulation

In this trial, the Institute's recommendation on yield stimulation is tested in small-holdings. The holdings selected in both Kalutara and Kegalle regions were stimulated twice in 1990, i.e. August and December 1990. In 1991 stimulation was carried out in December. The mean yields (g/t/t) for the period 4 months after stimulation, both in stimulated and control tapping blocks are given in Table 4.

Table 4* *The mean yield (g/t/t) for the 4 month period after stimulation and the percentage incidence of dry trees in both stimulated and control plots.*

Region	Holding	Yield (g/t/t)		% dry trees	
		Stimulated	Control	Stimulated	Control
Kalutara	1	21.9	19.1	5.6	1.6
	2	30.4	27.9	7.8	1.0
	3	24.8	17.5	4.1	3.6
	4	45.6	51.0	7.5	1.2
	5	22.7	17.3	15.4	6.4
	6	28.6	20.4	3.4	5.8
	Mean	29.0	25.5	7.3	3.3
Kegalle	1	28.2	25.7	1.6	1.1
	2	28.8	18.3	3.9	3.9
	3	28.2	20.1	2.5	1.1
	4	15.9	17.3	3.7	4.1
	5	23.9	20.3	11.4	4.2
	6	36.7	24.8	3.7	2.0
	7	36.7	24.8	3.7	2.0
	Mean	28.3	21.7	4.1	2.4

The response to stimulation varies from holding to holding. Smallholdings in which the management practices are good may have responded well to stimulation. The mean yield increase for the 4 month period following stimulation is 14 and 30 percent for Kalutara and Kegalle regions respectively. Nevertheless, stimulation has also caused an increase in the percentage of dryness (Table 4). (L. S. S. Pathiratne and E. A. T. Senadeera)

Rainguards

A holding from each region, Kalutara, Kegalle and Avissawella were selected to study the possibility of introducing rainguards to the smallholders. A selected holding consisted of 2 or more tapping blocks and rainguards were fixed in one tapping block. The number of extra tapping days recorded in the task with rainguards are given in Table 5.

Table 5* *Number of extra tapping days recorded for the period indicated in blocks with rainguards in different regions.*

<i>Region</i>	<i>Period concerned</i>	<i>Extra tapping days</i>
Kegalle	July—November	21
Ratnapura	October—November	06
Kalutara	August—December	30

(A. Nugawela, R. P. Karunasena, W. C. Dayaratne, F. P. W. Silva and E. A. T. Senadeera).

Soil moisture and conservation practices

Use of leguminous trees as hedges and their effects on soil and moisture conservation in smallholdings are in progress at Kalutara and Kegalle regions details of which are given below;

<i>Region Name and address</i>	<i>Ext.</i>	<i>Clone</i>	<i>Treatment</i>
Kegalle M. M. W. Bandarathilake, Mawella, Hingula	2 Ac.	—	Banana Pepper.
Kalutara A. S. A. Faiz, Gallewatta, Agajawatta.	1 Ac.	RRIC 100	—

Girth of rubber plants in Kegalle region was collected in December 1991.
(L. Samarappuli, W. C. Dayaratne, F. P. W. Silva and E. A. T. Senadeera)

Table 6 ; *Effect of leguminous trees on girth of rubber.*

	<i>Average Girth (c.m.)</i>
Without legumes	12.74
With tree legumes	13.26

Bush legumes grown in the above sites provided a fair amount of mulch. This mulch was spread around the trees and inbetween trees, this provided benefit in terms of weed control effect and contribution of organic matter.

Use of organic fertilizer (poultry litter) in mature & immature rubber:

Scope

In this trial the response in terms of growth and yield to application of organic fertilizers (poultry litter) in Mature and Immature rubber are being studied.

Treatments :

Immature Rubber.

T₁ = RRI (¼ recommendation + Poultry litter)

T₂ = RRI (½ recommendation + Poultry litter)

T₃ = RRI (½ recommendation — Subsidy)

T₄ = RRI Recommendation

Mature Rubber 1979R/P PB 86.

T₁ = Control

T₂ = Poultry litter only

This field had not been maintained for the past 8 years.

Kalutara District (Immature Area)

1. Hijra Farm, Beruwala.

Ext.
½ Ac.

Clone
RRIC 100

Colombo District (Mature Area)

2. V. Sirisena Perera, 'Ramyapaya', Batawela Padukka. 1 tapping PB. 86 Block

(Mrs. L. Samarappuli and F. P. W. Silva).

Use of organic fertilizers for Intercrops (Pineapple)

Treatments

T₁ = Normal recommendation

T₂ = ¾ Normal recommendation + Poultry litter

T₃ = ½ Normal recommendation + Poultry Litter.

(Mrs. L. Samarappuli, L. Rodrigo, F. P. W. Silva and L. S. Kariyawasam)

1991 Programme

01. Effluent disposal and treatments.

This programme was started at Kalutara Region to study the effect of waste water (effluent) as fertilizer in smallholdings. The work is in progress. (P. P. Jayasinghe)

02. Development of latex processing.

Using coated coconut shells to increase the yield of latex, to decrease the percentage of cuplamps and to preserve the quality and produce is in progress in Colombo region. (P. P. Jayasinghe)

03. Introduction of plastic cups to smallholders.

This programme is also in progress in the Kalutara region (Bentota). (P. P. Jayasinghe).

Multicropping of rubber with tea

State Sector I

Studies on multicropping of rubber with tea were started in 1985 in collaboration with the Tea Research Institute (TRI) State Plantation Corporation (SLSPC) and Janatha Estate Development Board (JEDB) and were done on 7 sites viz. Neuchatel, Perth, Miriswatta, Kiriporuwa estate, Sapumalkanda estate, Panawatta estate and Karundupona estate. The following treatments are tested in these 7 sites.

Treatments :

1. Tea only (after rehabilitation)
2. Rubber only
3. Tea (after rehabilitation) and rubber

Spacing : (Spacing of Rubber in Tea X Rubber Block)

- (i) 8' x 30' — 3 sites (SLSPC estates)
- (ii) 8' x 40' — 4 sites (JEDB estates)

Plot size : 01 ha.

Yield of Tea (made tea) and girth of Rubber plants were recorded in December 1991 (Table 7&8) (N. Yogaratnam, S. M. M. Iqbal and G. de Mel).

Table 7; Yield of Tea (made tea) and girth of rubber in Tea and Rubber multi-cropping experiments (State sector I).

<i>Estate</i>	<i>Year</i>	<i>Tea only Yield of made tea: kg/ha</i>	<i>Tea x Rubber Yield kg/ha</i>	<i>Rubber girth (cm)</i>	<i>Rubber only Girth (cm)</i>
I SLSPC					
Neuchatel	1990	321 (3 months)	642	—	—
	1991	390 (7 months)	422	51.46	47.65
Perth	1991	714 (7 months)	560 (4 months)	42.04	41.90
Miriswatta	1991	1627	1274	52.74	48.47
II JEDB					
Panawatta	1988	594 (6 months)	494 (8 months)	—	—
	1989	198 (3 months)	995	—	—
	1990	790	544 (Pruned)	—	—
	1991	449 (Pruned)	1137	50.25	50.72
Karandupana	1988	693 (5 months)	595 (5 months)	—	—
	1989	964	734	—	—
	1990	1795	2308	—	—
	1991	1035 (Pruned)	1590 (Pruned)	55.02	56.79
Sapumalkanda	1989	1000	750	—	—
	1990	1520	2160	—	—
	1991	1046.6	1700	36.93	34.47
Kiriporawa	1991	1189	1021	50.89	52.10

State Sector Estates

Three experiments were started, to study the effects of multicropping of rubber lands with tea on growth and production of rubber and tea.

Experiment 1.

This experiment was started in June 1990 at RRISL Substation, Kuruwita. Plucking of tea commenced in December 1991 in the plot in tea-unrehabilitated with rubber

Girth of the rubber plants were recorded in December 1991. Girthing of rubber was not affected by treatments (Table 8).

Table 8; *Effects of multicropping of rubber lands with tea on girth of rubber in December 1991.*

<i>Treatments</i>	<i>Mean girth (cm)</i>
Rubber only (12' x 18')	10.32
Rubber (8' x 27') + Tea (Rehabilitated)	10.70
Rubber (8' x 27') + Tea (Unrehabilitated)	11.34
Rubber (8' x 40') + Tea (Rehabilitated)	11.14
Rubber (8' x 40') + Tea (Unrehabilitated)	11.38

Experiment 2 & 3

These experiments are in progress at Dartonfield, Agalawatta (Expt. 2) and Atherfield Avissawella (Expt. 3).

These programmes are funded partially by the Council of Agricultural Research Policy under their contract research programme.

(N. Yogaratnam, S. M. M. Iqbal and G. de Mel).

Smallholder Sector

This programme will be started in year 1992.

REVIEW OF THE AGRICULTURAL ECONOMICS SECTION

By

I. N. SAMARAPPULI

SUMMARY

A cost benefit analysis on the application of fertilizer for Mature rubber was done in collaboration with the Soils and Plant Nutrition Department by re-analysing the published experimental data. This study revealed that its economical to apply fertilizer for mature rubber even under prevailing fertilizer prices particularly under soils and foliar basis.

A study was done to asses the economics of the Replanting Subsidy Scheme for a 25 year replanting cycle under different forecasted situations.

The actual C. O. P. of bareroot Green budded and Brown budded plants, managed under RRI recommendations were worked out in collaboration with the Plant Science Department. The C. O. P. of a Green budded plant was Rs. 5/25 whereas a Brown budded plant costed Rs. 8/75.

A corporate plan (1992—1996) was prepared indicating goals, targets, strategies, measuring indicators, resource requirements etc., with respect to the Agricultural Economics Section.

Also, assisted in preparing the status review report of the RRISL.

DETAILED REVIEW

Staff

Mr. H. Talgaswatta, Assistant Agricultural Economist continued his postgraduate training at the Lincoln College, New Zealand. Mr. P. H. M. U. Herath and Mrs. S. Amaratunga assumed duties as Assistant Agricultural Economists and Mr. I. N. Samarappuli as Agricultural Economist. Mr. P. H. M. U. Herath and Mrs. S. Amaratunga commenced postgraduate studies at Post Graduate Institute of Agriculture (P. G. I. A.) and University of Colombo respectively. Mr. I. N. Samarappuli continued his studies for the PhD degree of P.G.I.A. while covering the official duties of the Agricultural Economics Section.

Meetings and Seminars

* Mr. P. H. M. U. Herath participated in the promotion of TPNR tapping cup meeting held in JEDB Regional Board of Avissawella on 19th June, 1991.

* Mr. P. H. M. U. Herath attended the fourth Central Scientific Committee meeting of the RRI held on 5th July, 1991.

* Mr. I. N. Samarappuli participated in a Field Day organized by SLSPC, Galle.

* Mr. I. N. Samarappuli participated in discussions with the computer consultant, Ministry of Plantation Industries to formulate a data base for rubber.

Economics of fertilizer application for mature rubber

This study was done by using the data of a long term experimental trial (1952—1969) reported by A. J. Jeevaratnam (1969).

The recorded yield increase due to application of fertilizer for mature rubber was 225 kg/ha/year.

The profit margins under smallholder and estate (based on Soil and Foliar Analysis) conditions are given in Table 1 and 2.

Table 1 *Producer margins under smallholder conditions at various fertilizer prices*

Year	fertilizer price (Rs/kg)	Cost of fertilizer (Rs/kg/yr)	Additional Income (Rs/ha/yr)	Profit Margin (Rs/ha/yr)
1987	3.30	1181	4950	3367
1989	4.30	1539	4950	3411
1991	7.70	2756	4950	2194

Table 2 *Producer margins under Estate conditions (* Soil and Foliar Analysis) at various fertilizer prices*

Year	Fertilizer Price (Rs/kg)	Cost of Fertilizer (Rs/kg/yr)	Additional Income (Rs/ha/yr)	Profit Margin (Rs/ha/yr)
1987	3.30	525	4950	4425
1989	4.30	684	4950	4266
1991	7.70	1225	4950	3725

This study shows that application of fertilizer for mature rubber is highly economical even under the prevailing fertilizer prices in areas where yield increases in the region of 225 kg/ha/year can be obtained. The current producer margins under smallholder and Estate conditions have been Rs. 2194/- and Rs. 3725/- per hectare per year respectively.

It must however be emphasised that the above interpretation is based on the results obtained from a single experiment done under a specific condition using clones that are not currently planted in large scale. Moreover, experiments done by Dr. N. Yogaratnam over the last 15 years suggest that it is unlikely that yield increases of such magnitude can be obtained in general under Sri Lankan conditions to application of fertilizers. In fact his studies show that mature rubber responds to application of N and K in some instances and does not response in many instand to application of P and Mg, in terms of yield increase.

Economic assesment of the Replanting Subsidy Scheme

An analysis was done to asses the accumulated value of the replanting cess (deducted from a one hectare of land) after a 25 year replanting cycle. The accumulated value yielded Rs. 66,700/- based on the existing rates of the replanting cess (Rs. 1/15 per kg) and at a 12% interest rate. The balance left in the replanting fund at the end of the 7th year of the 2nd replanting cycle (after paying the subsidy instalments) calculated under two different subsidy rates viz. present subsidy rates and two fold increase in present subsidy rates are shown in Table 3 and 4.

Table 3* *Balance left in the replanting fund after paying the subsidy instalments under existing subsidy rates.*

<i>Year after planting</i>	<i>Compounded replanting cess at beginning of the year (Rs/ha)</i>	<i>Subsidy Payment (Rs/ha)</i>	<i>Balance left (with-out interest) Rs/ha</i>	<i>One plus interest rate (12% interest rate)</i>	<i>Amount left at the end of the year (Rs/ha)</i>
1	66,700	1482	65,218	1.12	73,044
2	73,044	9880	63,164	1.12	70,744
3	70,744	4940	65,804	1.12	73,700
4	73,700	3952	69,748	1.12	78,118
5	78,118	3952	74,166	1.12	83,066
6	83,066	3952	79,114	1.12	88,608
7	88,608	8892	79,716	1.12	89,282

Table 4 ; *Balance left in the replanting fund after paying the subsidy instalments under twofold increase in the subsidy rates.*

Year after planting	Compounded replanting cess at beginning of the year (Rs/ha)	Subsidy Payment (Rs/ha)	Balance left (with-out interest) (Rs/ha)	One plus interest rate (12% interest rate)	Amount left at the end of the year (Rs/ha)
1	66,700	2964	63,736	1.12	71,384
2	71,384	19760	51,624	1.12	57,819
3	57,819	9880	47,939	1.12	53,692
4	53,692	7904	45,788	1.12	51,283
5	51,283	7904	43,379	1.12	48,584
6	48,584	7904	40,680	1.12	45,562
7	45,562	17784	27,778	1.12	31,111

The Table — 3 shows that a sum of Rs. 89,282/- per hectare is left in the replanting fund after paying the subsidy instalments according to the existing rates. This amount was Rs. 31,111/- if the subsidy rates were doubled.

Calculation of C. O. P. for bareroot Green budded and Brown budded plants.

The Cost of Production of a bareroot green budded and brown budded plant was Rs. 5/25 and 8/75 respectively. A summary of the analysis are given in Table 5 and 6.

Table 5 ; *Summary of Cost of Production for bareroot green budded plants per 0.4 hectares.*

Item	Labour Units	Labour Cost (Rs)	Material Cost (Rs)	Total Cost (Rs)
Germination Beds				
1.1	Seeds	—	890.00	890.00
1.2	Sand	—	240.00	240.00
1.3	Preparation of Seed beds	1.00	50.00	50.00
1.4	Planting of Seeds	6.70	335.00	335.00
1.5	Shading	4.00	2750.00	2950.00
1.6	Watering	15.00	750.00	750.00
Sub Total		26.70	3880.00	5215.00

<i>Item</i>	<i>Labour Units</i>	<i>Labour Cost (Rs)</i>	<i>Material Cost (Rs)</i>	<i>Total Cost (Rs)</i>	
2. Nursery Beds .					
2.1	Fencing (Renovation)	0.85	42.50	866.00	908.50
2.2	Land Preparation (Re-establishment)	134.00	6700.00	—	6700.00
2.3	Basal Mixture	2.00	100.00	900.00	1000.00
2.4	Transplanting	12.00	600.00	—	600.00
2.5	Shading (Temporary)	12.00	600.00	—	600.00
2.6	Manuring (Top dressing)	16.00	800.00	7700.00	8500.00
2.7	Weeding	44.00	2200.00	—	2200.00
2.8	Thinning out	15.00	750.00	—	750.00
2.9	Watering	40.00	2000.00	—	2000.00
2.10	Fungicides	30.00	1500.00	17250.00	18750.00
2.11	Budgrafting	84.00	16800.00	12495.00	29295.00
2.12	Uprooting, Cutting, Waxing Packing	56.00	2800.00	170.00	2970.00
2.13	Tools and Sundry Expenses (Nominal)	—	—	—	2000.00
2.14	Interest	—	—	—	6750.00
	Sub Total	445.85	34892.00	38391.00	83023.00
	Grand Total	472.55	36227.50	43261.00	88238.50

Cost per plant = Rs. 5.25

Table 6: *Summary of Cost of Production for bareroot brown budded plants per 0.4 hectares.*

1. Germination Beds					
1.1	Seeds	—	—	890.00	890.00
1.2	Sand	—	—	240.00	240.00
1.3	Preparation of Seed beds	1.00	50.00	—	50.00
1.4	Planting of Seeds	6.70	335.00	—	335.00
1.5	Shading	4.00	200.00	2750.00	2950.00
1.6	Watering	15.00	750.00	—	750.00
	Sub Total	26.70	1335.00	3880.00	5215.00

<i>Item</i>	<i>Labour Units</i>	<i>Labour Cost (Rs)</i>	<i>Material Cost (Rs)</i>	<i>Total Cost (Rs)</i>
2. Nursery Beds				
2.1 Fencing (Renovation)	0.85	42.50	866.00	908.50
2.2 Land Preparation (Re-establishment)	134.00	6700.00	—	6700.00
2.3 Basal Mixture	2.00	100.00	900.00	1000.00
2.4 Transplanting	12.00	600.00	—	600.00
2.5 Shading (Temporary)	12.00	600.00	—	600.00
2.6 Manuring (Top dressing)	16.00	800.00	23100.00	23900.00
2.7 Weeding	64.00	3200.00	—	3200.00
2.8 Thining out	15.00	750.00	—	750.00
2.9 Watering	40.00	2000.00	—	2000.00
2.10 Fungicides	36.00	1800.00	18200.00	20000.00
2.11 Budgrafting	42.80	12150.00	11300.00	25450.00
2.12 Uprooting, Cutting, Waxing Packing	135.00	6750.00	225.00	6975.00
2.13 Tools and Sundry Expenses (Nominal)	—	—	—	2000.00
2.13 Interest	—	—	—	18000.00
Sub Total	509.65	35492.50	54591.00	113083.00
Grand Total	536.30	36827.50	58471.00	118298.00

Cost per plant = Rs. 8.75

REVIEW OF THE BIOMETRY SECTION

By

WASANA KATULANDE

SUMMARY

During the year under review, around 500 data sets were analysed and interpreted. The majority of them were from research students, while only around 30 % from routine projects of Research Departments.

A new computer system with a storage capacity of 125 MB, accompanying with an Uninterrupted Power Supply Unit (UPS) was installed. This new system with a main memory of 2 MB is capable of handling lengthy data sets and data bases. A laser Beam Printer was also purchased during this year. The SAS application package was upgraded from version 6.3 to 6.4.

Rainfall data for the last 27 years recorded in the Dartonfield meteorological station have been analysed for the computation of expected rainfall values. A computer programme was developed in order to determine the optimum plot size from the uniformity trials.

DETAILED REVIEW

Staff

Technical officer, Mr. L. P. Witharana was transferred to the Ratmalana Office on his request and Ms. Sagari Kudaligama was recruited as a technical officer from 01 st of March. Ms. Nanadanie Jayasinghe was promoted to the S. T. O. grade with effect from 09th July 1991.

Ms. Wasana Katulande assumed duties as the Asistant Biometrician on 15th July. Ms. Kudaligama was transferred to the Bio Chemistry section on her request and Mr. T. Hettiarachchi joined the Biometry section on a mutual basis.

Senior Technical Officer, Mr. L. T. Peiris who served the Institute for nearly 22 years, and Mr. T. Hettiarachchi have resigned from their posts with effect from 03rd and 31 st of December respectively.

Training

Two officers have followed the training programmes for Micro Computers conducted by the ARP.

Mr. L. T. Peiris	—	Microsoft Windows
Ms. Nandanie Jayasinghe	—	Introductory Course on DOS, WP5.1 and LOTUS 1-2-3.

Symposia and Workshops

Ms. Wasana Katulande attended the 3rd Annual Congress of the Postgraduate Institute of Agriculture held on 12-13th of November, 1991.

Publications

Samita, S., B. W. Katulande, R. O. Thattil and N. E. M. Jayasekera (1989). Optimum plot size for Rubber, 3rd Annual Congress., Postgraduate Institute of Agriculture, Peradeniya.

Statistical Services

This comprises of two types of services, namely:

Assistance given to research staff for their routine or postgraduate research work and ;

Assistance provided to the research students, conducting research leading to postgraduate degrees or specialization projects.

Statistical analyses handled by the Biometry section during the year, 1991 are summarized below.

Department of Soils and Plant Nutrition

1. Soil-Plant-Water relation studies (Mrs. Lalani Samarappuli).
2. Phosphate nutritional studies (Mr. D. M. A. P. Dissanayake).
3. Nutrient Cycling in Tropical Rain Forests — Part of TSBF project (Mr. U. Senarath, Temp. Research Assistant.)

4. Nutrient Cycling in Tropical Rain/Forests — Part of TSBF project (Mr. S. Jayawardene, Temp. Research Assistant)

Department of Plant Science and Physiology

1. Studies on the effect of genotypic differences, tapping systems and application of stimulants on tapping pannel dryness (Dr. A. Nugawela)
2. Performance of 13 Rubber clones under different tapping systems (Mr. L. S. S. Pathiratne)
3. Physiological studies on Rubber latex (Ms. Muditha Ranasinghe).

Department of Plant Pathology

1. Clonal screening trial for leaf and panel diseases (Mr. C. K. Jayasinghe)
2. Fungicide screeing trial (Mr. C. K. Jayasinghe)

Department of Bio Chemistry

1. Studies on effluent treatment (Mr. T. Warnakula)

During the year 1991, 5 experiments conducted by University students were also analysed.

Computing services

Assistance were given to the Department of Genetics and Plant Breeding to enter their data of Genotype X Environment experiment, in 7 sites for last 8 years. The computer programme for the soil and foliar analysis of the department of Soils and Plant Nutrition was redesigned. Another computer programme was developed for the analysis of uniformity trials and was utilized by a post graduate student in his research "Optimum plot size for field experimentation of Rubber".

Equipment

The following were installed in the computer unit during the year under review.

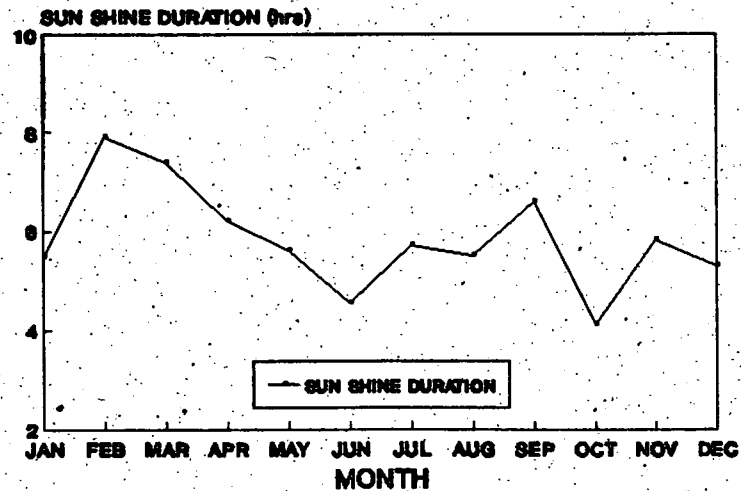
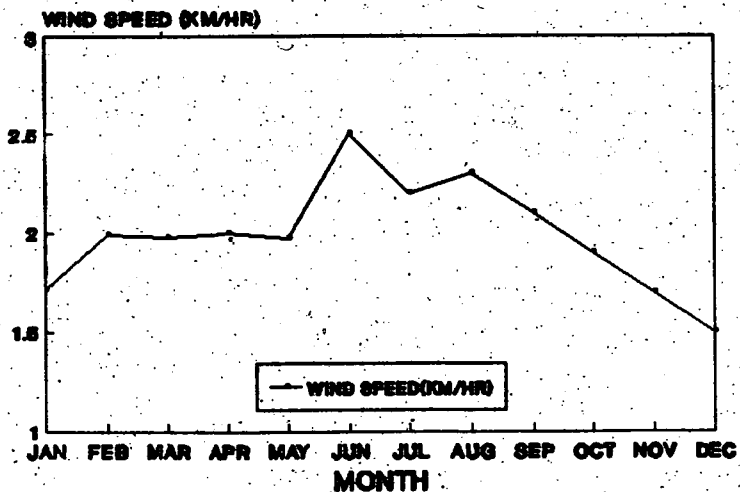
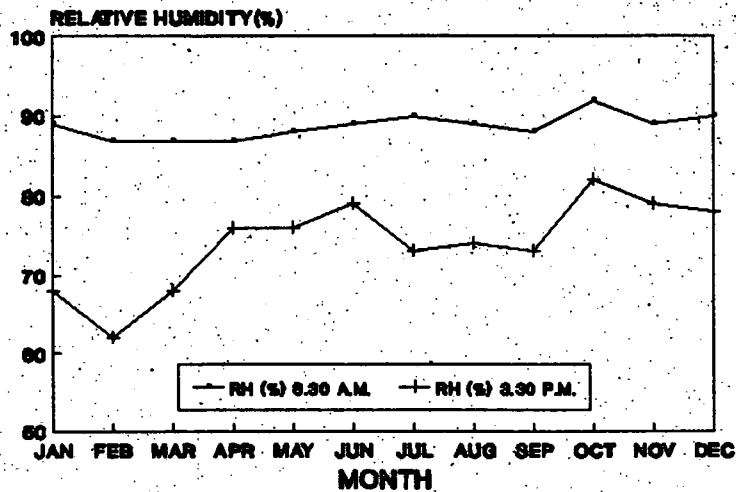
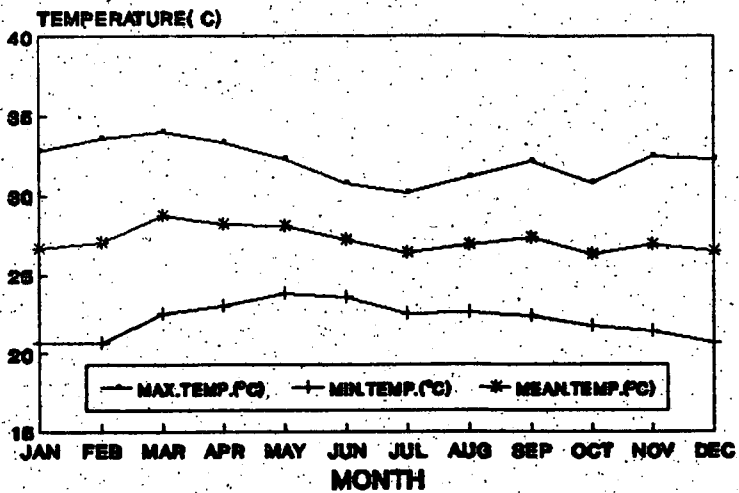
- (a) *A new computer system with;*
 - 125 MB hard disk capacity which enables more storage and;
 - 2 MB Random Access Memory for handling lengthy data sets and data bases.

(b) *Canon LBP —A laser beam printer.*

(c) *Uninterrupted Power Supply Unit.*

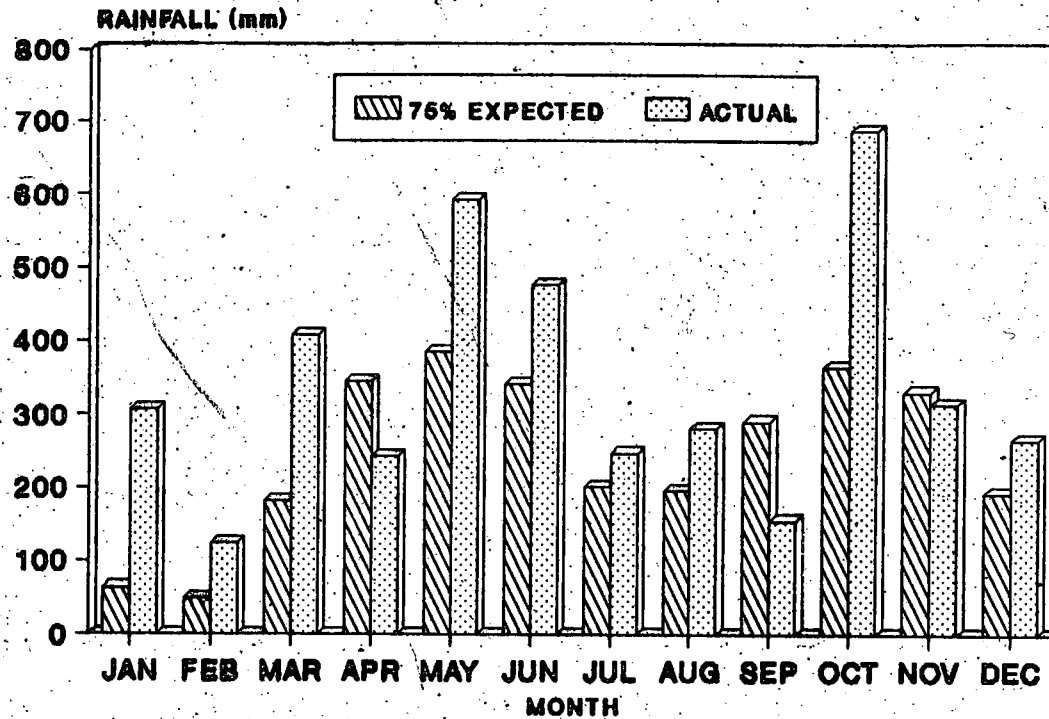
Meteorological Data Base Management.

The data base of the Dartonfield Meteorological Station was successfully maintained and monthly reports were sent to the Central Meteorological Station. The rainfall data of the period 1964—1991 were analysed to establish 75% expected rainfall values. The yearround variation of some of the important meteorological parameters are presented in the following figures.



THE VARIATION OF METEOROLOGICAL FACTORS DURING THE YEAR 1991

RAINFALL DISTRIBUTION 1991



EXPECTED VALUES DERIVED FROM 27 YEARS (1964-1991)

REVIEW OF THE LIBRARY & PUBLICATIONS SECTION

By

KAMANI PERERA

SUMMARY

The routine work of the Library & Publications Section such as maintaining, processing and publishing of the Institute's regular publications and collecting and disseminating of information on all aspects of natural rubber (NR) and related areas have been carried out successfully throughout the year 1991.

DETAILED REVIEW

Mrs. Kamani Perera, Librarian & Publications Officer, Mrs. T. Dantanarayana, Library Assistant & Assistant Publications Officer, Colombo Office were on duty throughout the year. Mr. D. C. Thambawita, Library Assistant & Assistant Publications Officer, resigned from his service with effect from 12th April 1991. Mrs. Ramani Amaratunga, Clerk/typist was on maternity leave from 7th September 1991.

Acquisitions

i. Books

With the addition of 81 new acquisitions, book collection recorded at 4363 at the end of the year. 49 books were received from the Asia Foundation on donation.

ii. Periodicals

Number of periodical titles received during the year was 127 including 12 Annual Reports. Out of this 63 Journals were received on subscription and 52 on exchange.

Meetings

The Librarian & Publications Officer attended the following seminars/workshops regarding Library & information Science.

1. Workshop on 'A model library for developing countries held at IFS, Kandy 2nd - 3rd January 1991.

2. Seminar on National Library of Sri Lanka held at OPA Centre, Colombo, 16th February 1991.
3. Seminar on 'The future of non-print library materials – Pros and Cons' held at the British Council, Colombo, on 17th June 91.
4. Workshop on 'The role of information in technology development' held at NARESA, Colombo, on 19th June 91.
5. CINTEC/NARESA workshop on CDS/ISIS held at BMICH, Colombo on 29th July – 2nd August 1991.

Reports

Vithana, Kamani, N. (1990). Review of the Library and Publications Section. Annual Review ; Rubb. Res..Inst. Sri Lanka, 1990.

Publications

Processing and publishing of RRISL publications were continued. The following publications were published during the year.

Rubber Puwath	Vol. 14, 1986
RRISL Journal	Vol. 68, 1988
RRISL Journal	69, 1989
RRISL Bulletin	Vol. 25, 1988
RRISL Bulletin	26, 1989
RRISL Bulletin	27, 1990
RRISL Bulletin	28, 1991

Annual Review 1990

Annual Report 1989.

Equipments

A Canon electronic typewriter (AP 8000) and a CITIZEN quartz wall clock were purchased during the year.

Services

The Library actively engaged in all its inhouse activities as well as the activities of the Sri Lanka Scientific & Technical Information Centre (SLSTIC) and Agricultural Information Network System (AGRINET). Recent additions to RRISL library and content pages of periodicals were circulated for ready reference.

Inter Library loans

Photocopies of articles and journals, text books etc. were received from other braries when requested for cur users ond we did same for other libraries.

REVIEW OF THE ESTATE DEPARTMENT

By

V. M. KATUGAHA

SUMMARY

Dartonfield Group managed by the Rubber Research Institute has three divisions namely, Dartonfield, Gallewatte in the Agalawatte Electorate and Nivitigalakele Division in the Matugama Electorate.

The total extent of the Group is 331.02 Hectares and the planted area is 260.85 hectares of which 162.14 hectares were in bearing during the year.

Wet weather prevailed throughout the season and the year ended with a recording of 1966.9 m.m. of rainfall above last year. This attributed mostly to the short-fall in crop.

The Replanting Programme could not be undertaken as per schedule, since the Contractor defaulted in keeping to the date of completion.

Budwood of Clone RRIC. 100 and RRIC. 110 were issued to the SLSPC/JEDB Estates and the small holders of the area, during the season.

All agricultural operations were carried out in Mature and Immature areas and Nurseries of the Group.

DETAILED REVIEW

Staff

Mr. V. M. Katugaha, Estate Superintendent, Mr. S. A. L. Chandrawansa, Chief Clerk, Mr. K. K. P. Gunawardene, Senior Assistant Clerk, Mr. K. D. Sumanasena, Mrs. C. Dissanayake, Mr. A. K. A. Wickremasinghe, Junior Assistant Clerks, M/S. N. L. D. Piyadasa, A. K. D. Hemapala, H. M. J. Premalal and S. K. S. de Silva, Field Officers Mr. J. A. Wimalasena, Assistant Field Officer, M/S. S. R. Vadivel, T. Somaratne and

N. L. D. Reggie, Field Supervisors, Mr. D. S. K. Ranaweera, Rubber Factory Officer Mr. W. D. D. Senanayake, Factory Supervisor, Mrs. C. S. Hettiarachchi, Creche Attendant, M/S. H. W. Amaradasa, Tractor Driver, H. L. Sarath, Jeep Driver Mr. A. K. Piyasena, Office Peon were on duty throughout the year.

The Group Cadre stood at twenty at the end of the year, made up as follows.

Senior Staff	01
Assistant Staff	15
Minor Staff	04
	20

Mr. N. L. D. Piyadasa, Field Officer of Dartonfield Division is under interdiction since December 1991 on disciplinary grounds.

Hectarage :

A summary of the Hectarage is given in Table 1.

Table 1 * *Land distribution in Dartonfield Group.*

	<i>Dartonfield</i>	<i>Gallewatte</i>	<i>Niyitigalakele</i>	<i>Total</i>
Mature Area	9.82	107.48	44.84	162.14
Immature Area	28.75	55.00	—	83.75
Nurseries	7.27	—	7.69	14.96
Paddy Fields/Deniya	—	3.05	—	3.05
Earth Slip Area	1.65	1.40	2.62	5.27
Jungle	.80	—	.71	1.51
Rocks	.29	—	1.21	1.50
Waste Land	.19	—	—	.19
Roads	3.27	3.55	.32	7.14
Buildings	16.14	9.33	7.79	33.26
State Land taken-in	.27	—	—	.27
Abandoned	3.83	—	8.06	11.89
Reserved for Building Complex	—	5.69	—	5.69
Total	72.28	185.50	73.23	331.02

Weather

Rainfall figures (m.m.) for 1991 and 1990 are given below in Table 2.

Table 2 ; - Rainfall distribution for 1991 and 1990.

	1991	1990
January	291.8	61.9
February	102.3	42.8
March	314.4	145.5
April	260.7	244.5
May	531.0	414.8
June	478.6	346.4
July	199.9	262.1
August	263.2	35.0
September	129.2	88.4
October	660.4	492.5
November	423.3	558.4
December	205.2	200.9
	<u>3860.0</u>	<u>2893.2</u>

Total number of wet days 185 164

The highest rainfall was recorded during the month of October, which was 660.4 m.m. on 22 wet days.

Crop :

The yield data for the last five years, is given below.

Table 3 ; Yield Records from 1987 to 1991 (kg/hect).

	1991	1990	1989	1988	1987
Dartonfield Division	709	696	612	1094	1316
Gallewatte Division	636	805	795	802	1229
Nivitigalakele Division	632	929	706	1083	729
Average	640	866	738	1002	1128
Estimated	715	740	700	1244	1213
Tapping Hectares	145.14	108.00	107.00	148.00	177.00

A decrease in yield has been recorded mainly due to a large extent of the hectareage being in the 4th year 400% and 300% intensified tapping. Further loss of 145 days tapping due to wet weather prevailed throughout the season were also a contributory factor towards the short-fall in crop.

The tapping standard was good and the tapping panels were treated with fungicides.

Manufacture

A summary of manufacture records during the year is given in Table 4.

Table 4 ; *Details of manufactured crop in Dartonfield.*

(Aggregate of latex and scrap percentage)

	<i>Total Kgs.</i>	<i>Crop %</i>
Pale Crepe No. 1	72378	58
Pale Crepe No. 2	11930	10
Scrap Crepe No. 1	4748	04
Scrap Crepe No. 2	1681	01
Scrap Crepe No. 3	188	—
Smoked Sheet No. 1	32808	26
Smoked Sheet No. 3	595	01
	<hr/>	<hr/>
	124328	100

The Estate continues to purchase latex from Small Holders and the total purchased in 1991 was 28,311 kgs. as against 148,831 kgs. last year, and the Small Holders were paid an average price of Rs. 17/24, during the year.

Factory Machinery

A complete over-hauling of the Factory Machinery was carried-out by Messrs. Gamini Engineering Works.

Factory Building

Condition of the buildings could be considered satisfactory.

Roads

The macadamised roads which are leading to the Institute Bungalows and the estate divisional roads were maintained in good order.

Pests & Diseases

The periodical diseases which were evident were controlled.

Fertilizer

Fertilizer applications for Mature and Immature fields were carried-out as per programme.

Replantings

The clearings which were scheduled for planting were planted and completed this year. The extent planted was 22.93 hectares.

Two fields of Dartonfield division amounting to 10.68 hectares could not be uprooted and completed due to the Contractors defaulting in keeping to the date of completion. These have been programmed to be planted in 1992.

Nurseries

All nurseries were well maintained.

The over-matured plants of 1987/89 and 1988/90 Seedling nurseries of Niviti-galakele division were uprooted and the nursery accounts were closed down.

Field and Factory Experiments

The Research Departments were given the necessary assistance in carrying-out their field and technological experiments.

Institute Buildings

The general maintenance expected from the Estate Department was undertaken and individual problems attended to, when necessities arose.

Labour and Health

All non-working resident children over one year of age and below 13 years continued to be issued With $\frac{1}{4}$ lb. bread per day, per head. In addition, cash payments were made in lieu of half cream milk to resident non-lactating mothers with infants under 01 year of age.

The health of the entire population was satisfactory during the year.

National Tree Planting Campaign

Medicinal and herbal plants were planted in Dartonfield Group, on the 17th of September 1991.

Accounts

Final Accounts for the season 1991 is in progress.

Estimates

Estimates of Capital and Revenue expenditure for 1992, in respect of Dartonfield Group were submitted to the Rubber Research Board and awaiting approval of the Estate Committee.

General

A programme on welfare and upliftment of the Social awareness to the resident and Non resident workers of the estate was initiated by the Women In Need Organisation (WIN) headed by Mrs. Chinta Balasooriya.

Construction of new latrines, renovation of existing latrines, Lighting of line room compounds, construction of drinking water wells, supplying of new roofing sheets for line rooms, supplying of materials for laying of pipe lines to obtain drinking water, setting-up of two children's play grounds on Dartonfield and Gallewatte divisions respectively, renovation of two creches, donation of a sewing machine to women's group formed by the WIN, supply of basic utensils for the creches, furniture to the Medical Centre, supply of a envelope making machine along with the paper etc., a grant for the Janasaviya Programme to initiate self employment, construction of a bus-halt, Co-operative Stores starter grant, Cash Boxes for women's health groups, inaugurating of Sinhala and Tamil language classes, Health and Nutrition work shops, training on (Bon Bon making) etc., The above mentioned work was done in connivance with the Estate Department and the Works Sections. The financial commitment on the labour component was met by the Institute, and the monetary value expended by WIN, on figures submitted was Rs. 697,314/-.

Whilst concluding, I wish to place on record the amount of work put in by the ladies who visited the estate from this Organisation should be commended very highly. They have created a feeling of being wanted amongst the work force thus enabling me to build-up a close and encouraging rapport which has immensely helped me in my man management and thus enabling the smooth running of the Plantation.