

The Rubber Research Institute of Sri Lanka

Annual Review 1990



THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW 1990

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RUBBER RESEARCH INSTITUTE OF SRI LANKA

BOARD OF MANAGEMENT

Ex-Officio Members

- Mr G.P.S.U. de Silva, Secretary, State Ministry of Plantation Services (01.07.90-31.12.90)
Mr G.W.S.K. de Silva, Acting Rubber Controller (01.01.90 - 31.12.90)
Mr M.A.L. Perera, Chairman, JEDB (01.01.90 - 31.12.90)
Mr Nihal Ilangakoon, Chairman, SLSPC (15.06.90 - 31.12.90)
Mr Sarath Ranawaka, MP for Kalutara District (01.10.90 - 31.12.90)
Mr A Rajapakse, Deputy Director (Budget Division), Ministry of Finance
(01.01.90 - 31.12.90)

MEMBERS APPOINTED BY THE HON. MINISTERS OF PLANTATION INDUSTRIES

- Professor I. Balasooriya, Professor of Botany, University of Kelaniya - Chairman, RRB
(15.03.90 - 31.12.90)
Mr Sepala Ilangakoon, Secretary-General, Planters' Association of Ceylon
(01.01.90 - 31.12.90)
Mr P.I. Pieris, MA (Cantab), Deputy Chairman, M/s. Richard Pieris & Co., Ltd.
(01.01.90 - 31.12.90)
Mr. M.M.A. Naina Marikar, Planter (01.01.90 - 31.12.90)
Mr R. Wijegunaratne, Working Director (15.10.90 - 31.12.90)

STANDING COMMITTEES

Estate Committee

- Professor I. Balasooriya, Chairman, RRB
Mr M.A.L. Perera (20.09.90 - 31.12.90)
Mr M.R.C. Peiris (29.06.90 - 31.12.90)
Mr C.N.M. Rodrigo (09.07.90 - 31.12.90)
Mr Rohan Fernando (29.06.90 - 31.12.90)
Dr L.M.K. Tillekeratne, Director, RRI
Mr V.M. Katugaha, Estate Superintendent, Dartonfield Group
Mr K. Ginige, Secretary

Central Scientific Committee (Agriculture)

- Professor I. Balasooriya, Chairman RRB
Mr G.P.S.U. de Silva, Secretary, MPS
Mr C.S. Ilangakoon, Board Member, RRB
Mr M.M.A.N. Marikar, Board Member, RRB
Mr Sunil Silva, Rubber Controller, RCD
Dr A de S. Liyanage, Director, RRI .upto end of April 1990
Dr L.M.K. Tillekeratne, Director, RRI (from 01.05.1990)
Mr S.W. Karunaratne, Deputy Director (Research)
Dr N. Yogaratnam, Assistant Director, RRI (Convenor)
Dr (Mrs) A.C.I. Samaranyake, Head, Plant Science Department, RRI
Dr N.E.M. Jayasekera, Head, Genetics & Plant Breeding Dept. RRI
Dr M.K.S.A. Samaraweera, Head, Soils & Plant Nutrition Dept. RRI
Mr C.K. Jayasinghe, Acting Head, Plant Pathology & Microbiology
Dept. RRI
Mr M.T. Warnakula, Assistant Biochemist
Mr W.N. Wickremasinghe, Biometrician, RRI
Mr A. Dahanayake, Acting Director, ASD
Mr K. Meegahawatta, Head, Development Division, ASD
Mr V.M. Katugaha, Estate Superintendent, Dartonfield Group, RRI
Mr N. Ilangakoon, Chairman, SLSPC Central Board
Mr Stanley de Silva, Personal Assistant to the Chairman, SLSPC Central
Board
Mr C.N.M. Rodrigo, Agriculture Advisor (Rubber), JEDB Central Board
Mr Parakrama Hettiarachchi, Personal Assistant to the Chairman, JEDB
Central Board
Mr S.S.R. Rodrigo, Chairman, SLSPC III, Horana
Mr D.E.C. Wijesinghe, Superintendent, Padukka State Plantation
Major M.R.C. Peiris, Chairman, SLSPC V, Ratnapura
Mr B.S. Samarasinghe, Superintendent, Peenkanda State Plantation,
Nivitigala- kele
Mr P.S. de Silva, Superintendent, Elpitiya State Plantation
Mr I. Rupasinghe, Director, SLSPC IV, Matale
Mr N.G. Dias Abeysinghe, Chairman, SLSPC IV, Galle
Mr S. Fernando, Superintendent, Hapugaspititiya State Plantation, Metihakka
Mr T.L.M. Mendis, Chairman, JEDB III, Badulla
Mr A.M. Perera, Superintendent, Bibile Group
Mr G. Amarasinghe, Chairman, JEDB IV, Avissawella
Mr D.H. Giragama, Superintendent, Mahaoya Estate
Mr I.L.A. Fernando, Director, JEDB IV, Kegalle
Mr S.N. Gunaratne, Director, JEDB IV, Avissawella
Mr Lee Madawala, Director Marketing (Rubber), SLSPC Central Board

Scientific Committee - Technology & Marketing

Professor I. Balasooriya, Chairman, RRB
Mr P.I. Pieris, Vice Chairman, Richard Peiris & Co. Ltd.
Mr P.A. Silva, Chairman, C.W. Mackie & o. Ltd.
Dr A. de S. Liyanage, Director, RRI (upto 30.04.90)
Dr L.M.K. Tillekeratne, Director, RRI (from 01.05.90)
Mr S.W. Karunaratne, Deputy Director (Research) (Convenor)
Mr A. Dahanayake, Acting Director, ASD
Dr (Mrs) K.G.K. de Silva, Rubber Chemist
Dr E.D.I.H. Perera, Assistant Rubber Chemist
Dr (Miss) N.M.V. Kalyani, Assistant Rubber Chemist
Mr S. Silva, Acting Rubber Controller (from 01.04.90)
Mr D.E.C. Wijesinghe, Factory Advisor, SLSPC
Mr L. Perera, Factory Advisor, JEDB
Mr Jim Amarasinghe, Marketing Specialist, JEDB
Mr Desmond Fernando, Marketing Specialist, JEDB
Mr Lee Madawala, Marketing Specialist, SLSPC

Combined Administrative & Financial Committee

Professor I. Balasooriya, Chairman, RRB (15.03.90 - 31.12.90)
Mr G.P.S.U. de Silva, Secretary, State Ministry of Plantation Services
(01.07.90 - 31.12.90)
Mr A. Rajapakse, Deputy Director (Budget Division); Ministry of Finance
(01.01.90 - 31.12.90)
Mr G.W.S.K. de Silva, Acting Rubber Controller (01.01.90 - 31.12.90)
Mr Nihal Ilangakoon, Chairman, SLSPC (15.06.90 - 31.12.90)
Mr Naina Marikar, Planter (01.01.90 - 31.12.90)
Dr A. de S. Liyanage, Director, RRISL (upto 30.04.90) - In attendance
Dr L.M.K. Tillekeratne, Director, RRISL (from 01.05.90 - 31.12.90) - In
attendance
Mr. K. Ginige (Secretary)

Provident Fund Committee

Mr M.M.A. Naina Marikar - Chairman, Provident Fund Committee
Dr A. de S. Liyanage - Director, RRISL (upto end of April 1990)
Dr L.M.K. Tillekeratne - Director, RRISL (from May 1990)
Mr K. Ginige - Secretary, Provident Fund Committee
Mr W.C. Dayaratne - Elected Committee Member
Mr A.L. Ratnayake - Elected Committee Member

Extension Committee

Professor I. Balasooriya, Acting Chairman, RRB
Mr Sunil Silva, Rubber Controller
Mr Naina Marikar, Member of Rubber Research Board
Dr A. de S. Liyanage, Director, RRI
Mr A. Dahanayake, Director, ASD
Mr L.K. Meegahawatte, Head Development Division, ASD
Dr (Mrs) A.C.I. Samaranyake, Head, Plant Science Department, RRI
Mr S.W. Karunaratne, Deputy Director (Research) RRI
Dr N. Yogaratnam, Assistant Director, RRI.
Dr N.E.M. Jayasekera, Head Genetics & Plant Breeding Dept. RRI
Dr L.M.K. Tillekeratne, Head of Specifications & Analysis Dept. 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. Dassanayake, Regional Advisory Officer (Kegalle District)
Mr A.H. Kularatne, Regional Advisory Officer (Ratnapura District)

Secretary to the Board

Mr K. Ginige

Lawyers

M/s F.J. & G. de Saram,
Attorneys-at-Law
P.O. Box 212,
Colombo.

- Functioned from 01.01.90 to
15.08.90

M/s de Silva & Gurusinghe,
Attorneys-at-Law,
No. 135, 1/3, Gunasinghepura Complex,
St. Sebastian Street,
Hultsdorf
Colombo 12.

- Functioned from 01.01.90 to
15.08.90

Mr Manilal Fernando,
Attorney-at-Law,
14, De Silva Road,
Kalutara.

- Functioned from 01.01.90 to
15.08.90

Attorney-General.
Attorney General's Department,
(Government Institutions),
Colombo 12.

- Functioned from 16.08.90 to
31.12.90

Auditors

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

Bankers

Bank of Ceylon,
Corporate Branch,
75, Janadhipathi Mawatha,
Colombo 1.

Bank of Ceylon,
Agalawatta.

Registered Office and Laboratories

Dartonfield, Agalawatta.

Telephone : 034 - 71426

Colombo Office and Laboratories consist of :

Rubber Research Board Office

Advisory Services Department

Polymer Chemistry Department

Raw Rubber & Chemical Analysis Dept.

Raw Rubber Process Development Chemical Engineering Dept.

Rubber Technology & Development Dept.

Electronic Instruments Repair Unit

Telawala Road, Ratmalana.

Mt. Lavinia.

Telephone : 63 - 5851

63 - 5852

63 - 3351

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

(As at 31st December 1990)

- Chairman** - Professor I. Balasooriya, BSc (Cey.), PhD (Liverpool) (from 15.03.1990 to 31.12.1990)
- Director** - A. de S. Liyanage, BScAgric (Cey.), PhD (Lond.) (upto 30.04.90)
L.M.K. Tillekeratne, BSc (Cey.), MSc (Aston) PhD (Aston), F.I. Chem. C. (from 01.05.90 to 31.12.90)
- Deputy Director (Research)** - S.W. Karunaratne, BSc (Cey.), MSc (Aston) ARIC, ANCRT, FPRI, FIC
- Deputy Director (Administration)** - K. Ginige, BA (Cey.)
- Assistant Director** - N. Yogaratnam, BScAgric (Alhabad), PhD (Lond.)
- Secretary to the Chairman** - Mrs L.J.C. Perera
- Clerk/Typist** - Miss S.N. Munasinghe

RESEARCH DEPARTMENTS

Plant Science

- Head of Department** - Mrs A.C.I. Samaranayake, BSc (Cey.), PhD (Lond.)
- Botanist** - R.C.W.M.R.A. Nugawela, BSc (SL), MSc (Lond.) PhD (Essex)
- Assistant Botanists** - *Mrs G.P.W.P.P. Seneyiratne, BSc (SL)
*Miss M.S. Ranasinghe, BSc (SL)
L.S.S. Pathiratne, M.I. Biol., MPhil (SL)
- Research Assistant (Intercropping)** - *V.H.L. Rodrigo, BScAgric (SL)
- Experimental Officer** - R.B. Gunaratne
- Senior Technical Officer** - L.S. Kariyawasam
- K.A.G.B. Amaratunga

Technical Officers

- Mrs C.W. Ranasinghe, BA (Cey.)
- Mrs G.A.S. Wijesekera
- Miss A.R. Kusum
- R.P. Karunasena
- U.S. Weerakoon
- S.L.G. Ranjith
- R.S. Wijesundera

Experimental Assistant

- S. Wilbert

Clerk/Typist

- Mrs H.D.D.E. Jayawardana

Genetics & Plant Breeding

Head of Department

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

Assistant Geneticists & Plant Breeders

- Mrs S.C. Dharmaratne, BSc (SL), PhD (Scot.)
- *D.P.S.T.G. Attanayake, BScAgric (SL)

Experimental Officer

- *K.B.A. Karunasekera

Senior Experimental Assistant

- B.M.S.G. Peiris

Senior Technical Officer

- K.W. Rупatunga

Technical Officers

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

Experimental Assistant

- A.K.M.S. Senaratne

Clerk/Typist

- Mrs K.D.R. Tissera

Plant Pathology & Microbiology

Acting Head of Department

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

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. Amaratunge
- W.A.D.D.S. Wettasinghe
- E.B. Fernando

Technical Officers

- Mrs P.C. Wettasinghe
- S.S. Wannapura
- E.A.T. Senadheera

Clerk/Typist

- Mrs W.S.P. Amarasekera

Soils & Plant Nutrition**Head of Department**

- M.K.S.A. Samaraweera, BSc (SL), MSc (Bristol), PhD (Bristol)

Agronomist

- Mrs M.L.A. Samarappuli, BScAgric (SL) MSc (Calf.)

Assistant Soils Chemist

- D.M.A.P. Dissanayake, BScAgric (SL)

Experimental Officers

- W.C. Dayaratne
A.M.A. Perera
H.D.S.P. Perera, BSc (SL)

Senior Technical Officer

- J.G. de Mel

Technical Officer

- Miss S.D.C.K. Maheepala
Mrs M.K. Mahanama
S.N. Silva
P. Karunadasa
A.H.U. Mitrasena
A.N. Yakandawala
T.B. Dissanayake
T.M. Ahamadeen

Specification Assistant**(Special Grade)****English Stenographer**

- 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****Head of Raw Rubber &****Chemical Analysis**

- L.M.K. Tillekeratne, BSc (Cey.), MSc (Aston) PhD (Aston), F.I.Chem.C.

Rubber Chemists

- **Mrs K.G.K. de Silva, BSc (SL), MSc (SL), PhD (Aston)
Miss N.M.V. Kalyani, BSc (SL), PhD (Lond.)
E.D.I.H. Perera, BSc (SL), MSc (Reading), PhD (Reading)

Assistant Rubber Chemists

- Mrs S.A.P.P. Sirimanne, BSc (SL), PhD (Sussex)
W.M.G. Seneviratne, BSc (SL), PhD (Sussex)
*B.P. Weeraratne, BSc (SL)
S.M.C.E. Silva, BSc (SL)

Assistant Biochemist

- M.T. Warnakula, 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
D.D. Medagama
Mrs M.G.M.M. Neelawceera

Senior Technical Officers

- Mrs H.S. Weeraman
E.E. Irugalbandara
Mrs D.I.R. Denawaka

Technical Officers

- Mrs K.N.A. Baduge, BA (Cey.)
Mrs L. Wanigatunge
Mrs W.C.M. Kuruppu
Mrs H.V.K. Gamage
Mrs S.I. Yapa
Mrs D.M.K.L.K. Dissanayake
Miss W.K.C. Nalinie
***Mrs P.R. Bogahawattage
Miss H.K.D.C.S. Jayawardena
Miss C.S. Gallage
K.M.U. Mitrananda
P.H. Sarath Kumara, DPRI
M.D.C. Seneviratne
T.A.S. Siriwardena
D.P. Wettasinghe
E.C.D. Senanayake

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
W.W. Nandasena
K.R.N. Karunatileke
P.L. Perera

Clerk/Stores Assistant

- Mrs L. Rukmanie

Clerk/Typists

- Mrs S.A. Paronavithana
Mrs I. Wijesinghe
Miss R.S. Wijeratne

Adaptive Research Unit

Assistant Development Officers

- F.P.W. Silva
P.P. Jayasinghe, LPRI

Biometry Section

Senior Technical Officer

- L.T. Peiris

Technical Officers

- Miss J.D. Nandanie
L.P.P. Vitharana

Director's Office

Assistant Agricultural Economist

- *H. Talgaswatte, BScAgric (SL)

Library

Librarian & Publications Officer

- Miss Kamani N. Vithana (ASLLA)

Library Assistant &

Assistant Publications Officers

- D.C. Thambawita
Mrs D.T. Dantanarayana

Clerk/Typist

- Mrs R.M. Amaratunga

ADMINISTRATION DEPARTMENT

Deputy Director (Administration)

- K. Ginige, BA (Cey.)

Assistant Administrative Officer

- T.H. Wijesena

Office Assistant

- J.D. Gunaratne

Assistant Medical Practitioner

- K.V. de Silva

Chief Clerk

- Mrs D.F. Thambawita

Clerks (Special Grade)

- Mrs W. Paul
Mrs R.S. Amarasekera
R.G.D. Sakaraja

Assistant Store Keeper

- P.D. Somadasa

Translator/Clerk

D.U. Kannangara

Clerk/Typists

Mrs P.W. Neelamanie
Mrs K.P.R. Gunasekera
Miss M.D.P. Gunasekera

***Mrs E.W. Dhammika

Telephone Operator

Mrs P. Edirimanne

Internal Audit Unit

Assistant Internal Auditor

- Neil C. de Silva

Internal Audit Assistants

W. Kularatne
S.W.S.G. Gunawardene
D.E.C. Warnakula

Works Section

Works Engineer

Chief Clerk

Transport Officer

Building Foreman

Electrical Foreman

Clerk/Typists

Mechanical Supervisor

Charge Hand (Buildings)

Charge Hand (Electrical)

Accounts Department

Accounting Assistant

Book-Keeper

Graduate Assistants

Accounts Clerks (Special Grade)

Accounts Clerks

Clerk /Typists

Store Keeper

Assistant Store Keeper

Cashier

Estate Department

Estate Superintendent

Chief Clerk

Senior Assistant Clerk

Junior Assistant Clerks

Rubber Factory Officer

Rubber Factory Supervisor

G. Mahanama

D.D.D. Adikaram

B.D. Ponnampereuma

K.K.A.S. Kannangara

W.D. Ratnasinghe

Miss M. Gunawathie Silva

Miss J.A.S. Dharshanie

Miss K.C.S. Jayaweera

S.D. Gunawardena

H.A. Somasiri

J.D. Sirisena

K.G.A.K. Dharmawardena

D.A. Rajapakse

Mrs G.K. Somasiri, BA (Cey.)

Mrs. K. Jagoda, BA (Cey.)

G.S. Doolwela

G.A. Kannangara

Mrs C.C. Silva

Miss S. Irene

Mrs M. Gunawardena

Mrs K. Kapuge

Miss N.M.M.N. Nawaratne

K.C. Fernando

Mrs W.A.S. Weeramanthrie

Mrs R. Handungoda

D.C.P. Pothmitiyage

P.L.A.W. Cooray

D.C.A.D.B. de Silva

V.M. Katugaha

S.A.L. Chandrawansa

K.K.P. Gunawardena

K.D. Sumanasena

Mrs C. Dissanayake

A.K.D.A. Wickremasinghe

D.S.K. Ranaweera

W.D.D. Senanayake

Field Officers

- N.L.D. Piyadasa
- A.K.D. Hemapala
- H.M.J. Premalal
- S.K.S. de Silva (attending to clerical work)

Assistant Field Officer

- 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. Samarasokera

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



Dr. A. de S. Liyanage resigned from the Post of Director, Rubber Research Institute to take up an assignment in the University of Western Samoa having served the Institute for 22 years of which the last 3 years as the Director of the Institute.

Dr. Liyanage who had a bright career at St. Aloysius College, Galle both in academic fields and in sports, graduated from the University of Ceylon with Honours in Agriculture. He joined RRI in 1968 as the Assistant Plant Pathologist. He obtained his PhD from Wye College, UK under the supervision of Dr. D. J. Royle. The topic of the thesis is "*Powdery Mildew on Hop.*"

Before he became the Director, he was the Head of the Plant Pathology Department until 1987 ; in which capacity he rendered a tremendous contribution to the rubber industry. Biological control of diseases in *Hevea* plant instead of the traditional chemical control, which is costly and dangerous, is an invention of Dr. Liyanage. Termination of traditional sulphur dusting in rubber estates to control *Oidium* disease was also a significant contribution made by him in association with Dr. O. S. Peries, former Director of the RRI. The concept of Adaptive Research training introduced to the rubber industry of Sri Lanka is a brain child of Dr. Liyanage. These two new developments enabled to save lot of foreign exchange to the country. For his valuable contribution to the rubber industry, the PRI merit award 1990 was awarded to him.

His talents were highly accepted by International Organization such as the International Rubber Research & Development Board and recognised the Plant Pathology Lab of the RRI, Sri Lanka as a Centre for training Plant Pathologists for Rubber Plantations. Under this scheme both Thai Indonesian and Vietnamese scientists have had the opportunity of obtaining their training in Sri Lanka. His talents as the skipper of cricket team of the University of Peradeniya and at the RRI helped him to lead the team of scientists at the RRI to win the prestigious NRESA award for research in 1989

His large number of publications in reputed Journals as well as his wide experience regained recognition as a prominent Plant Pathologist helped him to achieve the prestigious position as a Senior Lecturer in Crop Protection in the University of South Pacific, Western Samoa.

He is a great social mover. His deligence, enthusiasm and cheerful gesture enabled him to meet challenges effectively and efficiently during the period he held the challenging position as the Director, RRISL.

We wish him and his family good luck and the blessing of tripple Gem.

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA
DIRECTOR'S REVIEW

By

L. M. K. TILLEKERATNE

In 1990, World Natural Rubber Consumption decreased by 0.8% to 5.180 million MT; total consumption of synthetic rubber also decreased to 9.63 million MT; representing a decrease of 3.6% over the previous year. However, the production of NR also decreased by 3.6% to 4.9 m MT thereby creating a net deficit of 2.5 m MT. The SR production also decreased to 9.9 m MT over the previous year. Hence in 1990 the total percentage share of synthetic rubber consumed dropped to 66.0% from the previous years figure of 66.3%.

The forecast for NR production in the world in 1991 is 5.425 m MT while the synthetic production is expected to reach 10.58 m MT. Expected consumption of NR in 1991 is around 5.51 million MT while synthetic rubber consumption will be about 10.63 million MT, thereby lowering the percentage share of SR consumption down to 65.9%. Price of NR during 1990 was the most stable since 1982. The Daily Market Indicator Price (DMIP) was 182.8 US cents in January 1990 and it has remained at 182.4 cents at the end of the year. Invasion of Kuwait by Iraq in August 1990 made the DMIP to rise to its highest level for the year to 192.6 US cents. However, the sharp depreciation of the US dollar influenced the DMIP to decline again.

All major types of synthetic rubber, specially Styrene Butadiene Rubber (SBR) and Ethylene Propylene rubber had gone up in price during 1990. As the NR price is relatively stable the relative price of SR/NR will continue to rise in the future too. Sri Lanka has maintained her sixth position among the world's NR producing countries producing close to 110,000 MT. The country which offered the biggest competition to Sri Lanka in 1989 was Liberia, with an anticipated production of 118,000 MT in 1990, which it was not able to meet, due to the domestic tribal problems they encountered. Almost all the rubber factories in Liberia have been destroyed by racial riots thereby lowering their rubber production to 70,000 MT and paralyzing the industry for a further couple

of months at least. However, both the Philippines and Nigeria have shown an increase in production, producing over 80,000 MT in each country, despite the political problems they too had faced.

Even though the total NR production in Sri Lanka continued to be about 2.5% of the world production in 1990 too, she managed to maintain her top position as the highest quality latex crepe producer in the world. Except for a very small quantity of crepe offered by Malaysia, in 1990, almost all the finest plantation sole crepe and latex crepe both thick and thin, have been produced by Sri Lanka.

Ansells (a subsidiary of Dunlops) commenced Production using local latex for their dipped rubber products industry at Biyagama in November 1989. However, the crepe production in the country has not shown any substantial drop as a result. This indicates that bulk of the latex utilised for the manufacture of centrifuged latex in the country is still produced by the small holders. With the increase of the dutiable threshold price for NR exports from Sri Lanka to Rs. 21.00/kg on the 6th of September, the price of all grades of rubber came down by about Rs. 2/kg. Also due to the withdrawal of USSR from the auction, latex crepe suffered further and in the last quarter of the year latex crepe IX grade recorded a price even below that of sheet rubber No. 1.

The total production in Sri Lanka during 1990 has been 110,000 MT: which is about the quantity produced in 1989. According to the present production forecast, even in the year 2000 Sri Lanka will produce only about 145,000 MT. This will still be below the quantity produced in 1978. In spite of all efforts taken to increase rubber production by introducing high yielding clones and new improved planting techniques neither the yield per acre nor the total production has increased according to expectation. The main reasons identified as contributory factors for this low yield per acre are the low stand per acre of rubber land, reduction in the quantity of fertilizer applied due to high fertilizer price, very high incidences of brown bast mainly due to too intensive tapping over recommendations, and the development of root diseases to epidemic level due to bad management practices. During the year under review many small holdings remained untapped because of the low price of rubber and it is estimated that around 3000 acres have been going out of rubber during the last few years. All these factors have ributedcont to keep the total rubber production in the country at its present low level.

Drought has also affected the global NR production badly during the 1st half of 1990. Relative strength of the latex based grades of Technically specified NR produced by Malaysia and Thailand have reduced sharply due to the drought experienced in those two countries. However, drought did not affect the production of rubber in Sri Lanka to any appreciable extent in 1990.

All Eastern European countries in general and East Germany in particular, are facing up to the enormous challenge of economic reform. These reforms have opened new opportunities for natural rubber in these countries. Western technology, processing methods and product knowledge are finding their way to Eastern Europe, mainly because of the overwhelming consumer demand in those countries. Reputed tyre manufacturers in Western Europe are trying to invest heavily in East Germany and in

other Eastern European countries making use of the cheap labour, space and skills available there to expand, their industries. Eastern Europe countries also offer a nice assortment of subsidies and tax concessions to attract investors. Already several joint ventures have been established in these countries and these are beginning to consume more and more NR.

In 1990, the Fiat company launched a programme in Poland to produce 200,000 cars annually and Pirelli set up a new tyre factory there to cater to this increasing demand. Similarly many other factories have been started to supply rubber accessories which are needed for this motor car industry.

The estimated NR consumption in Western Europe in 1990 is 3.16 MT. This is a nearly one hundred thousand tonnes more than the North American consumption during the same year. Eastern Europe alone, on the other hand has consumed another 3.61 million tonnes, mainly for these new projects. This does not take into account the consumption in Eastern Germany. Even USSR, in the light of recent political and economic changes taking place there, has increased her import of NR to 140,000 MT; thereby increasing the NR/SR ratio.

One of the important regulations formulated and implemented by the Ministry of Plantation Services in 1990 to the industry is the requirement for channeling of all quality claims for rubber exports through the Ministry of Plantation Services to the Rubber Research Institute of Sri Lanka. Release of foreign exchange for the settling of these claims will only be made by the Treasury on the recommendation of the RRB. This will help to prevent any malpractices in the rubber export trade and minimise quality claims. Legislation has already been passed by the Ministry, during this year, to make it mandatory to obtain a certificate for the RRI for the export of deprotenized rubber thereby controlling the selling price of this grade of rubber.

RESEARCH HIGHLIGHTS

Rubber Chemistry & Technology

We take pride in reporting that a soluble form of cyclised rubber was successfully prepared out of latex to replace synthetic resins imported at a high price for the paint industry. There is a lot of interest among industrialists to make use of this patent to manufacture their requirement of cyclised rubber by this method. Several batches of MG 30 and MG 49 have been made by us during this year in collaboration with a shipper and the response of the recipients so far for the same has been very good. There is every possibility for us to go for commercial lots of these two grades in the near future. Semi-commercial batches of can sealant manufactured by us have also been sold successfully, replacing the imported sealant. There has been an increasing demand for the thermo-plastic natural rubber latex collecting cups during this year as a result of an initial introduction of TPNR cups in the field.

Raw Rubber and Chemical Analysis Department has been engaged mainly in the analysis of raw rubber and rubber latex for certification of the quality. They have been able to prove that addition of Sodium dihydrogen phosphate into Sri Lanka field latex is not essential except in certain special times of the year to reduce the Mg level in the latex concentrates produced. This has helped not only to save foreign exchange to the country; but also to eliminate the baseless fear some industrialists had that Sri Lanka latex contains very high levels of Mg compared to the SEA countries.

A water sealing adhesive sealant developed by this Section for the skirt type polythene rainguards has shown excellent properties and hence this type of rainguards are becoming popular in most of the rubber growing areas. This new sealant undergoes partial vulcanisation during use in the field thereby forming a gum which expands with the girth of the tree without cracking. This Section was able to introduce a new and economical method of fractionation of latex for latex crepe manufacture by aeration. This new method enables not only to cut the cost of manufacture of crepe but also to remove the required percentage of fraction by regulating the rate of air flow.

The Technology Department on the other hand has been able to produce a new preservative system for radiation vulcanisation of latex in collaboration with the Atomic Energy Authority. This new preservative system has already been accepted as the best preservative system so far developed for this purpose anywhere in the world. They have also been able to produce a type of positex which could be incorporated into bitumen while developing a special latex compound for the manufacture of broom sticks, rubberised coir belts and adhesive etc. One of the most important findings of this Department is the trial carried out to show the improvement of abrasion properties of retreaded tyres by incorporating up to 20% by weight of oil in NR. This Department proudly announces its ability to introduce in 1990 a fluorescent form of sole crepe rubber produced by means of an optical brightener used in textiles instead of the bleaching agents.

Raw Rubber and Chemical Engineering Department continued their advisory visits to advise Estates on effluent disposal methods. They have also evaluated the "Sonra" effluent treatment plant installed at Dartonfield and reported that it cannot solve the problem by lowering the COD and BOD levels of rubber factory effluents below the CEA requirements.

A seminar on effluent disposal, treatment and utilisation was organised by this Department to the planters of JEDB and SPC. They have been heavily engaged in inspection of factories for subsidy payment through out 1990.

Biology

Breeding and testing of clones continued to receive very high priority and clone RRIC 121 is emerging as the best clone with respect to vigour and yield. This clone has now been recommended for large scale planting both in the state and small holder sector estates. The new selection from hand pollinated population viz. 74 - 193 continued to give promising yields in the region of 75 gm/tree/tapping in small scale trials.

It has also been found that both *in vitro* and *in vivo* pollination can be used to study the floral biology of *Hevea*. Crossability between clones was used to study the incompatibility between *Hevea* clones.

Although by the introduction of techniques such as 'young budding' it was possible to achieve high success in field establishment, growth of plants at the end of 9 months appears to be comparable to that with bare root green and brown budded stumps.

An islandwide survey on the availability of budwood of high yielding clones was done, and around 26,000 budded stumps of different clones were issued to private and state sector nurseries for the establishment of budwood multiplication nurseries.

With regard to exploitation practices, low frequency tapping with and without stimulation have given higher yield (g/tree/tapping) compared to conventional $\frac{1}{2}$ S d/2 system. In the later stages of the growth cycle, higher panels could be exploited whilst resting the lower panels to obtain economic yields for approximately 2 years. The rested lower panels give relatively higher yields than those continuously tapped.

Intercropping and multicropping in immature rubber land is becoming very popular and crops such as banana, passion fruit and pineapple are now recommended as intercrops during the immature period with the objective of providing an income in particular period to the small holders during the long immature period. Multicropping of rubber lands with tea has now been recommended on a limited scale with a spacing of 40 ft. by 8 ft. which would provide approximately 70% the recommended planting density of rubber and 75% of the recommended planting density of tea.

Studies on fertilizer use continue to receive attention and significant interaction between clone and levels of applied potassium in most of the experiments suggests that the K requirement for growth of immature-RRIC 100 series is likely to vary between clones.

Among the different soil management practices dead mulch (rice straw) exhibited the highest girthing of plants in comparison with other practices such as growing leguminous covers or naturals. Similarly, tappareability % and yield were much higher in mulched plots. Contribution of soil nutrients, soil pH and CEC also, were all in favour of mulching. Another benefit of mulching is that it gave the highest soil and leaf K content in comparison with the other practices.

Studies on moisture stress indicated quadratic response with application of K, an increase in girthing at K¹ level and a decrease at K² level, under no stress conditions. It was also noted that the plant diameter and height at 50% field capacity with recommended potassium level were almost equal to the diameter and height at the 10% field capacity in combination with the K² level suggesting that under condition of moisture stress increasing the level of K would help in restoring normal growth of rubber plants. These results were supported by some physiological parameters such as stomatal conductance, transpiration and leaf water potential.

Incidence of *Oidium* and *Gloeosporium* leaf diseases was low but a heavy incidence of *Phytophthora* Leaf Fall and Bark Rot was observed. The incidence of the *Corynespora* Leaf Fall was mild and new clones were not affected in the field. However, most of the clones in several polybag nurseries were found to be severely affected with *Corynespora cassiicola*.

Dithane M 45 and Sandofan M were identified as potential fungicides for the control of Bark Rot. Thiovit and sulphur performed best *in Vitro* when seven fungicides were screened against *Oidium heveae*.

Adaptive Research Programmes were started on small holder fields in the Kalutara, Galle, Kegalle and Ratnapura regions to evaluate and refine or modify if necessary, the technologies developed at the research station and state owned plantations to fit better smallholder 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.

STAFF

Overseas Visits

Mr D.M.A.P. Dissanayake, Assistant Soils Chemist resumed duties on 13 August after 18 months post-graduate studies. He is scheduled to leave the country again after 15 months to continue post-graduate studies for a period of 03 months.

Mr V.H.L. Rodrigo, Research Assistant (Intercropping) left for UK for a period of one (01) year commencing 01 October to read for his MSc degree at the University of Essex, U.K.

Mr B.P. Weeraratne, Assistant Rubber Chemist left for UK for a period of two (02) years commencing 01 October to read for his MPhil degree at the University of Loughborough, UK.

Miss M.S. Ranasinghe, Assistant Botanist continued her post-graduate studies at the University of New England, Australia.

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, UK.

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

Mrs G.P.W.P.P. Seneviratne, Assistant Botanist continued her post-graduate studies at the University of Bath, U.K.

Dr L.M.K. Tillekeratne, Director attended the International Rubber Research and Development Board Meeting held in Kunming, China from 05 to 11 October. He also attended a Conference on "Rubber and Eastern Europe" held in UK and also met, and held discussions with the dealers of rubber in Europe regarding Marketing Strategies for Crepe Rubber during the period 21 to 24 November.

Dr M.K.S.A. Samaraweera, Head of Soils and Plant Nutrition Department visited the University of Calgary (Canada) and Long Ashton Research Station and School of Chemistry of the University of Bristol, Department of Biological Sciences of the University of Exeter and Department of Soil Science of the University of Reading (UK) during the period 4 to 20 August.

Mr C.K. Jayasinghe, Acting Head of Plant Pathology and Microbiology Department attended a training course on South American Leaf Blight and other diseases of rubber in Malaysia during the period 11 to 30 June.

Dr (Miss) N.M.V. Kalyani, Assistant Rubber Chemist left for UK for a period of three (03) months commencing 20 September on a UNIDO Contract.

Dr (Mrs) K.G.K. de Silva, Rubber Chemist left for Canada for a period of one (01) year commencing 15 July on Sabbatical Leave.

Mr K.B.K. Karunasekera, Experimental Officer left for UK to undergo a Technical Assistance Co-operation Training Programme for a period of fifteen (15) months commencing 24 October.

Mrs P.C. Wettasinghe, Technical Officer and Mr E.A.T. Senadheera, Technical Officer visited the Rubber Research Institute of Malaysia to attend a training course on South American Leaf Blight and other diseases of rubber during the period 24 October to 16 November.

Mr W.N. Wickramasinghe, Biometrician visited Thailand to attend an ANRPC Workshop on the Cost of Production of Natural Rubber in the Smallholder Sector during the period 22 to 24 January.

Mr S.W. Karunaratne, Deputy Director (Research) was on leave in the United Kingdom during the period 1 to 16 March.

Local Training

Mrs E.W. Dhammika, Clerk Typist followed a Course on Development of Clerks at the National Institute of Business Management during the period 26 to 30 March.

Mr W.W. Nandasena, Specification Assistant followed a Diploma Course on Rubber Technology at the Plastics and Rubber Institute from 3 February to 2 November.

Miss W.K.C. Nalinie Technical Officer followed a Diploma Course on Rubber Technology at the Plastics and Rubber Institute for a period of three (03) months commencing 3 February.

Mr K.M.U. Mitranande, Technical Officer followed a Diploma Course on Rubber Technology at the Plastics and Rubber Institute for a period of three (03) months commencing 3 February.

Mrs I. Denawaka, Technical Officer followed a Course on Rubber Technology at the Plastics and Rubber Institute for a period of three (3) months commencing 3 February.

Mrs I. Wijesinghe, Clerk Typist followed a Course on Word Processing (Word Perfect) at the Data Processing Aides Limited for a period of six (6) weeks commencing 5 April.

Mr D.P. Wettasinghe, Technical Officer is following a course on NDT Chemical Engineering for a period of one (1) year commencing 14 May.

Mrs S.A. Paranawithana, Clerk Typist followed a Course on Word processing (Word Perfect) at the Data Processing Aides Limited for a period of six (6) weeks commencing 5 April.

Mrs W.S.P. Amarasekera, Clerk Typist followed a Course on Word Processing (English) at the Ceylinco Management and Accountancy Services Ltd., for a period of four (4) months commencing 3 March.

No Pay Leave

Mrs E.W. Dhammika, Clerk Typist is on no pay leave for a period of one (1) year and five (5) months commencing 23 August, in order to join her husband in New Zealand.

Mrs P.R. Bogahawatta, Technical Officer is on no pay leave for a period of thirteen (13) months commencing 1 November to follow a course of training on Laboratory Techniques on Agriculture in the Federal Republic of Germany.

The Salarised staff of the Institute at the end of year (1990) was as follows :

Director	—	01
Deputy Director (Research)	—	01
Deputy Director (Administration)	—	01
Assistant Director	—	01
Officers in Grade I - VI	—	44
Officers in Grade VII - XIII	—	128
Officers in Grade XIV - XVI	—	95
Total	—	<u>267</u>

VISITORS

Visitors to the Institute included :

Professor Dennis Parkinson, University of Calgary, Canada
Professor R.K.S. Wood, Imperial College, London, UK
Dr R. Ftrong University of Glasgow, Scotland
Dr J.D. Connolly, University of Glasgow, Scotland
Dr R.H.O. Kekwick, University Birmingham, UK

REVIEW OF THE PLANT SCIENCE DEPARTMENT

By

CHANDRA SAMARANAYAKE

SUMMARY

Trees of lower girth classes gave significantly lower yields than those of higher girth classes.

Low frequency tapping with and without stimulation have given higher g/t/t yields compared to conventional 1/2S d/2 system. In the latter stages of a tree, stimulated higher panels could be exploited, whilst resting the lower panels to obtain economic yields for ca. 2 years. The rested lower panels give relatively higher yields than those continuously tapped.

In young buddings, whilst the success of field establishment is superior the growth after ca. 9 months is comparable with bare root green and brown budded stumps.

An islandwide survey on the availability of budwood of high yielding clones were done. Around 26,000 budded stumps of different clones were issued to private and state sector nurseries for the establishment of budwood multiplication nurseries.

DETAILED REVIEW

Staff

The Head of Department Dr. (Mrs.) A.C.I. Samaranayake, Dr. A. Nugawela, Botanist, Messrs L.S.S. Pathiratne, R.B. Gunaratna, Experimental Officers, Mr. L.S. Kariyawasam, Senior Technical Officer, Messrs K.A.G.B. Amaratunga, R.P. Karunasena, U.S. Weerakoon, S.L.G. Ranjith, R.S. Wijesundera, Mrs. C.W. Ranasinghe, Miss R.K. Aluthewage, Technical Officers, Mr. S. Wilbert, Experimental Assistant and Mrs. D.E. Jayawardena, Clerk/Typist were on duty throughout the year. Mrs. G.A.S. Wijesekera was on maternity leave from 20th May, 1990 to 15th August, 1990.

Assistant Botanist, Mrs. G.P.W.P.P. Seneviratne, and Miss M.S. Ranasinghe continued their Post-graduate studies abroad.

Mr. L.S.S. Pathiratne, Experimental Officer was appointed Assistant Botanist on 10th August, 1990.

Mr. K.A.G.B. Amaratunge, Technical Officer was appointed Senior Technical Officer with effect from 17th September, 1990.

Messrs B.D. Seemon and W.H. Seneviratne, Field Attendants retired from service on 9th August and 9th December respectively.

Research Students

Miss. I.D. Gunetilleke (Temporary Research Assistant 01.04.1985 - 01.10.1987) was awarded a MPhil degree by the University of Sri Jayewardenepura for her thesis on "Tissue culture of *Hevea braziliensis* (seedling) shoot tip culture." Her thesis was based on her research studies done in the Plant Science Department under the supervision of Dr. (Mrs.) A.C.I. Samaranyake.

Miss P.H.A.P. Chandrakanthi, Temporary Research Assistant completed her Research Assistantship on 30th September. She is registered with the University of Peradeniya to read for a MPhil Degree and is expected to submit a thesis on her studies on shoot tip culture of *Hevea* done at the Department.

Visits

Department staff made advisory visits to plantations and smallholdings and regular visits to experimental areas.

Meetings and Conferences

Head of Department attended,

Monthly meetings of the Steering Committee of the Smallholder Rubber Rehabilitation Project.

Rubber Sector Review meeting.

Central Scientific Committee meeting.

Discussions on the Rubber Replanting Programme for 1991 with the Regional Boards of the SLSPC and JEDB.

Training Programmes

Department staff were involved with the following training programmes :

Training of budders for Private Commercial Nurseries on green budding techniques and preparation of young buddings.

Induction course for Rubber Extension Officers of the Advisory Services Department.

Training of Rubber Inspectors of the Rubber Control Department on Nursery Inspection.

Field days for the planters of JEDB Avissawella and Kegalle Zones.

Publications

Nugawela, A. (1990). Physiological Research done on Plantation Crops of Sri Lanka. Proceedings of the *Ann.Sess.* of the Physiol. Soc. of Sri Lanka (in press).

Nugawela, A., and Aluthewage, R.K. (1990). The effect of tapping on the CO₂ assimilation rates of *Hevea brasiliensis* Muell. Arg. Leaves. *J. Rubb. Res. Inst.* (Sri Lanka).

Pathiratne, L.S.S., Waidyanatha U.P. De S. and Peries O.S. (1989). The effect of apatite and elemental sulphur mixtures on growth and P content of *Centrocema pubescens* Fertilizer Research 21 : 37 - 43.

Rodrigo V.H.L., Nugawela, A., Kariyawasam, L.S. and Aluthewage, R.K. (1990) Field performance of young coffee seedlings and cuttings intercropped with rubber *J. Rubb. Res. Inst. Sri Lanka* (In Press).

Reports

Samaranayake, Chandra (1989) Ann.Rev. of the Plant Science Department.

Samaranayake, Chandra. Availability of budwood of high yielding clones for the future replanting programme. Report submitted to the Steering Committee of the SRRP.

LABORATORY INVESTIGATIONS

Shoot tips

Studies were continued to improve proliferation of buds in seedling and clonal shoot tip cultures. Proliferation of buds could be improved by supplementing the growth medium with certain growth substances with high cytokinin activity. In clonal shoot tip cultures the proliferated buds did not survive on separation and subculture. (P.H. A.P. Chandrakanthi and Chandra Samaranayake).

Gas Exchange Studies

Non-steady CO₂ assimilation

Given the rapid changes in light that will occur within a tree canopy in the field, any difference in the rapidity of adaptation between genotypes would have implications for canopy photosynthesis. Thus, using artificial step changes in light such responses were compared in genotypes RRIC 100, RRIC 102 and RRIC 121 under laboratory conditions.

Early selection of new genotypes

Gas exchange measurements were made on 54 genotypes (individual seedlings) of the 1987 breeding programme. These genotypes were ranked according to their mature yield potential as indicated by the selection index, calculated from their gas exchange characters.

With the objective of further improving the selection index, in two seedling populations (25 seedlings in each) established in September, 1990, gas exchange studies are being made on each leaf whorl of a seedling. Measurements will be made until plants are around a year old. Whether the ranking according to the selection index based on gas exchange measurements of different leaf whorls differ will be investigated. (A. Nugawela and R.K. Aluthewage).

FIELD EXPERIMENTS

Tapping

Interaction of clones and tapping systems - St. George (CT/77/3)

The purpose of this experiment was to ascertain the most suitable tapping systems for different clones. Five tapping systems were tested on fifteen clones from 1984 - 1987. Trees of clones RRIC 103 and 104 were uprooted in 1987 due to infection with *Corynespora* leaf spot disease and the experiment was continued with the 13 clones. The tapping systems were changed in 1987 and the following systems were adopted :

Treatment 1 - 1/2S d/3

Treatment 2 - 1/2S d/2

Treatment 3 - 2 × 1/2S d/3

Treatment 4 - 1/4S d/2 + E

Treatment 5 - PT.d/2

Yield data recorded for 1991 are summarised in Table 1.

Most clones which gave significantly higher yields with 2S/2 d/3 system of tapping in 1988 have not yielded high yields with this system in 1990. There has been no significant interaction of clones and tapping systems on girthing of trees in 1990. (Chandra Samaranayake, L.S.S. Pathiratne and C.W. Ranasinghe).

Table 1. Mean yield g/t of clones, TT/77/3

		1/4S d/2	2 × 1/2S d/3	PT	1/2S d/2	1/2S d/3
RRIM	600	34.03	65.95	30.70	53.03	60.75
RRIC	117	42.83	52.88	44.13	61.45	40.58
RRIC	113	41.35	53.38	33.13	47.45	60.40
RRIC	110	41.95	44.33	41.93	50.95	42.95
PB	86	33.35	58.23	25.00	47.28	54.25
RRIC	100	35.75	42.60	41.48	41.55	53.95
RRIC	109	38.33	49.38	31.30	48.45	42.58
RRIC	102	35.05	44.33	31.58	52.95	43.13
RRIC	108	31.58	39.85	30.33	43.45	40.15
RRIC	101	30.30	36.23	28.73	33.78	41.33
HP	2427	31.33	27.25	32.95	30.13	34.75
RRIC	105	28.43	28.35	29.00	28.78	37.00
RRIC	112	23.50	42.23	20.38	27.35	34.68

L.S.D. .05 To compare tapping systems within same clone - 13.6065

L.S.D. .05 To compare tapping systems in different PT clones - 14.4896

Girth at commencement of tapping, PB 86 replantation - Dalkeith (T/84/2)

In this experiment several initial girths for commencement of tapping are compared to study their effect on yield and subsequent girthing of trees.

Data recorded for 1990 are summarised in Table 2.

Table 2. Mean Yield for Different Girth Classes

Girth classes	Yield (g/t/t)	
T ₁ - 40.0 - 44.9 cm	24.37	C
T ₂ - 45.0 - 49.9 cm	29.38	B
T ₃ - 50.0 - 54.9 cm	32.43	A
T ₄ - >55.0 cm	34.37	A

(Means with the same letter are not significantly different).

Trees of lower girth classes T₁ and T₂ gave significantly lower yields than those of girth classes T₃ and T₄. Experiment was terminated at the end of 1990 (Chandra Samaranayake and S. Wilbert).

K levels on tapping systems X clones - Eladuwa (F/76/5)

Effect of three levels of K and three tapping systems on the performance of clones PB 86, RRIC 100 and 101 was studied in this experiment. The fertilizer treatments were applied by the Soils and Plant Nutrition Department and the application of different levels of K was discontinued in 1990. The experiment was continued as a tapping experiment. The results recorded in 1990 are summarised in Table 3.

Table 3. Mean yield (g/t) for different clones and tapping systems (F/76/5)

Clones	Tapping systems		
	1/2S d/2	1/2S d/3	1/2S d/4 + E
PB 86	19.25	27.48	32.95
RRIC 100	38.80	31.22	41.82
RRIC 101	23.07	22.35	30.05

L.S.D.(0.05) = 5.90

The low frequency 1/2S d/4 system of tapping with Ethrel stimulation has recorded significantly higher yields in clones PB 86 and RRIC 101. Clone RRIC 100 has given comparable yields on 1/2S d/2 and 1/2S d/4 + E systems of tapping. (Chandra Samaranyake and S. Wilbert)

Low frequency tapping

RRIC 100, 1981 replanting - Gallewatta (LIT/88/1)

The objective of this experiment is to study the performance of clone RRIC 100 on low frequency tapping systems with yield stimulants.

The following tapping systems are being tested, on a randomized block design.

- T₁ - 1/2S d/2
- T₂ - 1/2S d/3 + 2.5 Ethrel
- T₃ - 1/2S d/4 + 2.5 Ethrel
- T₄ - 1/4S d/2 + 2.5 Ethrel

Ethrel was applied at 3 monthly intervals and the yield and girth data recorded for 1990 are summarised in Table 4.

Table 4. Mean yield (g/t) and girth (cm) with different tapping systems (LIT/88/1)

Tapping system	Yield (g)		Girth (cm)	
T ₁ - 1/2S d/2	26.90	B	63.05	B
T ₂ - 1/2S d/3 + Ethrel	36.29	A	63.80	B
T ₃ - 1/2S d/4 + Ethrel	36.29	A	64.40	B
T ₄ - 1/4S d/2 + Ethrel	22.47	C	67.33	A

(Mean with same letters are not significantly different)

Low frequency tapping system 1/2S d/3 and 1/2S d/4 with Ethrel have given significantly higher yield than 1/2S d/2 system of tapping. 1/4S d/2 system with Ethrel has given significantly low yields and the girthing of trees has been significantly better with this short cut system. (Chandra Samaranayake and S. Wilbert)

RRIC 102 replantation, Neuchatel (LIT/88/2)

Five tapping systems are included in this experiment. Ethrel was applied at 3 monthly intervals. The yield and girth data recorded in 1990 are summarised in Table 5.

Table 5. Mean yield (g/t/t) and girth with different tapping systems (LIT/88/2)

Tapping system	Yield		Girth (cm)
T ₁ - 1/2S d/2	31.45	C	62.23
T ₂ - 1/2S d/3	39.01	B	62.78
T ₃ - 1/2S d/3 + 2.5 Ethrel	44.46	A	62.32
T ₄ - 1/2S d/4 + 2.5 Ethrel	41.88	A	62.40
T ₅ - 1/4S d/2 + 2.5 Ethrel	25.06	D	62.15

(Means with same letter are not significantly different)

Low frequency tapping with Ethrel have given higher g/t/t yields compared to conventional 1/2S d/2 and 1/2S d/3 systems. 1/2S d/3 system has given higher g/t/t yields than 1/2S d/2 system and 1/4S d/2 with Ethrel has yielded the lowest. There was no significant interaction between tapping systems and girthing of trees. (Chandra Samaranayake and K.A.G.B. Amaratunge)

High intensity tapping - Frocester (IS/84/1), (IS/84/2), Nakiadeniya (IS/84/2), (IS/84/4) and Ambadeniya (IS/84/6)

These experiments were laid down to investigate suitable systems of tapping during the last few years of exploitation to obtain maximum possible yields. The following tapping systems, Tables 6 and 7, were tested in Estates situated in different agroclimatic regions in which rubber is grown. The d/2 and d/3 systems were tested using 2 sets of experiments, i.e. Experiment 1 and 2.

Experiment 1.

Table 6. Yields (kgs/task/year) during the first 3 years of tapping (Each value is the mean of 12 observations) Task size - 180 trees.

Treatment	Yields (kgs/task/year) during first, 3 years.		
	1	2	3
1/2S + 1/4S* (1) d/3	986	624	536
1/2S + V (1) d/3	972	683	524
1/2S + 1/2S (1) d/3	1000	652	531
1/2S + 1/4S (1) d/3	864	604	521

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

Experiment 2.

Table 7. Yields (kgs/task/year) during the first 2 years of tapping (Each value is the mean of 18 observations) Task size 180 trees.

Treatments	Yields (Kgs/task/year) during first 2 years	
	Year 1	Year 2
V* (1) d/2	1166	949
1/2* (1) d/2	1119	861
1/2S + 1/4S (1) d/2	1117	928
1/2S + PT** (1) d/2	1054	882
* 5% ET, Ba 0.8 (2.5) 4/y		
** 5% ET, Ba 1.0 2W		

Significant yield differences were found only in the tapping systems tested in Experiment 1. Nevertheless, these significant differences were evident only during the first year of tapping (Table 6). When comparing the tapping systems of the 2 experiments (Table 1 and 2) stimulated upward cuts, i.e. 1/2S and V tapped d/2, have given higher annual yields than cuts tapped at d/3 frequency. The response to stimulation was highest during the first year of the study and then it gradually declined. In all tapping systems tested, the yields dropped steadily during the 3 years of tapping. Thus tapping was further intensified (Table 8).

Table 8. Yields (kgs/task/taskyear) during the first two years of tapping on the following tapping systems. The yields of trees where the lower panels were rested are given separately. (each value is the mean of 24 observations). Task size 180 trees.

Tapping systems	Lower panels rested		Lower panels exploited	
	Year 1	Year 2	Year 1	Year 2
1/2S + 1/4S (1) d/2	—	—	758	829
1/2S + V (1) d/2	968	905	717	876
1/2S + 1/2S (1) d/2	948	886	815	797
1/2S + (2 x 1/4S) (1) d/2	—	—	755	848

The yields from the tapping systems tested (Table 8) were not significantly different. However, the tapping systems 1/2S + V (1) d/2 and 1/2S + 1/2S (1) d/2 where the lower panels were rested during the 1st 3 years of the study, yielded better

than the trees where the lower panels were exploited during this period. The experiment was discontinued at the end of 1990. (A. Nugawela, S. Wilbert and R.P. Karunasena)

Tapping Panel Dryness (TPD)

A survey on the incidence of TPD is being conducted with the objective of finding genotypic differences and the influence of environmental factors 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 a clearing two adjacent tapping blocks were selected for the survey in an attempt to study the influence of the tapper. A detailed field map is drawn to study the distribution of dry trees. Information on yields and bark consumption rates are also being collected for each clearing.

The percentage number of total dry trees (TD), partial dry trees (PD) in clearings surveyed in the Kalutara and Kegalle regions are given in Table 9 and 10 respectively.

Table 9. *The percentage number of totally dry trees (TD) and partially dry trees (PD) in randomly selected Estates in the Kalutara region (wet.)*

Region	Estate	Panel	Task	Genotype			RRIC	
				PB 86	PB 86	RRIC 100		
				BO-1	BO-2	BI-1	BO-1	
Kalutara	1	1	TD	0	4.7	6.9	0.8	
			PD	1.5	4.3	5.0	0.8	
		2		TD	0	4.7	12.2	0
				PD	0.4	4.7	5.3	0.4
	2	1	1	TD	2.5	4.5	2.4	1.7
				PD	1.1	3.8	3.1	2.4
		2	2	TD	2.6	5.9	4.2	1.6
				PD	1.3	8.5	4.2	4.4
	3	1	1	TD	1.0	10.0	12.3	0
				PD	2.0	3.5	4.6	1.5
		2	2	TD	4.0	5.8	13.4	2.0
				PD	1.7	8.3	7.3	0.4
Means		TD	TD	1.7	5.9	8.6	1.0	
			PD	1.3	5.5	4.9	1.7	

Table 10. *The percentage number of totally dry trees (TD) and partially dry trees (PD) in randomly selected Estates in the Kegalle region.*

Region	Estate	Genotype		PB 86			RRIC 100
		Panel Task	BO-1	BO-2	BI-1	BO-1	
Kegalle	1	1	TD	2.9	12.0	15.4	8.1
			PD	4.5	15.3	8.8	7.8
		2	TD	3.3	17.3	16.7	11.1
			PD	13.2	9.8	4.3	6.8
	2	1	TD	1.3	3.7	20.6	9.0
			PD	3.9	5.2	3.6	1.6
		2	TD	3.0	2.9	22.1	2.7
			PD	4.7	3.8	1.6	2.2
	3	1	TD	3.3	9.7	30.0	—
			PD	3.3	3.2	4.3	—
		2	TD	2.9	3.2	21.4	—
			PD	4.0	7.9	2.3	—
	Mean	TD	TD	2.9	8.1	21.7	7.7
			PD	5.6	7.5	4.2	4.6

The incidence of TPD steadily increases with the number of years tapped. In both genotypes, the incidence of TPD in a panel, varies from Estate to Estate even in the same region. The incidence of TPD, between 2 adjacent tasks, could be either highly variable or similar.

The incidence of TPD is high in the relatively dry region. i.e. Kegalle. This is evident in all 3 panels tested in genotype PB 86 and in panel BO-1 of genotype RRIC 100. The incidence of TPD on panel BO-1 is high in genotype RRIC 100 than in genotype PB 86 in the Kegalle region whilst it is similar in the Kalutara region. The study is being continued. (A. Nugawela, S. Wilbert, R.P. Karunasena and R.S. Wijesundera.)

Rainguards

A rubber/bitumen based sealant developed by the Institute to fix polythene rainguards was compared with the sealant that was used in the past. Apron type pleated polythene rainguards were fixed with the new sealant and the shellkote/latex sealant before the South West monsoon rains. The sealant developed by the Institute was found to be far superior to the other. Rainguards using the new sealant was fixed in a 10ha. field at Gallewatta Division, Dartonfield Estate, before the North East monsoon rains for the economic evaluation of the use of rainguards (Chandra Samaranyake, S. Wilbert and R.P. Karunasena).

Introduction of the Malaysian Tapping Knife

The Malaysian draw knife was introduced into a number of estates in Kegalle, Avissawella, and Kalutara. The objective is to open tapping cuts at a greater height and provide more bark reserves in the base panels. The tapping cuts opened at a height of 150cm and tapped with the Malaysian knife are compared with cuts opened at 120cm height and tapped with the Mitchie Gollledge knife. (Chandra Samaranyake and S. Wilbert)

Propagation

Stock-scion relationships - Moraliya (St.Sc./81/7)

Five scion clones RRIC 100, 102, 103, GT 1 and PB 86 have been budded on seedling rootstocks of the same clones in all possible combinations and the experiment has been laid out on a randomized block design with 4 replicates. Plants with RRIC 103 scions had to be removed from the experiment in 1988 due to *Corynespora* leaf spot disease. The experiment was continued with the other treatments.

The yield and girth data recorded so far do not show any significant rootstock effect. The experiment was discontinued at the end of 1990. (Chandra Samaranayake and R.P. Karunasena)

Young Budding

Performance of young buddings - Gallewatta (PT.YB/89/1)

The purpose of this experiment is to compare the performance of young buddings with conventional planting techniques. In this experiment young buddings with two leaf whorls are compared with green and brown bare root budded stumps planted on a randomized block design. The success of field establishment with young budding was 93% and bare root green and brown budded stumps were 86 and 87% respectively. The lower success in young buddings was due to the handling of bagged plants by inexperienced labour.

The growth of plants assessed after 9 months from planting showed that the growth of young buddings was comparable to that of bare root brown budded stumps but significantly better than that of green budded stumps. However growth of plants assessed after 18 months from planting indicated that there was no significant difference in growth between young buddings and green and brown bare root budded stumps. (Chandra Samaranayake and K.A.G.B. Amaratunge)

Gallewatta, 1989 replanting RRIC 121, PT.YB/89/2

Experiment PT.YB/89/1 is repeated with 3 - 4 whorled young buddings of clone RRIC 121. Growth of plants assessed after 12 months from planting indicated no significant difference in growth between young buddings and bare root green and brown budded stumps. (Chandra Samaranayake and K.A.G.B. Amaratunge)

Gallewatta, 1990 replanting, RRIC 100 and RRIC 102 - PT.YB/90/1 and PT.YB/90/2

Two whorled young buddings of clone RRIC 100 are compared with bare root stumps in Experiment 1. Two whorled young buddings of clone RRIC 102 are compared with bare root brown budded stumps in experiment 2.

The success of field establishment of young budding was 100% in both experiments compared to 96% and 94% respectively with bare root budded stumps. (Chandra Samaranayake and K.A.G.B. Amaratunge)

Proposed experiment - PT.YB/91/1

Another experiment is planned to be established during the South West monsoon rains in 1991. The following treatments will be tested in this experiment.

- T₁ - Two whorled young buddings
- T₂ - Two whorled green buddings
- T₃ - Two whorled brown buddings
- T₄ - Bare root brown budded stumps
- T₅ - Bare root green budded stumps

To prepare young buddings seedlings were planted in polybags in September and budded with clone RRIC 121 towards the end of November. They were cut back and stock buds removed in late December. A ground nursery on stock seedlings was established in September to prepare green buddings and seedlings in a 15 months old stock nursery were budded with brown buds to prepare brown buddings in polybags. An experimental site has been selected in a SLSPC estate in the Kalutara district. (Chandra Samaranyake and K.A.G.B. Amaratunge)

Intercropping

Intercropping of 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. Both coffee and pepper were in bearing during the year. However the yields could not be recorded due to the loss of crop due to theft. (V.H.L. Rodrigo and L.S. Kariyawasam)

Comparison of rooted cuttings and seedlings of coffee - Dartonfield - IC/88/2

A detail growth analysis of the two types of material was done at 18 months from planting and the results were published in the Institute Journal. The root/shoot ratio of cuttings was found to be significantly higher than that of seedlings. There was a significant difference in photosynthetic capacities between the two materials. (V.H.L. Rodrigo and L.S. Kariyawasam)

Adaptive Research Programme

Intercropping

Banana, pineapple and passionfruit as intercrops were established in 32 rubber smallholdings in different planting districts in 1989 (This programme was done in collaboration with the ASD). An assesment of growth of rubber plants was done by measuring the girths and analysis of the data has shown that in some plots the growth of rubber is slightly better when banana is the intercrop than those plots without an intercrop. However this difference is not statistically significant (V.H.L. Rodrigo and L.S. Kariyawasam)

Use of Ethrel Yield Stimulant

Eight, fairly well managed smallholdings, planted with clone PB 86 and tapped on panel BI-1 and BI-2 with 1/2S d/2 system of tapping were selected in each of the districts Kalutara and Kegalle. Two tapping tasks in each of these holdings were selected and trees in one task were stimulated with 5% Ethrel and other task was kept as the control. First application of Ethrel was done in August in the Kalutara district and September in the Kegalle district. The second application was done in the last week of December. There has been a very good response to Ethrel application and the overall yield increase varies from 26 - 90% and 16 - 58% in the Kalutara and Kegalle regions respectively (Table 11). (L.S.S. Pathiratne and Chandra Samaranyake)

Table 11. *Total yield per tapping task (kg) for the 31/2 months of after the first application.*

Kalutara Region								
Estates								
	1	2	3	4	5	6	7	8
Treated	145.2	215.5	236.3	102.9	211.7	247.6	174.0	145.3
Control	114.8	133.0	168.4	57.4	127.8	130.5	91.3	96.0
Increase	30.4	82.5	67.9	45.5	83.9	117.1	82.7	49.3
% Increase	26.7	62.0	40.0	79.0	65.6	90.0	91.0	46.0

Kegalle Region								
Estates								
	1	2	3	4	5	6	7	8
Treated	314.9	150.0	182.0	229.8	179.0	242.8	237.7	236.9
Control	217.2	102.0	114.8	175.1	114.1	208.8	165.2	164.1
Increase	97.7	48.0	67.2	54.7	64.9	34.0	72.5	72.8
% Increase	45.0	47.1	58.5	31.2	56.9	16.3	43.9	40.0

Use of Rainguards

Apron type polythene rainguards were fixed in selected smallholdings in the Kalutara, Kegalle and Ratnapura districts just before the North East monsoon rainy season. Although the number of tapping days could be increased the response of the smallholder to the use of rainguards has been very variable. Most smallholders fear that with the use of polythene rainguards there can be an increased incidence of panel diseases. (Chandra Samaranyake, R.P. Karunasena and L.S.S. Pathiratne)

Nursery Inspection Unit

Budwood multiplication nurseries were inspected for the issue of permits by the Rubber Control Department.

An islandwide survey on availability of budwood of high yielding clones was done from April - June. The data collected were analysed and a report was prepared and submitted to the Rubber Sector Review Committee of the Ministry of Plantation Industries. The availability of budwood of high yielding clones in the country as at June, 1990 is given in table 12. (Chandra Samaranyake, R.B. Gunaratna, U.S. Weerakoon, S.L.G. Ranjith and R.S. Wijesundera)

Table 12

AVAILABILITY OF BUDWOOD — NO. OF POINTS IN THE COUNTRY

	PB 86	RRIC 100	RRIC 102	RRIC 110	RRIC 117	RRIC 121	RRIC 130	PB 28/59	PB 217
PCN'S	35,053	19,362	3,323	—	—	2,258	—	—	—
RCD	16,144	16,147	2,006	—	—	812	—	—	—
RRISL	1,096	6,844	1,730	1,642	652	2,729	676	615	115
ESTATES	17,061	28,286	6,636	2,526	771	12,258	2,375	1,443	27
TOTAL	69,354	70,639	13,695	4,168	1,423	18,057	3,051	2,058	142

Issue of Plants of Authentic Material for Budwood Multiplication Nurseries

The nucleus material to all budwood nurseries in the country is now being supplied by the Institute as budded stumps and during 1990 the following plants were issued to estates managed by SLSPC, JEDB and Private Commercial Nurseries (PCNs). (R.B. Gunaratne, U.S. Weerakoon and S.L.G. Ranjith)

Clone	S.L.S.P.C.	J.E.D.B.	Private
RRIC 100	1,155	1,400	3,234
RRIC 102	2,898	3,576	1,115
RRIC 121	2,301	1,350	100
RRIC 110	2,055	3,275	—
RRIC 130	100	525	—
PB 217	1,200	200	—
PB 28/59	400	1,020	—
PR 255	100	50	—
PB 235	100	50	—
BPM 24	100	—	—
RRIM 712	100	—	—
Total	10,509	11,446	4,449

REVIEW OF THE PLANT PATHOLOGY & MICROBIOLOGY DEPARTMENT

By

C. K. JAYASINGHE

SUMMARY

Incidence of *Oidium* and *Gloeosporium* leaf disease was low but a heavy incidence of *Phytophthora* Leaf Fall and Bark Rot was observed. The incidence of the *Corynespora* Leaf Fall was mild and no new clones were reported to be affected in the field. However, several polybag nurseries were found to be severely affected with *Corynespora cassiicola* regardless of the clone.

An interim circular was sent to all Zone Directors and Regional Advisory Officers in April requesting them to be vigilant of Bark Rot during the *Phytophthora* season. Two advisory leaflets viz. "Increasing Incidence of White Root Disease" and "New Diseases of Rubber" were circulated among all Superintendents and Officers of the Advisory Services Department.

A thread fungus and *Curvularia* sp., two uncommon pathogens were isolated from *Hevea* and sent to CMI for authentication.

Dithane M 45 and Sandofan M were identified as potential fungicides for the control of Bark Rot. Thiovit and Sulphur performed best *in Vitro* when seven fungicides were screened against *Oidium hevea*.

Seven *Hevea* clones namely RRIC 132, RRIC 133, HP 74-181, HP 74-193, PB 86, RRIM 717 and BPM 24 were established at eleven sites representing all rubber growing districts to screen for leaf and panel diseases.

Twenty single spore isolates of *C. cassiicola* were obtained from popular clones of *Hevea*. Only three isolates sporulated freely from these cultures.

Necessary advise on control of *Corynespora* Leaf Fall and other common diseases were provided to smallholders and the estate sector on their requests.

Colony morphology of *Cylindrocladium quinqueseptatum* varied markedly with different nutrient media and highest number of spores were produced on Czapek Dox Agar.

DETAILED REVIEW

Staff

Dr. A. de S. Liyanage, Director and Head of Plant Pathology Department resigned from the Rubber Research Institute on 30th April 1990. Mr. C.K. Jayasinghe, Asst. Plant Pathologist was appointed as the Acting Head of Plant Pathology and Soil Microbiology Department with effect from 1st of March 1990. Dr. (Mrs) N.I.S. Liyanage, Plant Pathologist left the services of the Institute with effect from 31st March 1990.

Asst. Plant Pathologist Mr. R. Jayaratne continued working for his post-graduate work at the University of Sheffield in U.K. Mr. K. Jayasooriya, M.Sc and Miss W.P. K. Silva, B.Sc, M.Sc assumed duties as Asst. Plant Pathologists on 1st August 1990.

Messrs. S. Wettasinghe and E.B. Fernando, Senior Technical Officers were promoted as Experimental Officers with effect from the 12th March 1990. The Experimental Officer, Mr. W. Amaratunge, Technical Officers Messrs S.S. Warnapura, E.A.T. Senadheera, Mrs. J.L.P.C. Wettasinghe and Clerk Typist Mrs. P. Amarasekera were on duty throughout the year.

Research students

Miss. L.C. Hewage, under-graduate student from the Ruhuna University completed her final year project entitled "Biology of *Cylindrocladium quinqueseptatum*" under the supervision of Mr. C.K. Jayasinghe.

Overseas visits

Mr. C K. Jayasinghe attended the Training course on South American Leaf Blight and other diseases of rubber held in ASEAN Plant Quarantine Centre, Malaysia from 11th to 30th June 1990. Mrs. J.L.P.C. Wettasinghe and Mr. E.A.T. Senadheera also participated the same course from 24th October to 16th November.

Training

Messrs. C.K. Jayasinghe, K. Jayasooriya and Miss, W.P.K. Silva were involved in training officers from Rubber Advisory Services Dept. and students from Hardy Technical College, Ampara.

Lectures/Seminars

Mr. C.K. Jayasinghe presented papers at following seminars.

Paper entitled "Root Nodule Bacterial Associations in Rubber Plantations of Sri Lanka" was presented on 30.03.90 at a seminar organised by the IFS, Kandy.

Paper entitled "Use of Agro Chemicals in Rubber" was presented on 5th November 1990 at a seminar organised by SLAAS Section D.

Committee

Mr. C.K. Jayasinghe served as a member of following committees.

Sri Lanka Association for the Advancement of Science Section B. Pesticide Formulary Committee

Visits

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

Experimental	175
Advisory	49
Miscellaneous	74
Total	298

GENERAL

Extremely dry weather that prevailed at the beginning of the year resulted in early and even wintering. Consequently, most clones escaped an attack of Oidium Leaf Fall (OLF) caused by *Oidium hevea*. However, low incidence of OLF and wet weather conditions that prevailed during May and June favoured the spread of Phytophthora infection causing the Abnormal Leaf Fall, Bark Rot and Die Back of Young Shoots in most of the rubber plantations. Phytophthora Leaf Fall (PLF) reached the epidemic proportions in the wet rubber growing areas of Kalutara, Ratnaputra, Galle and Kelani Valley regions during the months of May, June and July. This situation was predicted early and interim circular was sent to all Zone Directors and Regional Advisory Officers on the 2nd of April requesting them to be vigilant of Bark Rot. There were several requests throughout this period asking us to assist in identifying and controlling the disease.

The incidence of the *Corynespora* Leaf Disease was mild and no new clones were reported to be affected in the field. However, several polybag nurseries were found to be severely affected with *Corynespora cassiicola* regardless of the clone. Necessary advise was given immediately wherever this devastating disease was detected.

White Root (WR) disease caused by *Rigidoporus lignosus* is still the major root disease problem in the wet districts. Several reports were received stating that new clearings were affected with this disease. An advisory leaflet was sent to estate superintendents and Rubber Advisory Services Dept, in August explaining that eradication of WR disease could be achieved by strictly following the RRISL recommendations during uprooting old clearings and planting new clearings.

During the recent past three pathogenic fungi viz. *Fusicoccum Guignardia* and *Cylindrocladium* have been identified as potential pathogens on *Hevea* in Malaysia. Eventhough, our *Hevea* plantations are free from these pathogens presently, we have to be cautious as susceptible clones and two of the above mentioned genera are present in Sri Lanka. Hence, a leaflet was prepared on the symptoms of these diseases and circulated among the officers of Advisory Services Department and Superintendents of JEDB and SLSPC estates.

LABORATORY AND FIELD INVESTIGATIONS

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

(A) New fungicides for the control of Bark Rot

Initial experiments on the performance of fungicides were carried out using (a) poisoned food technique and (b) petiole technique. Field experiments were performed using virgin panels of the clone PB 86 with four potential fungicides viz. Sandofan M, Fruvit, Dithane M 45 and Folpet. Experiments were designed to find both prophylactic as well as curative effect of the fungicides. The recommended fungicides, Brunolinum plantarium and Sandofan paste were also used as controls.

Dithane M 45 (0.8% ai) performed best when petiole technique and poisoned food technique were employed to assess the fungicides. When Dithane M 45 was used lesion length on petiole was significantly low compared to the presently recommended fungicide, Brunolinum plantarium.

The results of the field experiments varied and three fungicides namely Folpet, Dithane M 45 and Sandofan M were identified as potential fungicides for the control of Bark Rot. Arrangements have been made to prepare new formulations of these fungicides incorporating into *Hevea* latex and Organic compounds with the collaboration of the Dept. of Specifications and Analysis. (C.K. Jayasinghe & E.B. Fernando)

(B) Screening of fungicides against *Rigidoporus lignosus*

Poisoned food technique and the Dipping method was used to screen two new fungicides viz. Bayleton and Bayfidan. To test the curative effect, artificially inoculated polybag plants and naturally affected field plants were drenched with Bayleton (10 g in

1 litre) and Bayfidan (10 g in 1 litre). Same fungicides were also tested for the prophylactic effect by drenching the inoculated plants before the establishment of the disease. Experiment is in progress. (C.K. Jayasinghe, K. Jayasooriya, S.S. Warnapura and E.A.T. Senadheera)

(C) Screening of fungicides against *Oidium hevea*

Seven chemicals namely BAYFIDAN (0.01% ai), THIOVIT (0.32% ai) BENLATE (0.03% ai), DITHANE M 45 (0.18% ai), CALIXIN (0.04% ai) SULPHUR (dust) and COBOX (0.12% ai) were assessed against *O. hevea* on the leaf surfaces of copper brown stage. Percentage germination was average germ tube lengths were measured. Statistical analysis of the results showed that Sulphur and Thiovit could be used successfully to control the *Oidium* infections.

In vivo screening could not be conducted as Powdery mildew did not reach the epidemic levels during the year 1990. (C.K. Jayasinghe and S.S. Warnapura)

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

Nurseries have been established since 1980 in 13 locations representing 5 major rubber growing regions for the field evaluation of clones. The clones so far established are RRIC 100, RRIC 101, RRIC 102, RRIC 109, RRIC 110, RRIC 111, RRIC 112, RRIC 113, RRIC 114, RRIC 115, RRIC 116, RRIC 117, RRIC 119, RRIC 120, RRIC 121, RRIC 132, RRIC 133, HP 74-181, HP 74-193, PB 86, RRIM 712, RRIM 717 and BPM 24

The nurseries are located at—

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

Seven *Hevea* clones namely RRIC 132, RRIC 133, HP 74-181, HP 74-193, PB 86, RRIM 717 and BPM 24 were established in 13 nurseries during the year 1990. The proposed programme on evaluation of diseases could not be carried out as expected due to

the limited transport facilities. However, sixteen clones were screened against Bark Rot in two sites and found that RRIC 100, RRIC 121, RRIC 113 are more resistant to Bark Rot compared to RRIC 112, RRIC 109 and RRIC 110. Petiole inoculation trial revealed that clones such as PB 260, HEIKEN, PR 305, PR 255, PR 306, PB 235, BPM 24, PB 217, RRIC 113, RRIC 119, RRIC 101, RRIC 130, RRIC 121, RRIC 111, PRIM 717 and RRIC 109 are less susceptible to *Phytophthora* infections. Conclusions cannot be made as experiments were conducted only in few localities. (C.K. Jayasinghe and S. Wettasinghe)

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

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

Biology of *Cylindrocladium quinquesseptatum*, a potential pathogen of *Hevea* in Sri Lanka was studied.

The hyphal growth of the fungus was radially straight with concentric zones on different nutrient media. However, the colony morphology varied markedly with different nutrient media. Colour of the fungus varied whitish pink to dark brown depending on the media. The radial growth of the fungus was highest on Corn Meal Agar (CMA) while the lowest growth was obtained on Water Agar (WA). No especial treatment was required for sporulation, Number of spore production was varied significantly depending on the media. Eventhough the highest number of spores were produced on Czapek Dox Agar (CDA), reasonable spore production was observed on Lima Bean Agar (LBA) and Potato Dextrose Agar (PDA) also. The lowest number of spores were produced when the fungus was grown on WA.

Studies on the effect of temperature showed that 30°C is the optimum temperature for the fungal growth. The best temperature and the pH value for the production of spores were found as 30°C and pH 8 respectively.

With regard to spore germination, maturity of spores played a vital role. If the spores were less than 8th day to 10th day in age the germination was poor and 10th to 12th day old spores germinated readily. There was no significant different in spore germination either on glass slides or leaf surfaces. Studies on the susceptibility revealed that copper brown *Hevea* leaves were more susceptible than apple green and mature stages.

Project is in progress to study the following aspects.

- (a) Effect of humidity on the pathogen
- (b) Host susceptibility
- (c) Variations in different isolates.

(C.K. Jayasinghe, L.C. Hewage, and S.S. Warnapura)

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

(a) During October 1990, a thread fungus was isolated from *Hevea* seedlings established in seed germination beds in Karapincha nursery at Ratnapura. Fungus appeared as a thin tissue paper on stems, petioles and lower surfaces of leaves. Affected leaves become brownish and papery. These leaves fall off or hang down from mycelial threads. Mortality rate due to the disease was 40%.

Suspected fungus was sent to CMI for identification. At the mean time its pathogenicity confirmed by fulfilling Koch's postulates (C.K. Jayasinghe & S.S. Warnapura)

(b) A phytophthora culture was isolated from the lesions of *Hevea* leaves at Bentota State Plantation.

Studies on the morphology revealed that this isolate is different from the species recorded in Sri Lanka. Culture was sent to CMI for confirmation. (C.K. Jayasinghe and S. Wettasinghe)

(c) A fungal isolate from the lesions of *Hevea* leaves of the clone LCB 1320, suspected as the genus *curvularia* previously not recorded pathogen on *Hevea* in Sri Lanka) was sent to CMI for authentication. Studies are in progress (C.K. Jayasinghe and J.L.P.C. Wettasinghe)

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

I. Variations in different isolates of *Corynespora cassiicola*

Twenty single spore isolates have been collected from various *Hevea* clones in different localities. Morphology, the growth patterns, and spore production were studied in these isolates on seven media namely Potato Dextrose Agar, Malt Agar, Czapek Dox Agar, Potato Sucrose Agar, Water Agar, Lima Bean Agar and *Hevea* Leaf Extract Dextrose Agar. This project is in progress. (C.K. Jayasinghe, W.P.K. Silva & J.L.P.C. Wettasinghe)

RRI/ASD/RCD Joint Operation on Eradication of CLF disease.

All requests received from smallholders and Rubber Control Department were forwarded to the Divisional Rubber Extension Officer for necessary action as RRI/ASD/RCD joint operation on eradication of CLF disease was terminated in 1989. However, arrangements have been made to provide the necessary advise if the Advisory Services Department could not solve the problem due to the complicated nature of the disease (C.K. Jayasinghe).

CLF Disease Survey in State Plantations

Eventhough this survey has been completed in the years 1986 and 1987, several new requests have been made during the year 1990. Necessary advise were given and certificates were issued to uproot the affected clearings. (C.K. Jayasinghe, E.A.T. Senadheera, S. Wettasinghe, S.S. Warnapura and B. Fernando)

The Effect of Planting Distance on Productivity and Nitrogen Fixation of *Pueraria Phaseoloides* (Nfxn/89/1)

Assessments were made on dry weight production and nodulation. Experiment is in progress. (C.K. Jayasinghe & D.S. Wettasinghe).

Effect of fungicide application on the success of young budding technique

An experiment was designed at three sites in Dartonfield to find the effect of fungicide application on above. All recommended practices were followed during the establishment and maintaining the polybag plants except that appropriate fungicides were not sprayed to the plants in the control plots. (C.K. Jayasinghe and S. Wettasinghe).

REVIEW OF THE SOILS AND PLANT NUTRITION DEPARTMENT

By

M. K. S. A. SAMARAWEERA

SUMMARY

The work of the Department is concerned mainly with investigations on methods of overcoming soils related constraints to increasing the productivity in rubber lands. A range of soil factors, namely, physical, chemical and biological which influences the performance of the rubber tree are being investigated. Several processes related to the nutrition of the rubber tree are also being examined. The programme is aimed at developing appropriate management techniques to improve the fertilizer use efficiency, soil exploitation and soil management which are acceptable to all grades of rubber growers. The fertilizer requirements of the rubber trees grown under different agro climatic conditions are being evaluated.

To maximise the research output and to allow for future research opportunities the Departmental work is organised both in specific disciplines such as soil science and in multidisciplinary programmes such as biological di-nitrogen fixation and physiology and biochemistry of carbon and nutrient assimilation.

Field trials, pot experiments and laboratory investigations are being conducted to achieve these objectives.

The progress during the period under review was good. However a large proportion of the time was spent in clearing the work accumulated due to unsettled conditions prevailed during the previous years.

Several advantages of having a mulch round the tree were seen. Among them are the increased growth and latex yield, better rooting pattern and improved soil conditions.

Nearly 20,000 ha in Avissawella, Kegalle and Ratnapura regions were surveyed and fertilizer recommendations were made on the basis of leaf analyses; thus clearing

the back log created during the last two years. The efficiency of sampling and processing procedure was increased by installing mobile laboratories at a few convenient plantations.

Staff

Dr. M.K.S.A. Samaraweera, Head of the Department and the Agronomist, Mrs. Lalani Samarappuli were on duty throughout the period. The Assistant Soils Chemist Mr. D.M.A.P. Dissanayake returned to Sri Lanka on the 5th August 1990 to continue his post graduate studies on a split programme.

Three Experimental Officers Messrs. W.C. Dayaratne, A.M.A. Perera and H.D. S.P. Perera were on duty throughout the year. The other Experimental Officer Mr. F.P.W. Silva moved out of the Department to assume duties as an Assistant Development Officer in an Adaptive Research Unit. We wish him all the success. The Senior Technical Officer Mr. J.G. de Mel, Technical Officers Messrs. S.N. Silva, P. Karunadasa, U. Mitrasena, A.N. Yakandawela, T.B.X. Dissanayake, Miss Chitra Maheepala and Mrs. Manel Mahanama the Specification Officer Mr. T.M. Ahamadeen and the English Stenographer Mrs. Lakshmi Rupasinghe Perera were on duty.

Mr. B. A. Nandalal Technical Officer was served with vacation of post notice on 1990.10.12 as he had not reported for work from 1990.09.20.

Temporary Workers

Three Research Assistants Messrs. K.G.S. Jayawardene, S.M.M. Iqbal and U. Senarath and three Technical Assistants Miss Chandani Jayalath, Miss Rasika Hettiarachchi and Miss Daivi Senaratna continued to work in the Department in NARESA funded projects.

Visits

Overseas:

At the invitation of Professor D. Parkinson, during the period 4th Aug. - 11th Aug., Dr. M.K.S.A. Samaraweera visited the Department of Biological Sciences and experimental stations of the University of Calgary, Canada to : (a) discuss and comment on ongoing research there (b) deliver seminars to the staff and (c) plan a collaborative research programme. A project with an overall aim of evolving cultural practices that could conserve the soil and increase the nutrient and water use efficiencies of plantation crops was formulated.

During the period 12th Aug.- 29th Aug. 1990 he visited the Long Ashton Research Station and School of Chemistry of the University of Bristol, Department of Biological Sciences of the University of Exeter and Department of Soil Science of the University of Reading to discuss research and to develop links that will facilitate foreign funded research programmes at the Rubber Research Institute. The progress of the project

entitled "Nutrient cycling in low land forests and rubber plantations in Sri Lanka" which is being funded by the National Environmental Research Council of the U.K. and done in collaboration with Professor J.M. Anderson of the University of Exeter was discussed. Visits were also made to the Department of Biological Sciences of the University of Bath and the Reactor Centre at the Imperial College of the University of London.

Advisory :

Following officers made several visits to large plantations and small holdings to advise the growers on soil related problems :

1. M.K.S.A. Samaraweera
2. W.C. Dayaratne
3. A.M.A. Perera
4. F.P.W. Silva

Working groups and committees

Dr M.K.S.A. Samaraweera served in the following Committees :

- 1 President of the Agriculture and Forestry Section (Section B) of the Sri Lanka Association for the Advancement of Science (SLAAS).
- 2 Co-ordinator — Special Committee appointed by the SLAAS to provide professional advice to the Government of Sri Lanka to increase the productivity in Agricultural and Industrial Sectors.
- 3 Co-ordinating committee on fertilizer supplies of the Ministry of Agricultural Research and Development.
4. Technical Committee on Biological Control of Aquatic weeds of the Natural Resources Energy and Science Authority of Sri Lanka.
5. Agricultural Committee of the Atomic Energy Authority of Sri Lanka.
6. Technical Committee on Fertilizers of the Sri Lanka Standards Institution.
7. Committee set up by the Ministry of Plantation Industries to Study methods of Rehabilitation of Degraded Lands in the Plantation Sector.
8. Technical Committee on "Management of Nurseries" of the Rubber Control Department.

Visitors

Professor D. Parkinson (FRSC) Department of Biological Sciences, The University of Calgary Canada.

Professor R.K.S. Wood (FRS) Imperial College, University of London, U.K.

Publications

SAMARAWEERA, M.K.S.A. (1990) Chemistry and Biology of the Rubber Tree — Presidential Address Forestry and Agriculture Section — Proceedings Sri Lanka Association for the Advancement of Science.

SENARATH, R.M.U., GUNATILLEKA, I.A.U.N., SAMARAWEERA, M.K.S.A. and ANDERSON, J.M. (1990)

Phonology and Nutrients of litter fall of some dominant tree species in Sinharaja Rain Forest. Proceeding of the Sri Lanka Association for the Advancement of Science.

SAMARAWEERA, M.K.S.A., JAYAWARDENE, K.G.S., GUNATILLEKE, I.A.U.N., ANDERSON, J.M. and JAYASEKERA VANOJA (1990) Some aspects of Nutrient cycling in rubber plantations.

Proceedings of the Sri Lanka Association for the Advancement of Science.

Seminars

Dr. M.K.S.A. Samaraweera presented papers at the seminars as indicated below :

- 1. Trees for Rehabilitation of Degraded soils of the Wet Zone at the SLAAS Section B and Institute of Biology Joint Seminar on " Trends in Agro forestry."**
- 2. Method of increasing the use efficiency of chemical fertilizers at the seminar on Chemistry in Agriculture, organised by the Institute of Chemistry Sri Lanka.**

Laboratory Investigations

Carbon and mineral nutrition of Hevea

Several aspects of the carbon and mineral nutrition, physiology and biochemistry of the rubber tree were examined employing field grown trees at Eladuwa State Plantation, Paiyagala. Because of the unsettled conditions prevailed during the previous years it was not possible to develop trees with correct dimensions needed for $^{14}\text{C}_2$ feeding. Hence these experiments were not conducted. However phloem sap samples from the rubber trees were freeze dried and sent to the University of Western Australia for detailed chemical analysis of the constituents. (M.K.S.A. Samaraweera, W.C. Dayaratne, A. M.A. Perera and Miss Chitra Maheepala in collaboration with professor C.A. Atkins of the University of Western Australia and professor J.A. Milburn of the University of New England, Armidale).

Field Experiments

Pot experiments - Dartonfield

The effect of potassium fertilizer on the performance of Hevea was studied in three pot experiments. In the first pot experiment, three levels of potassium were compared on five soil series viz. Agalawatta, Boralu, Ratnapura, Homagama and Parambe using clone RRIC 100. In the second pot experiment the effects of five levels of K were studied on five clones viz. PB 86, RRIC 100, RRIC 102, RRIC 110 and RRIC 121. The details of the 3rd experiments which was started in January 1990, are similar to those of pot experiment 2, and it is being continued.

In pot experiment No. 1, significant increases in plant diameter and height were observed with applied K at level 1, with plants grown in Parambe series soil showing the highest plant height and diameter compared to plants in other soil series.

Clone RRIC 102 in experiment 2 was significantly superior in plant diameter in comparison with other clones.

In both these experiments, there was a significant interaction between levels of applied K and clones and K and soil series, on leaf K and Mg contents. (S.M.M. Iqbal and N. Yogaratnam).

The experiment No. F/76/5 is in progress at Eladuwa Estate in Matugama on Boralu Soil series deals with the effects of 3 levels of potassium and 3 tapping systems on 3 clones viz. PB 86, RRIC 100 and RRIC 101. Girth measurement indicates a significant interaction between clones and K suggesting that the K requirement for growth would vary between clones. However, the yield data did not suggest any such interacting effect (S.M.M. Iqbal, N. Yogaratnam, and G. de Mel).

The field experiment, C/77/8, was started in 1977 at St. George Estate, Kalutara to study the residual effects of K on covers and on the nitrogen status, growth and yield of clone PB 86. Application of K to the rubber and cover at the first level showed significant increased in girth and yield. (S.M.M. Iqbal, N. Yogaratnam and U. Mitrasena).

Nutrient cycling and K-Mg nutrition of rubber

Two sets of experiments aimed at evolving cultural practices to improve soil fertility and fertilizer use efficiency in rubber plantations are in progress. Experimentations involve study of a litter fall and decomposition and testing of hypotheses;

The following hypotheses are now being tested :

1. The rate of decomposition and nutrient release from particular litter is primarily controlled by moisture and closely correlated with the onset of rain.

2. Increasing the proportion of the low quality litter inputs at the onset of rain extends the time period of nutrient availability to plants.
3. The availability of fertilizers to plants can be delayed by microbial immobilization on low quality litter, hence decreasing the risk of losses by leaching
4. Increased soil organic matter results in an increased time of nutrient availability to plants even in the presence of high quality litter or fertilizer.
5. Fertilizer is conserved by utilizing ground cover as a sink and as a source (mulch) of plant nutrients.

Testing of hypotheses

(a) First set of experiments

The first set of field experiments to test the hypotheses were laid in clearings replanted in May/June 1984. Effects of three factors, namely the planting hole treatment use of organic matter, the levels of K and Mg are being considered. Quantities added are given in table 1.

Table 1. Amount of fertilizer and organic matter applied annually in three applications.

	1st yr. 84/85	2nd yr. 85/86	3rd yr. 86/87	4th yr. 87/88	5th yr. 88/89	6th yr. 89/90
Urea (g)	75	150	200	250	250	250
Rock Phosphate (g)	150	300	400	500	500	500
Muriate of potash K1 (g)	50	100	135	170	170	170
Kieserite Mg1 (g)	50	100	135	170	170	170
Rice straw (kg)	4	3	4	6	9	9
Coir dust (kg)	8	6	8	12	18	18

$K_0 = 0$; $K_2 = 2K_1$; $K_3 = 3K_1$

$Mg = 0$; $Mg_2 = 2Mg_1$; $Mg_3 = 3Mg_1$

Treatments

Planting hole treatment

All plants received a basal application of urea (10g) and rock phosphate (100g).

There are four planting hole treatments as follows :

1. Control with no organic matter, no K, Mg fertilizers at the time of planting (T1)

2. Application of K, muriate of potash (15g) and insoluble Mg, dolomite (30g) before planting (T2). (This was changed in mid 1987 by allowing the cover to grow up to the tree. Testing of the 5th hypotheses) (T2)
3. Application of rice straw (organic matter rich in K) together with fertilizer (T3)
4. Application of coir dust (organic matter that absorbs and retains water) together with fertilizer (T4)

K levels ; There are four K levels K0, K1, K2 and K3

Mg levels ; There are four Mg levels, Mg0, Mg1, Mg2 and Mg3

All the plants are being given the same amount of N and P. Details are given in Table 1. Three fertilizer applications were made during a given year.

Design

Split plot – confounded

Main treatments – T1, T2, T3 and T4

Sub treatments – K levels and Mg levels ie 16 combinations

At the beginning there were eight blocks, thus two replicates. There locations are as follows : Eladuwa State Plantation, Payagala (2 blocks) Divitura State Plantation Elpitiya (2 blocks) Panawatta Estate, Yatiyantota (1 block) Atale Estate, Atale (1 block) Pitiyakanda Estate Mawatagama (1 block) Padukka State Plantation, Padukka (1 block). The trees of the experimental block at Padukka State Plantation were uprooted in 1987 as they were infected with *corynespora* leaf fall disease. In each block there are 16 plots and the number of trees per plot varies from 16 – 20. The plots are separated from each other by guard rows of trees. However, the design does not permit the study of K-Mg interaction.

The nutritional composition of available organic matter such as rubber and Pueraria plant parts, rice straw and coir dust was determined and findings are given in Table 3.

The response of the trees to different treatments are being measured by monitoring the growth rate, water status of the plants, and nutritional composition of leaves & latex collected at regular intervals. The changes in the quality of the soil are being monitored by measuring the cation exchange capacity, PH, organic carbon content and nutrients in the exchange complex (mainly K & Mg) of the soil samples taken at two depths (0 – 15 cm and 15 – 30 cm).

(b) Second set of experiments

The second set of experiments were initiated in 1987, in the 1984 replanting at Eladuwa State Plantation, Pajyagala in the Kalutara District. The land is with a slight slope and the separation between trees is 4 - 4.5 m.

Replicated plots of nine trees in each are being used to defined experimental plots. There are four treatments and three replicates. Hence a total of twelve plots and experimental details are given in Table 2. Each plot is separated by the adjoining plot using a guardrow of trees and treatments are laid out in a randomized block.

Table 2. *Treatments details of the 2nd set of experiments*

Treatments	Trees	Control (no trees)
No application (0)	+	+
Fertilizer (F) [(NH) ₂ 2 So ₄]	+	+
Coir (low quality litter) (C)	+	+
Fertilizer & Coir (C + F)	+	+

Soil samples are collected at least twice a year (times of sampling according to climatic conditions) at 2 depths, 0 - 15 cm and 15 - 50 cm, from the area round the trees where the fertilizer is being applied and this is done separately at the upper and lower strata of the plots. Thus at any given sampling there are four (4) samples per plot. These samples are processed and analysed.

Fertilizer application and other treatments are made three times, a year. Where necessary sulphate of ammonia (150g), rock phosphate (150g), muriate of potash (70g), kieserite (70g) and coir dust (5 kg dry wt) were added to each tree at a given application. Individual tree responses to treatments are measured in terms of changes in girth, latex yield and nutrient composition of the leaves and latex. The changes in defoliation - refoliation patterns are also being studied.

Litter decomposition studies are being carried out by regular monitoring of the fate of a known amount of litter inside standard bags which were placed in the ground. Box like (30 cm x 30 cm x 2.5 cm) polyvenyl bags with 7 mm mesh, provided by the Tropical Soil Biology and Fertility Programme were used, for this purpose. In May 1988 60 bags, each containing 20 g of dried rubber leaves and 40 bags, each containing 20 g of dried Pueraria litter were placed at random in the plots. Five (5) bags of each type were removed randomly at a given sampling, their contents are washed to remove the soil and clay particles and dry weights of remaining litter were recorded. The study was to be repeated during 1989, but due to unsettled conditions prevailed the experiment was not conducted.

Study of N₂ fixation, N mineralization denitrification and leaching of nutrients :

Employing a gas liquid chromatograph fitted with a poropak column and an electron capture detector N₂O determinations required for assessing the denitrification processes are being carried out.

Samples of xylem sap (root bleeding exudates and tracheal fluid) were collected from legume covers grown in different plots and sent to the University of Western Australia for the determination of nitrogenous solutes in them with a view to developing the UREIDE assay method for measuring the contribution made by the biologically fixed N₂ to the nutrient cycle.

Ceramic cups installed at two depths (20, 50 cm) and kept under tension are being used to collect soil solutions needed to study the leaching of nutrients.

The changes with time of the contents of total N, NO₃, and NH₄ on the soil are also being monitored.

Nutrient composition of different organic matter available are as given in table 3 and a comparison is also made with litter found in Sinharagja forest.

Table 3. *Nutrient composition of different organic matter.*

	N%	P%	K%	Ca%	Mg%
Forest litter	0.82	0.03	0.10	0.94	0.24
Rubber	1.21	0.05	0.10	2.15	0.21
Pueraria	2.10	0.08	0.56	1.52	0.40
Coir dust	0.83	0.02	0.27	0.47	0.18
Rice straw	0.80		1.60	0.41	0.13

The concentrations of N and K in live mature leaves of rubber and *pueraria* are 3.3% and 1.4% respectively. These figures indicate that 64% of N and 90% of K in mature live rubber leaves have been reabsorbed into the tree frame before the leaf fall whereas corresponding values for *Pueraria* are 36% of N, and 57% of K. The total annual litter production in the rubber plantations was 9.00t/ha, of which 2.15t/ha was from the rubber tree and the balance came from the *Pueraria* ground cover.

Even though the litter fall of the rubber tree occurred throughout the year, a peak accounting for 45% of the annual litter fall was found during the dry season January-February. The litter fall of *Pueraria* too was high during the same period. With litter, nutrients at the rate, 120N, 5K and 40K kg/ha were returned to the soil.

Both rubber and *Pueraria* litter decomposed fast and their half lives were 4 and 5 weeks respectively. Changes with time of the nutrient composition of litter are given in table 4 and it can be seen while these was a rapid decline of K content, N and P contents remained unchanged. This indicates that loosely bound K was rapidly leached,

whereas N and P which are in organic forms had to undergo mineralization before becoming available. Because of the low root density (5.2mt/ha at 0. - 15 cm), low organic carbon content (1 - 21/2) and poor cation exchange capacity (3.9meq/100g soil) of the soils of the rubber plantations, the nutrient released during the litter decomposition were not retained, instead leached out of the feeding zone. The tree leaf litter of a mixed forest decomposes at a moderately slow rate, with a half life of about 9 months and hence the forest has a closed nutrient cycling system. Thus it is clear that the one of the management option available to the grower to improve the land is to incorporating organic matter into the area where chemical fertilizers are applied. The organic material needed can be either produced in the plantations by growing the appropriate crop, or brought in as crop residues like rice straw and coir dust which are freely available in the regions where rubber is grown. The results of the mulching experiments are encouraging. In most locations trees treated with organic matter, especially with coir dust, grew better than the trees in control plots without organics.

Table 4. *Changes with time of the nutrient composition of rubber and Pueraria litter.*

Time (days)	Litter Composition (%)					
	Rubber			Pueraria		
	N	P	K	N	P	K
0	1.1	0.05	0.12	1.7	0.07	0.64
6	1.2	0.06	0.05	1.6	0.08	0.03
23	0.9	0.04	0.04	1.3	0.06	0.05
35	1.1	0.05	0.05	2.0	0.09	0.06
51	1.0	0.06	0.05	1.7	0.08	0.04
65	1.2	0.06	0.05	1.8	0.09	0.04
80	1.3	0.05	0.06	1.8	0.08	0.05
91	1.2	0.05	0.06	2.0	0.09	0.05

Overall response to K and Mg application are summarised in table 5 and it can be seen that application of K and Mg upto level 1 was beneficial to the tree.

The commercial exploitation of the trees for latex is just begun and hence it is too early to comment on the results.

Table 5. *Analysis of variance of response of the tree growth to K, Mg applications.*

Treatment	1990 - Tree Girth (cm)
K ₀	42.2
K ₁	45.0
K ₂	45.5
K ₃	44.6
Mg ₀	43.9
Mg ₁	45.6
Mg ₂	46.0
Mg ₃	46.2
LSD	1.70

Relatively low denitrifications were seen under the coir mulch. This is because coir acted as a good carbon source for microbial immobilization of N. Studies are in progress to investigate the changes in the microbial biomass of the treated plots. The fate of the applied crop residues is also being examined. *Pueraria* follows the ureide pathway during the symbiotic N₂ fixation and this is being exploited to measure the N₂ fixation in (rubber plantations).

(M.K.S.A. Samaraweera, W.C. Dayaratne, A.M.A. Perera, K.G.S. Jayawardene, Chitra Maheepala, S.N. Silva in collaboration with Professor I.A.U.N. Gunatilleke University of Peradeniya and Professor J. M. Anderson, University of Exeter.)

Soil-plant water relations

Effects of cover management practices on moisture stress and mineral composition, growth and latex production of Hevea trees were studied in the experiment SM/82/5. The treatments were natural covers, mixed legumes and dead mulch cover. Girth and yield data (Table 1) obtained in the year 1990 shows significant girth and yield increase to application of straw mulch as a cover, management practice.

Table 1. *Effect of different soil management practices on girth and yield of Hevea*

Treatment	Girth (cm)	Yield (kg/ha/yr)
Naturals	48.27	878.6
Legumes	50.37	907.0
Dead mulch	57.60***	1035.0*

As similar results were obtained in 1988 and 1989 also, it appears possible to obtain significant girth and yield increase by mulching. (L. Samarappuli, P. Karunadasa, U. Mitrasena and M. Mahanama in collaboration with N. Yogarathnam).

Data from the experiment SM/83/1 indicated that the plots with mulch around the plant grow with better girthing (Table 2) and had higher leaf nutrient contents (Table 3) than the trees in plots without a mulch. However a reversed trend was observed in the leaf Mg content.

Table 2. *Effect of mulch on the girth of rubber plants*

Treatment	Girth (cm)
Without mulch	35.826
With mulch	39.004**

Table 3. *Effect of mulch on the leaf nutrient of rubber plants*

Treatment	N%	P%	K%	Ca%	Mg%
Without mulch	2.837	0.215	0.722	0.98	0.244
With mulch	2.887	0.225	0.809	1.11*	0.215*

Soil application of potassium increased the growth and the leaf K content of the rubber tree (Table 4) However low leaf Mg contents were seen in trees receiving high potassium doses (K1 & K2).

Table 4. *Effect of levels of potassium on girth, leaf K and leaf Mg content of rubber plants*

Treatment	Girth (cm)	Leaf K (%)	Leaf Mg (%)
K0	34.37	0.585	0.277
K1	39.37**	0.832**	0.203***
K2	38.51	0.880**	0.208***

(L. Samarappuli, P. Karunadasa and U. Mitrasena in collaboration with N. Yogarathnam).

Data of the experiment SM/88/1 conducted to study the influence of ground covers and potassium on growth of immature rubber in the wet region indicated that application of potassium to the soil improves the girthing of the trees Table 5.

Table 5. *Effect of potassium on diameter of rubber*

Treatment	Tree diameter (mm)
K0	8.91
K1	9.49*

The effect of different soil management practices on growth of immature *Hevea* was assessed by measuring the diameter of six months old plants. The growth of the plants in mulch treated plots and plots with legume was superior to those with naturals. Exceptions to this was seen in plots with *Sylosanthus gracillis* where a depressive effect was seen in the clone RRIC 102 Table 6.

Table 6. *Effect of ground covers on the growth of immature Hevea*

Treatment	Plant diameter after 6 months (mm)
Naturals	8.617
Mulch	9.783*
Pueraria	9.200*
Desmodium	9.400
Tephrosia & Sesbania	9.133*
Stylosanthus	8.667

(L.) Samarappuli, P. Karunadasa and U. Mitrasena in collaboration with N. Yogarathnam).

In experiment SM/88/4 the effect of different soil moisture regimes and potassium application on the performance of young Hevea was studied. At the recommended K dosage, level K1 when the soil moisture content was increased there was a progressive increase in stomatal conductance (SC), transpiration (T) and relative water content (RWC) Similar observations were made at K2 level with a decrease in all the parameters at 70% field capacity. The water loss in plants with out potassium was heavy and maximum SC and T were seen at 10% field capacity. Similar trends were also observed in plant diameter and height.

In the absence of added potassium plant growth was slow at all soil moisture levels. It was noted that plant diameter and height at K 50% field capacity were similar to those obtained when the lowest moisture regime is combined with the highest K level.

(L. Samarappuli, P.Karunadasa, U. Mitrasena and M. Mahanama in collaboration with N. Yogaratnam).

K/Mg Nutrition - Field

Effect of three levels of K and Mg fertilizers on the performance of clone PB 86 is being studies in experiment No. F/84/01 at Eladuwa Estate, Matugama. Significant increase in plant girth was observed with application of K at the first level and no further increase was seen at the second level of applied K. (S.M.M. Iqbal and N. Yogaratnam).

In experiment, F/88/01 is in progress at Clyde estate, Kalutara, the effect of five levels of K and two sources of Magnesium fertilizers on the performances of immature rubber ; leaf K content was significantly increased and leaf Mg content decreased with applied K and also application of kieserite resulted in higher leaf Mg content in comparison with application of Dolomite. (S.M.M. Iqbal and N. Yogaratnam).

Extension trials on fertilizer

Extension trials were laid at eight locations, Salawa, Mahaoya, Devalakande, Sunnycroft, Densworth, Atale, Udupola, Urumiwela Estates belonging to Janatha Estates Development Board. The objective of the exercises to re-assure the planters that the quantity of fertilizer recommended after the "Soil and Foliar Survey" is sufficient for the tree through it may be less than the amount given in the advisory circular. The treatments at any given site are :

1. Control with no fertilizer
2. Fertilizer applied according to the "Soil and Foliar Survey" recommendations
3. Fertilizer applied according to the advisory circular.

The size of a plot is a tapping task and there are three replicates at each site. Fertilizer was applied and latex yield of each plot is being recorded. (M.K.S.A. Samaraweera, H.D.S.P. Perera and T. Dissanayake).

Chemical analysis

Routine chemical analysis of soil leaf and latex samples collected for experimental and advisory purpose. Water and other materials sent by the Specification and Analysis Department were carried out. Samples sent by other Departments and organisations were also analysed. (M.K.S.A. Samaraweera, A.M.A. Perera, Chitra Maheepala, Manel Mahanama and T.M. Ahamadeen).

Soil and Foliar Survey

Nearly 20,000ha was surveyed during the period July - November and fertilizer recommendations were made; thus clearing the back log accumulated over the past two years. This is the highest area covered in any given year. Several mobile laboratories were installed in Avissawella, Kegalle and Ratnapura Regions and preliminary processing of leaf samples was done at an increased efficiency by using the facilities available at these laboratories. The corporation received from Messrs M.R.C. Peiris, S. de S. Daluwatte of the SLSPC V and S.N. Gunaratne and I.L.A. Fernando of JEDB IV is gratefully acknowledge.

(M.K.S.A. Samaraweera, A.M.A. Perera, H.D.S.P. Perera, C.K. Maheepala, M.K. Mahanama, S.N. Silva, T. Dissanayake, A.N. Yakandawela and T.M. Ahamadeen)

REVIEW OF THE GENETICS AND PLANT BREEDING DEPARTMENT

By

N. E. M. JAYASEKERA

SUMMARY

Experimental data suggest that RRIC 121 is emerging as the best RRIC clone with respect to vigour and yield. Both *in vitro* and *in vivo* pollinations can be used to study the floral biology of *Hevea*. Crossability between clones was used to study the incompatibility between *Hevea* clones.

The new selection 74 - 193 continued to give promising yields in small scale trials. Multiplication nurseries of proven foreign clones were expanded.

DETAILED REVIEW

General

Staff

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

Mr D.P.S.T.G. Attanayaka, Assistant Geneticist and Plant Breeder continued his postgraduate studies at the Genetics Department of the University of Birmingham, U.K.

Mr. K.B. Karunasekera, Experimental Officer left for U.K., in July 1990, for a training in Genetics and Plant Breeding.

Meetings, Seminars and Discussions

Head of the Department attended the following meetings and seminars :

1. Regional Scientific Committee meeting.
2. Rubber Council meetings.
3. Seminar on Conservation of Genetic Resources organized by NARESA.
4. Adaptive Research discussions.
5. 1990 forward replanting programme for JEDB Kegalle and Avissawella.
6. Workshop on Plant Breeding held at the Faculty of Agriculture Peradeniya.
7. Second Congress of the Postgraduate Institute of Agriculture.
8. SLSPC and JEDB Visiting Agents' conference.

Training and Field days

Head of the Department addressed the participants in the field day programme held on Opatha State Plantation.

Dr. (Mrs) Dharmaratna gave a talk on "recommended rubber clones" at the two field day programmes held at Dartonfield for Superintendents and Assistant Superintendents of JEDB Kegalle and Avissawella regions.

Four NDT students were also trained.

visitors

Dr. M.J. Kearsy and Dr Roy Kekwick of school of Biological Sciences of the University of Birmingham visited the Department.

Clone recommendation for SLSPC and JEDB Estates

Head of the Department and Head, Plant Science Department visited all regional Boards of SLSPC and JEDB and discussed the 1991 replanting programme. Each estate was given a clone recommendation for 1991 replanting considering the following important factors :

- (i) Extent to be replanted.
- (ii) Annual rain fall.
- (iii) Elevation above mean sea level.
- (ic) Clones already planted on the estate.
- (c) Budwood availability.

Further, after considering the future replanting programme each estate was given where ever necessary, a list of clones to expand their budwood multiplication nurseries.

Publications

Reports

Jayasekera, N.E.M. (1990) Annual Review of the Genetics and Plant Breeding Department.

Research

Hand Pollination Programme for 1990 (BST/HPS/90/1)

Only few crosses were possible due to premature drop of flowers as a result of extreme dry conditions. Crosses between promising foreign clones such as BPM 24, RRIM 717 and RRIM 722 and local clones such as RRIC 100 were not possible as bamboos delivered by the contractor were of poor quality and could not use for erecting scaffolding.

Crosses done on Clyde State Plantation (S.P.), number of pollinations made and other relevant details are given in Table 1. N.E.M. Jayasekera, K.B. Karunasekera and K.W. Rупatunga.

Table 1. *Details of the hand pollination programme for 1991 carried out on Clyde S.P. (BST/HPS/90/1)*

Crosses made	No. of Pollinations	No. of pods at 1st Exam	No. of pods at 2nd Exam	No. of pods collected	No. of seeds	No. of seeds germinated
RRIC 100×RRIC 121	160	7	6	6	19	13
RRIC 121×RRIC 100	30	6	5	5	15	12
RRIC 121×RRIM 600	62	4	3	3	9	6
Total	252	17	14	14	43	31

Hevea reproductive biology (PB/FBH/86/2)

Comparison of Invivo and Invitro pollinations by fluorescence microscopy

Intercrosses were made between RRIC 100 and RRIC 121 for this purpose. Pollinations were done in set of 3 flowers and 2 sets were carried out for each cross. This crossing programme was done both in the field (*invivo*), on Clyde S.P., and in the laboratory (*invitro*) and 24 hours after the pollination entire gynoecium was removed and fixed in approximately 2 ml. of chloro-acetic-alcohol solution. Pistils were left in fixative for 2 - 24 hours rinsed in distilled water for about 30 seconds and softened in 0.8N NaOH

for one hour at 60 C. They were then left to stain in a solution of 0.1% water soluble aniline blue in 0.1N tripotassium phosphate. Sufficient staining of the pistils usually occurred after 3 - 4 hours. For examination pistils were mounted in 80% glycerine and gently squashed by touching the coverslip with the forceps. A Microstar IV microscope with incident illumination was used. Pollen grains, pollen tubes and ovules were counted in each pistil, Pollen tubes penetrating the ovules provided the data that could be used to determine the fertility. Stigmas which have been pollinated with compatible pollen exhibited a mass of brightly stained fluorescent material. Pollen grains were observed attached to the papillae as dark circular bodies, with a faintly fluorescent rim and yellow fluorescent spot at the point of tube emergence. Pollen grains which have penetrated the stigmatic papillae deposited a relatively large amount of fluorescent callose material. As the tube enters an ovule it tends to thicken with the deposition of greater amount of callose. After entry, the tube ceases to be visible. The fate of tubes which do not reach an ovule is not clear. Though over 12 tubes may penetrate the stigma only 3 or 4 of them ultimately penetrate the ovules depending on the number of ovules in the female, while others are of no real use.

There was no large difference between the invitro and invivo pollinations in crosses between RRIC 121 female into RRIC 100 male. However the reciprocal cross showed considerable difference between invitro and invivo pollinations, number of pollen tubes in the stigmatic surface and percentage of pistils with all ovules penetrated by pollen tube are presented in Table 2. (S.C. Dharmaratna.)

Table 2. *Crosses, number of pollen tubes per stigmatic surface and percentage of pistils with all ovules penetrated in two methods.*

Cross combination		Mean number of pollen tubes per stigma		Percentage of pistils with all ovules penetrated by a pollen tube	
Female	Male	invivo	invivo	invitro	invivo
RRIC 121R	× RIC 100	14	12	30	28
RRIC 100	× RRIC 121	12	06	31	10

Incompatibility in Hevea

Three *Hevea* clones were crossed in all possible combinations. On the basis of cross relationships progenies were separated into three intra-sterile inter-fertile groups and three intra-fertile groups which are not fully inter-fertile (Table 3). This would be repeated in next flowering season with a long number of crosses.

Table 3. *Incompatibility/compatibility groups*

Clone	RRIC 102			RRIC 130				RRIC 100		
	A	B	C	D	E	F	G	H	I	J
RRIC 130	A	-	+	+	+	+	+	+	-	+
	B	+	-	+	+	+	+	-	+	+
	C	+	+	-	+	+	+	-	+	+
	D	+	+	+	-	-	+	+	+	+
	E	+	-	+	-	-	-	+	+	+
RRIC 100	F	+	-	+	+	-	-	+	+	+
	G	+	+	-	+	+	+	-	+	+
	H	+	+	+	+	+	+	+	-	+
	I	-	+	+	+	+	+	+	+	-
	J	+	+	+	-	+	+	+	+	+

+ Compatible pollinations
 - Incompatible pollinations

Clone evaluation

Selection and evaluation of 1974, 1975 and 1978 hand pollinated (H.P.) seedlings (BST/HPS/74/1, 2, 3 and BST/HPS/74, 75, 78/1)

A girth measurement was recorded in the two small scale trials established on Moraliya Estate and Yatadola S.P. to evaluate some of the selections made from 1974 H.P. seedlings.

Mean yield in terms of grammes per tree Per tapping (g/t/t) collected from these two trials are presented in Table 4a. In both trials best control clone was RRIC 121 yielding 46.6 and 60.2 g/td/t at Yatadola and Moraliya respectively.

Non of the new selections out yielded RRIC 121 though several new selections have out yielded other two control clones viz RRIC 100 and RRIM 600.

Table 4a. *Mean yield of some promising new selections at Yatadola (BST/HPS/74/1) and Moraliya (BST/HPS/74/2)*

Yatadola S.P.		Moraliya Estate		
Clone No.	Mean yield (g/t/t)	Clone No.	Mean yield (g/t/t)	
74-218	9.8	74-6	43.8	
74-220	29.0	74.173	38.9	
74-210	28.0	74.200	38.7	
74-207	27.8	RRIC 121	60.2	
RRIC 121	46.6	RRIM 600	37.7	control clones
RRIM 600	27.6	RRIC 100	22.7	
RRIC 100	24.6			

A girth measurement was recorded in the other clone trial established at Kuruwita Sub station to evaluate eleven clones selected from 1974 H.P. seedlings. Highest girth of 70.4 cm was recorded by RRIC 121 closely followed by a new selection 74 - 41 with an average girth of 70.4 cm. 74 - 193 had an average girth of only 56.7 cm.

With respect to yield, 74 - 193 is still the highest yielder. But in 1990 average yield of this selection is lower than the previous year. On the other hand the best control clone RRIC 121 indicated an increasing yield trend in 1990 when compared to 1989 (Table 4b).

Table 4b. Average girth and mean yields (g/t/t) of the clones evaluated in small scale trial at Kuruwita Sub station (BST/HPS/74/3)

Clone	No. of trees tested	Girth cm at 150 cm	Yield g/t/t		Dry trees
			1989	1990	
74-193	20	56.7	74.1	65.8	1
RRIC 121	20	70.4	40.5	54.4	— control
74-41	19	68.0	54.9	54.4	—
74-135	20	66.0	57.1	52.0	3
74-180	19	60.0	55.5	51.3	—
74.205	18	59.6	55.6	48.1	—
74-198	20	65.4	34.6	42.9	—
74.162	20	59.6	42.7	41.4	1
74-12	20	65.5	39.0	38.3	12
RRIC 100	16	54.6	37.2	36.3	1 control
74-199	19	54.1	40.2	35.8	2
74.139	19	54.9	33.9	33.2	1
RRIM 600	16	52.3	33.9	33.2	— control
74-221	19	50.8	34.7	29.0	—
PB 86	13	50.3	25.0	23.8	— control

A girth measurement was recorded in the small scale trial (BST/HPS/74, 75, 78) established on Paiyagala S.P. to evaluate the 14 genotypes (seven selection each from 1974 and 1976 H.P. seedlings).

Only one selection 75 - 268 had an average girth as good as control clones (Table 5) N.E.M. Jayasekera, K.W. Rупatunga, B.M.S.G. Peiris and I.D.M.J. Sarathkumara.

Table 5. Average girth of control clones and 75 - 268 (BST/HPS/74, 75, 78) - Paiyagala S.P.

Clone	Average girth (cm)
76 - 268	45.2
RRIC 102	45.2
RRIC 121	43.7
RRIC 100	41.3

} control clones

Evaluation of 1976 H.P. selections (BST/HPS/76/2) Tempo division, Hill Stream S.P.

A girth measurement was recorded in this trial and three new selections, 74-8, 74-52 and 74-182 had better average girth measurements than the three control clones (Table 6). N.E.M. Jayasekera and K.W. Rупatunga.

Table 6. Average girth of the three control clones and the three new selections.

Clone No.	Mean girth (cm)
78-8	58.7
78-52	54.3
78-182	54.1
RRIC 121	53.2
RRIC 100	48.0
RRIC 102	46.0

} control clones

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

Average girth and mean yields in g/t of the seedling families derived from 1979 hand pollination programme are given in Table 7. Highest average girth was recorded by the family derived by crossing RRIC 100 and RRIM 623 while the highest mean yield was also registered by the same family originated from a cross between RRIC 103 and RRIM 623. The five highest yielding genotypes will be selected and cloned for the establishment of clone trials for further evaluation. N.E.M. Jayasekera and I.D.M.J. Sarathkumara.

Table 7. Average girth and mean yield of 1979 H.P. seedlings on Eladuwa S.P. (SBT/HPS/81/2).

Family	Family size	Mean girth (cm)	Mean yield g/t/t
RRIC 101 X RRIM 600	269	56.5	24.3
RRIC 101 X RRIM 623	55	55.0	16.2
RRIC 100 X RRIM 600	18	64.7	27.3
RRIC 100 X RRIC 101	16	61.7	24.7
RRIC 102 X RRIM 600	23	54.5	19.6
RRIC 102 X RRIM 623	2	64.5	19.5
RRIC 103 X RRIM 600	10	54.0	22.5
RRIC 103 X RRIM 623	15	66.0	43.4
RRIC 103 X RRIC 101	6	62.4	25.7

1981 H.P. Seedlings (BST/HPS/81/2), Molaboda Division, Eladuwa S.P.

Average girth and mean yields of eight families in this hand pollinated seedling population are given in Table 8. Highest average girth was recorded by the families that had RRIC 52, which is a very vigorous clone, as one of the parent.

On the other hand highest yield was registered by the family derived by crossing RRIC 102 and IAN 45/710. This family had a mean yield of 59.6 g/t/t, where as the second best family, a cross between RRIC 102 and PB 28/59 had only 37.2 g/t/t. N.E.M. Jayasekera, K.W. Rупatunga and I.D.M.J. Sarathkumara.

Table 8. *Average girth and mean yield of 1981 H.P. seedling families (BST/HPS/81/2) on Malaboda Division of Eladuwa S.P.*

Family	Family size	Mean girth (cm)	Mean yield (g/t/t)
RRIC 52xPB 28/59	17	68.9	33.0
RRIC 52xIAN 45/710	4	68.3	27.1
RJC 102xIAN 45/710	3	64.5	59.6
PB 28/59RxRIC 52	9	58.5	29.3
PB 28/59xIAN 45/710	31	58.5	33.3
RRIC 102xPB 28/59	10	57.5	37.2
PB 28/59xRRIC 121	18	54.6	26.4
PB 28/59xRRIC 102	27	52.9	31.2

Clone trial (BST/V/73/37), Bibile Group

In this trial highest average girth (78.8 cm) and highest mean yield of 78.8 g/t/t were recorded by RRIC 110. The second best clone both in terms of vigour and yield was the unregistered clone, 1461. N.E.M. Jayasekera and R.A.S.K. Ranatunge.

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

Only a girth measurement was possible as required percentage of plants have not reached the tappable girth. As in the previous year clone RO 51 had the highest girth (37.1 cm) among the new introductions. But this was less than the figures attained by control clones (Table 9). N.E.M. Jayasekera and K.W. Rupertunga.

Table 9. *Average girth measurement of (BST/ICC/85/02), Paiyagala S.P.*

Clone No.	Mean girth (cm)
RO 51	37.1
GU 1296	36.0
RO 46	35.0
P 122	34.7
O 55	34.3
U 86	33.7
AC 54	32.9
PFB 5	30.9
AC 57	27.0
AC 55	25.7
RRIC 121	45.7
RRIC 100	41.6
RRIC 102	41.3

} Control clones

Small scale trails at Kuruwita Sub station (SBT/VSM/67/5 and BST/VSM/68/2).

Average girth and mean yield of clones tested in BST/VSM/67/5 are given in Table 10. RRIC 121 had the highest girth and yield. Other clones had very poor yield and girth figures. N.E.M. Jayasekera and B.M.S.G. Peiris.

Table 10. *Average girth and yield (BST/VSM/67/5)*

Clone	Trees tapped	Dry trees (B.B.)	Mean girth at 150 cm	Mean yield g/t/t	
				1989	1990
RRIC 121	15	3	108.0	78.0	60.7
RRIM 623	23	2	87.5	38.6	27.8
7281	17	5	84.9	37.0	23.6
RRIC 122	5	2	76.8	19.0	17.6
10727	14	5	73.2	16.8	12.6

In the small scale trial BST/VSM/68/2 at Kuruwita, highest mean yield of 113.1 g/t/t was recorded by RRIC 121 while the second best clone was the unregistered 6/541 which yielded only 77.6 g/t/t. With respect to girth RRIC 133 had the highest average girth of 127.1 cm closely followed by RRIC 121 with an average girth of 124.0 cm.

RRIC 45 had the lowest mean yield and lowest girth. N.E.M. Jayasekera and B.M.S.G. Peiris.

International clone trial (BST/ICT/78/2), (BST/ICT/79/2) — Hewagam Estate

Average girth and mean yield are given in Table 11.

Table 11. *Average girth and mean yield of clones tested in International clone trials (BST/ICT/78/2 and BST/ICT/79/2)*

Planting Year	Clone	Mean yield g/t/t	Mean girth cm at 150 cm	No. of trees tapped
1979	RRIC 121	31.6	64.3	35 - 95
1978	RRIC 110	31.4	63.8	96 - 101
1978 & 1979	RRIM 600	31.0	58.1	130 - 137
1979	RRIC 117	30.8	54.4	33 - 84
1979	BPM 24	29.3	51.1	78 - 84
1978 & 1979	RRIC 100	27.9	58.4	111 - 119
1978	RRIM 703	25.2	59.4	119 - 130
1978	PR 306	22.0	60.2	111 - 117
1979	BPM 22	20.5	57.1	47 - 115
1978	RRIM 722	19.2	61.4	42 - 42
1979	BPM 3	11.6	53.3	50 - 53

RRIC 121 registered the highest yield and girth and RRIC 110 was the second highest in both trails.

The other high yielding clones in this trials are RRIM 722, PR 306, BPM 24 and RRIM 702 and FRIC 100 N.E.M. Jayasekera and R.A.S.K. Ranatunga.

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

During 1st half of the year test tapping was not possible due to changing over of the tapping panels and adverse wet conditions.

Yield data is presented in Table 12 showed a wide variation over different agro-climatic areas confirming our previous finding that latex yield, to a very great extent, is influenced by agro-climatic factors.

Girth data in Table 13 also show a variation over sites On the average RRIC 52 is the most vigorous clone. N.E.M. Jayasekera, K.W. Rупatunga, I.D.M.J. Sarathkumara and R.A.S.K. Ranatunga.

Table 12. *Mean yield (g/t) of clones in genotype environment interaction experiments (GE/75/1)*

Clone	Kanana	Bentota	Montovia	Deansworth	Hunuwella	Golinda	Bibile
RRIC 36	25.1	35.7	33.0	40.0	17.1	37.8	29.6
RRIC 52	15.5	23.8	20.9	31.3	18.1	16.2	16.6
RRIC 100	34.7	31.7	21.5	32.1	15.2	25.5	17.8
RRIC 101	37.1	20.8	22.8	47.5	34.3	34.1	21.1
RRIC 102	29.7	27.9	15.8	26.9	21.0	21.9	20.8
RRIM 600	45.9	36.0	40.3	38.5	38.0	41.2	34.3
RRIM 623	45.6	26.9	31.3	46.7	20.0	13.4	27.0
PB 86	34.7	21.4	23.6	35.9	22.0	24.0	23.5
IAN 45/710	60.2	53.9	28.7	42.2	24.2	22.4	31.6

Table 13. *Mean girth (cm) (GE/75/1)*

Clone	Kanana	Bentota	Montovia	Densworth	Hunuwella	Golinda	Bibile
RRIC 36	61.3	71.7	68.5	74.1	58.5	69.4	66.8
RRIC 52	86.8	89.3	85.3	95.1	85.2	77.7	85.0
RRIC 100	69.8	70.8	66.6	66.7	62.0	66.2	64.4
RRIC 101	66.1	65.3	65.9	72.2	67.4	60.9	64.8
RRIC 102	68.2	72.2	66.8	72.0	73.7	61.5	68.5
RRIM 600	76.1	82.8	77.3	80.5	81.1	73.3	71.7
RRIM 623	76.6	84.5	75.1	84.8	78.5	75.6	75.9
PB 86	75.6	72.1	68.9	77.0	68.8	76.0	64.7
IAN 45/710	88.0	84.3	76.1	80.5	79.4	72.6	80.1

Adaptive Research - clone trials

Two sets of trials were established in Kalutara and Kegalle Districts to study how well the four new RRIC clones viz RRIC 100, RRIC 102., RRIC 121 and RRIC 110 will adapt to the small holder management conditions. These trials were established in two sizes of small holdings viz 0.5Ac to 1.5Ac and 2.0Ac to 3.0Ac.

In each district four clones were planted in 8 small holdings of 0.5Ac to 1.5Ac size so that there will be two holdings planted in each clone in each district. Two treatments, small holder practice and RR.I. recommendations were assigned, at random, to the two holdings of each clone.

In the case of 2.00Ac to 3.00Ac holdings four such holdings were planted one in each clone per district. Each holding was divided into 2 blocks with more or less equal number of plants, and two management regimes were assigned, at random, to each block of each holding.

These trials were established in 1990 South West Season and vacancies were supplied in 1990 North East Season. N.E.M. Jayasekera in collaboration with Officers of the Advisory Department in the two Districts.

Small scale clone trial (BST/HPS/86/1)

A small scale clone trial was established at Kuruwita Sub station to evaluate new selections made from 1986 H.P. seedlings.

A randomized block design with four replicates was used and the replicate size was 5. N.E.M. Jayasekera, K.W. Rupatunga and B.M.S.G. Peiris.

Proven foreign clones received from Thailand

Multiplication nurseries of these clones that are to be tested under Accelerated Testing Programme were expanded up to 200 points per clone.

Seedling nurseries have been established and experimental sites selected to establish two trial sites in Kalutara and Kelani Vally districts to evaluate these proven clones.

RRIDB Germplasm Collection (GPC/85/4)

Routine maintenance work of the multiplication nurseries of the germplasm clones was carried out. It is hoped to test - tap some of the clones in this collection. (N.E.M.) Jayasekera, S.C. Dharmaratna and K.W. Rupatunga.

REVIEW OF THE BIOCHEMISTRY DEPARTMENT

By

M. T. WARNAKULA

SUMMARY

Lack of staff limited the research work of the department.

Research work of the department was mainly focussed on effluent treatment and utilization.

Effluent treatment system installed at Dartonfield by Industrial Engineers was tested in collaboration with the Raw Rubber Development and Chemical Engineering Department. Further trials are being done.

A new method of effluent treatment, apart from the above was evolved. The results of the fabricated miniature plant is very promising.

Staff

M.T. Warnakula, Asst. Biochemist, M.D.C. Seneviratne, Technical Officer, P.D.J. Rodrigo Specification Assistant, D. Ramawickerema, Laboratory Attendant & G.W. Gunasena, Factory Attendant were on duty throughout the year.

Susil de Zoysa, Postgraduate Student, continued with his studies upto September 1990, on application of Rubber Factory effluents as a fertilizer under a CIDA funded programme, supervised by Dr N. Yogaratnam and Dr P.A.J. Yapa.

Effluent treatment

According to new environmental laws, any factory that causes environmental pollution repeatedly, should be closed. So there is a threat to discontinue the activities of rubber factories.

Currently available waste treatment systems are not suitable for rubber plantations of Sri Lanka. Because some of them are very expensive. Cheaper methods, for example ponding system are not suitable for our topography. Moreover, ponding system needs a considerable area of flat land but most of our rubber plantations are in hilly area.

As the Rubber Research Institute is responsible for giving advices to the plantation sector on treatment of effluents of rubber factories, there is an immediate necessity to establish cheaper and easier method of waste water treatments system which should suit our topographic conditions.

A modified effluent treatment system with a modified areator was installed at Dartonfield by Industrial Engineers Ltd. and operated according to manufacturer's instructions first and then the method of operation was modified in order to increase the efficiency.

The following parameters were tested to determine the level of pollutants in waste water to monitor the effluent treatment systems :

Parameters	Method of testing
1. Biological oxygen demand (BOD)	Sodium azide modification of winkler method
2. Chemical Oxygen Demand (COD)	Dichromate reflex method
3. pH	Membrane Electrode method
4. Solids (Total suspended settleable)	Filtration and evaporation method

Results obtained so far :

The following table summarises the results obtained during the first set of trials. These trials were carried out according to the instructions given by the manufacturers of the system.

Effluent was kept for three days in sedimentation tanks prior to being sent to the aeration tank. On the fourth day effluent was fed to aerator tank.

Trial No.	COD		BOD		pH	
	Initial	After 24 hrs.	Initial	After 24 hrs.	Initial	After 24 hrs.
1	3200	1200	1092	832	6.5	7.5
2	3952	1600	2713	1188	5.3	5.9
3	2360	1680	1700	1175	5.6	6.5

Average value of COD & BOD of effluent.

In second set of trials

Waste water of aerator tank was set to pH 7 and aerated until the COD of it come down to about 250 mg l⁻¹ and then continuously fed with waste water to be treated.

The results obtained from that trial is as follows :

Date	Time	Time period	Rate	Amount fed	COD/mg l ⁻¹	
					In	Out
25.9.90	12.00 noon	25 h	5 l/min	7500	6720	240
26.9.90	8.30 am	20.5 h	5 l/min	6150	6880	1040
27.9.90	8.30 am	24 h	10 l/min	14400	7320	3360
28.9.90	8.30 am	24 h	10 l/min	14400	6220	2240
29.9.90	8.30 am	24 h	10 l/min	14400	6920	2000

Tank capacity = 16 m³
At start D.O. level = 3 mg l⁻³

Starting COD level of waste tank = 240 mg l⁻¹
COD of fed waste = 6840 mg l⁻¹

The above results reveal that the plant does not reduce the pollutant levels to acceptable limits, when operated according to instructions given by the manufacturer.

The results of the 'continuous feeding trial' shows that with the slow feeding rate it is possible to reduce the pollutant levels to acceptable levels but with higher loads it fails. However further trials should be done to find out the exact load that the system can bear. (Thurul Warnakula, E.D.I.H. Perera, S.W. Karunaratne, M.D.C. Seneviratne, S. Siriwardena).

To meet the urgent need to find a solution to the waste treatment problem, it has been possible to develop a new method to treat waste water. The efficiency of this new method is very high. Further details will be given after it is registered in the patent registry. (Thurul Warnakula).

Effluent utilization as a fertilizer

One of the methods of tackling rubber factory effluent problem is to utilize it as a fertilizer because of its high nutrient content. It has been reported to be rich in several important nutrients. The amounts of nutrient contained in the rubber factory effluents in Sri Lanka are, 366 ppm Sodium, 745 ppm Potassium, 140 ppm Magnesium, 83 ppm Calcium, 625 ppm Nitrogen and 646 ppm Phosphorous. Preliminary studies carried out in Malaysia, India and also in Sri Lanka have shown that it can be used as a fertilizer on a wide range of crops including rubber. The objective of the project is to study the possibility of using rubber factory effluent as a fertilizer to rubber and paddy with special reference to N, P and K. Trials on 'Rubber factory effluents as a fertilizer for young rubber,' 'Crepe rubber effluents on mature rubber,' 'Effect of rubber factory effluent on paddy' were continued during the year 1991. (Susil de Zoysa, N. Yogaratnam, P.A.J. Yapa, M.D.C. Seneviratne, and D.P.J. Rodrigo).

Preliminary studies were carried out with the intention of modifying the following projects) "New ways of utilization of rubber effluent," "Enzyme deprotonization of natural rubber," "Tapping panel dryness.", (Thurul Warnakula).

REVIEW OF THE RUBBER TECHNOLOGY AND DEVELOPMENT DEPARTMENT

By

N. M. V. KALYANI

SUMMARY

The influence of the latex properties such as VFA and KOH number upon the dipping characteristics of compounded latex used in both coagulant and heat sensitive dipping formulations has been evaluated. The special type of latex developed for radiation vulcanisation process was manufactured in large quantities and sent to Japan and Germany for evaluation. A positex which could be incorporated into bitumen emulsion was developed. Plans were made to perform the incorporation of latex during the preparation of bitumen emulsion itself. The use of suitably compounded latex in rubber mounts used in broom manufacture, rubberised coir belts, adhesives etc. has been evaluated. Further work on the evaluation of depolymerised latex synthesised using single oxygen was carried out. Chlorinated natural rubber of high stability and solubility was synthesised by using modified grades of NR latex.

An evaluation of various NR/SR blends in truck tyre retread formulations was conducted.

The project on the use of OENR in tyre retread industry has been revitalised. Initial small scale trials have indicated that a vast improvement in abrasion properties can be achieved with incorporation of oil in NR up to 20%. Use of TPNR in the plastics industry would be of great value specially in high impact product manufacture. This particular TPNR has now been introduced to one of the plastics industries and is now in the process of implementation. Soft and hard grades of TPNR was found to be suitable in applications where high impact resistance is needed while soft grades (flexible) are more suitable in the manufacture of articles such as shoe soles and flexible tubings. A few rubberised rollers were made with the special improved formulations at the request of two industrialists. The performance of the rollers is being evaluated. Use of optical brighteners in the place of bleaching agents in latex crepe manufacture has been investigated and positive results have been obtained.

DETAILED REVIEW

Staff

Dr (Miss) N.M.V. Kalyani, Rubber Chemist, was away at Tun Abdul Razak laboratory, MRPRA, U.K. for a period of three months participating in a UNIDO sponsored project on "Development of Natural rubber based truck tyre retreading materials."

Dr W.M.G. Seneviratne, Assistant Rubber Chemist, was on duty throughout the year.

Mr B.P. Weeraratna, Assistant Rubber Chemist, proceeded to UK in September for his post graduate studies at the University of Loughborough, U.K.

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

Experimental Officer, Mr P.P. Jayasinghe was promoted as an Assistant Development Officer with effect from 1 September 1990.

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

Technical Officer Mr D.P. Wethasinghe was on duty leave from 14 May 1990.

Publications

Kalyani, N.M.V. (1990) "Thickening of low protein natural rubber latex by zinc/ammine system" J. Plas & Rub Inst. Sri Lanka 3, 8.

Seminars

Dr (Miss) N.M.V. Kalyani delivered a lecture on 'Latex based rubber products manufacture' at a seminar organised by Industrial Development Board held at Nivithigalakelle Training Centre.

Dr (Miss) N.M.V. Kalyani attended the sessions on 'Tyre retreading and recycling' of 'Tyre Tech' conference held at Brighton U.K. in November.

Dr (Miss) N.M.V. Kalyani delivered a lecture on 'Composition of natural rubber latex' at a seminar organised by NIPM.

Dr W.M.G. Seneviratne delivered lectures on 'Speciality grades of NR' at the Planters seminar at Kegalle, JEDB and at the Nivithigalakelle factory officers seminar organised by NIPM.

Courses

Dr (Miss) N.M.V. Kalyani organised a course on 'Rubber Products manufacture' Theoretical as well as practical aspects of rubber based industries were discussed with about 700 participants.

Dr (Miss) M.N.V. Kalyani and Dr W.M.G. Seneviratne served as lecturers for the Diploma course in Rubber Technology organised by the Plastics and Rubber Institute.

Dr W.M.G. Seneviratne organised a two day lecture and demonstration programme for 10 youths sent by Kalutara Provincial Council under the direction of Mrs Sirima Kariyawasam.

Dr W.M.G. Seneviratne served as a lecturer (visiting) at the University of Colombo & University of Sri Jayawardanapura on Polymer Science and Technology.

Dr W.M.G. Seneviratne served as a panel member at the factory officers interview (oral exam) at the NIPM.

Meetings

Dr (Miss) N.M.V. Kalyani attended 3 committee meetings of RVNRL group held at Atomic Energy Authority.

Dr (Miss) N.M.V. Kalyani attended 7 progress control meetings of Road Development Authority to discuss the latex/bitumen project.

Dr W.M.G. Seneviratne participated in drafting committee meeting of Rubber compounding materials held at Sri Lanka Standards Institution.

Dr W.M.G. Seneviratne participated in a meeting on 'Setting up a central laboratory held at Central Environmental Authority.

Dr W.M.G. Seneviratne served as the Chairman of the committee appointed by the Hon Minister of Plantation Services comprising of Mr L. Karunanayake, Asst. Rubber Chemist RRI and Mr Dassanayake RAO Kegalle to look into certain irregularities that occurred at the Mawanella Natural Rubber Complex.

Dr W.M.G. Seneviratne served as the representative member of the Janasaviya committee appointed by the Ministry of Youth Affairs and Employment chaired by Hon Dayananda Wickramasinghe.

Mr B.P. Weeraratne participated in a drafting committee meeting on 'Rubber based adhesives' held at Sri Lanka Standards Institution.

Research Officers of the Department attended the annual sessions of PRI.

FIELD AND LABORATORY INVESTIGATIONS

Latex Technology

Properties and processability of NR latex concentrates

Further work on this project was continued. Correlations between the latex properties such as KOH number & VFA number and the dipping characteristics of

compounded latex used in both coagulant and heat sensitive dipping processes have been evaluated. The VFA number of latex strongly influences the dipping characteristics of coagulant dipping formula and the KOH number is of great significance in controlling the dipping characteristics of heat sensitive formulas used in ZnO/NH₄ Ac system.

Tests conducted using latex obtained from various sources indicated that depending on the method of production of latex concentrate the processing behaviour of the latex varies. This observation can again be attributed to the variations of above mentioned latex properties with the method of concentrate production. (N.M.V. Kalyani, Sriyani Yapa & D.P. Wethasinghe).

Influence of non-rubber constituents upon thickening behaviour of NR latex

The effects of non-rubbers upon the thickening of NR latex were further investigated. It was found that the thickening of NR latex in the presence of ZnO and NH₄ Ac can be controlled by adding suitable stabilisers. As the nature of the stabiliser had a marked effect on its ability to control thickening it appeared that thickening of NR latex in the presence of ZnO and NH₄ Ac is a balance of various factors.

(N.M.V. Kalyani, Sriyani Yapa & D.P. Wethasinghe)

Developments of special types of NR latex to be used in radiation vulcanisation

Further work on this project was carried out. Four special types of NR latex concentrates were prepared at Dartonfield and one of them was found to exhibit excellent stability towards the sensitiser n-BA. The physical properties of the developed latex after irradiation were also found to be good. Further more it was confirmed that through the careful selection of sensitiser concentration and radiation dose, prevulcanised latex with desirable physical properties can be obtained. A 5 litre sample of this special type of latex was sent to Dipped Products Ltd. after irradiation for evaluation. A separate sample of the same latex was evaluated by Dr Makuuchi at JAERI, Japan and it was reported that the results were very encouraging. Therefore a batch of 400 litres of the special latex was prepared at the Natural Rubber Complex at Mawanella and 200 litres of it was sent to JAERI, Japan on request for large scale trials. The remainder was shipped to West Germany to conduct large scale trials using electron beam.

(N.M.V. Kalyani, H.N.K.K. Chandralal, N. Nadarajah, S. Sooriyaarachchi (AEA & R. Devendra (CISIR)).

NR latex applications

(a) Latex bitumen emulsions in road construction

A positex which could be incorporated with both CRS-1, CSS-1 without any destabilisation has been developed. Initially the preparation of latex/bitumen blends were done only after the preparation of bitumen emulsion. Later it was decided to look

into the possibilities of incorporation of latex during the preparation of bitumen emulsion in the mill. Therefore a batch of 20 gallons of positex was prepared at Dartonfield and was sent to Road Construction and Development Co. (pvt.) Ltd.

(N.M.V. Kalyani, P.P. Jayasinghe, I.H.D. Sumanaratne, Y. Samarasinghe & B.C. Bodhinayake (RDA).

(b) *Rubber Mounts in broom manufacture*

At present, in commercially available brooms, fixing of coir base to the broom stick is done by means of a metal frame support. This type of broom has several disadvantages such as—

- a the durability of the broom is very limited since it is not tightly held in the mount.
- b too heavy
- c damage the furniture

Possibilities of the replacement of metal frame by a rubber mount are investigated.
(B.P. Weeraratne and N.M.V. Kalyani)

(c) *Rubberised coir belts*

Trials have been conducted to manufacture rubberised coir belts which can be used in coir processing mills and rice hulling mills in place of existing leather-fabric belts. Two rubberised coir belts were supplied to coir processing mills and it was reported that the performance of the supplied belts was far more superior to that of existing belts. Further requests have been made for rubberised belts and therefore the preparation of a few more such belts has been initiated.

(B.P. Weeraratne, N.M.V. Kalyani and M.T. Warnakula)

(d) *Adhesives*

Further experiments were conducted to develop adhesive tapes and fabric tapes. Following factors were tested using nine alternative formulas.

- Wetting ability or quick stick adhesion
- Cohesive strength

The plastisiers were found to play a significant role in controlling the wetting ability and quick stick properties.

(B.P. Weeraratne & P.P. Jayasinghe)

(e) *Carpet backing*

Trials have been conducted to produce coir based carpets with rubberised edges and latex foam backings. Samples of compounded latex, which could be used in foam backing were supplied to a small scale coir based carpet manufacturing company.

(B.P. Weeraratne, N.M.V. Kalyani, K.M.U. Mithrananda)

Chlorinated Natural Rubber (CNR)

Chlorination of synthetic polyisoprene in solvent phase (CCl_4) is the common way of producing chlorinated NR commercially. Generally CNR is sold under few trade names such as Alloprene (ICI) Pergut (Bayer) and Parlon (Hercules). However at present, production of these CNR grades has been prohibited in respective countries due to the environmental hazards involved in this solution process. Therefore commercial production of solution CNR rubbers from suitably stabilised latex would be of great value to a natural rubber producing country like Sri Lanka. This latex process is also very much advantageous over the solution process mainly due to its low production cost and time. In addition environmental pollution can also be kept at minimal levels if proper steps are taken to discharge excess of Cl_2 gas which is the only hazardous chemical involved in this latex process. Also this will be at very low levels under controlled conditions.

Early attempts showed that a stable product could be obtained at elevated temperatures but the solubility in solvents was found to be not adequate. However, trials carried out recently with modified grades of NR latex gave a product with high stability and solubility. Plans are now under way to implement this process commercially in collaboration with Messers C.W. Mackies Ltd.

(W.M.G. Seneviratne)

Depolymerisation of NR latex

It has been observed that the singlet oxygen produced by the reaction of Sodium Hypochlorite and Hydrogen peroxide react with C-C bonds of NR chains leading to chain scission in the NR molecules resulting in small chain NR molecules. A range of viscosity average molecular weight of NR can be obtained by adjusting the amount of chemicals used and the MW can even be brought down to as low as 5000 from average values of 1, 000, 000 at room temperature. This process is being patented in Sri Lanka and awaits possible implementation.

(W.M.G. Seneviratne)

Dry Rubber Technology

Development of NR based truck tyre retreading materials

Tyre technologists are keen to develop NR based truck tyre retreading compounds which would give tread lifetime equivalent to or better than those given by all synthetic rubber (SR) retread compounds under a variety of climatic conditions. The significant advantages of all NR tyre tread compounds over all synthetic compounds is their low rolling resistance. However wet skid properties of all NR tread compounds are usually inferior to those of synthetic counterparts. It has been shown that this problem can be solved with the use of proper NR/SR blends. An evaluation of various NR/SR blends has been conducted. Two properties namely rolling resistance and wet grip were considered in this evaluation. Assessment of these properties were made studying the hysteresis of the rubber compounds. The SBR/BR tread compound was found to have

the best wet skid properties while the NR/BR compound had the poorest wet skid properties. However, the rolling resistance of NR/BR compound was found to be the best.

(N.M.V. Kalyani, V. Kajornchaiyakul (Rubber Research Institute of Thailand)

Use of oil extended Natural Rubber (OENR) and NR/butadiene (BR) in tyre retreading industry

The tyre retreading in Sri Lanka is dependent entirely on NR for its elastomer requirements. There is no record of any attempts to—

- (a) Use elastomer blends or
- (b) Modification in the compound design to achieve cost/performance ratio.

The use of NR/BR and NR/SBR has been widely recommended to improve abrasion resistance of retreads. The use of OENR is recommended for better performance on ice in winter due to its higher skid resistance.

Some trials of NR/BR blends of improved formulations were tried out and the results show that abrasion resistance improved with increasing content of BR in the blend. Similarly, series of trials with OENR having varying proportions of oil in the OENR were carried out and the results reveal that a vast improvement in abrasion resistance can be obtained upto a certain level of oil in OENR (25%). However abrasion resistance gradually decreased with further increase in oil. Messers AMW Ltd kindly agreed to try out OENR in their retreads.

(W.M.G Seneviratne, N.M.V. Kalyani, Deepthi Kumari, B.P. Weeraratne, K.M. U. Mithrananda)

Thermoplastic Natural Rubber Blends

Polypropylene/Natural Rubber Blends

Extensive work carried out in this field revealed that a range of properties could be obtained by adjusting the ratio of NR to PP in the TPNR blends. NR rich, flexible soft grades of TPNR were found to be suitable in the manufacture of shoe soles, flexible tubing etc. while those containing higher proportions of PP in the blend were found to be suitable for applications where high impact properties are important. NR : PP 70 : 30 blend is being prepared at S-lon factory using twin screw extruder mixer at temperature above 180.c. Miscibility of PP with NR in this case was very effective than that of blends prepared in single screw pellatising machines. However some problems were encountered in the pellatising stage mainly due to the fact that the machine is not properly designed to cut such soft grades. Crushed samples of this material were supplied to Bata Shoe Co Ltd for making injection moulded shoe soles.

Use of oil extended, granulated NR is much superior to that of unextended grades of NR in the manufacture of TPNR because of the improved processability of OENR. 50 kg of OENR is being prepared at Dartonfield using petroleum jelly and trials are yet to be carried out.

Hard grades of TPNR were successfully prepared at Nawaloka Polysacks Ltd. Waste PP (in flake form) was tried out with granulated NR (NR : PP 20 : 80) with a view to make a cheaper grade of TPNR. Outcome of this exercise was attractive since the raw material cost can be cut down by almost 50% by using virgin PP.

(W.M.G. Seneviratne and H.N.K.K. Chandralal)

Rubber incorporated polystyrene and polymethyl methacrylate

Rubber incorporated to therm plastic material in the polymerisation stage of the respective monomer is in general regarded as the way of making high impact grades of thermoplastics, other than the dry blending. Extensive work carried out at the University of Sussex and also few trials at the RRISL showed that such grades can be easily produced commercially in Sri Lanka in suitably controlled polymerisation reactors. This will be of great economic importance to our country if this goes into commercial implementation as high impact grades are in high demand in most plastic applications.

(W.M.G. Seneviratne)

Rubber covered rollers

The main function of rubber covered rollers is to remove liquid from materials during processing, for example alkali or water from wool, water from wood pulp, dyeing solutions from yarns or fabrics, chemical solutions and water from sheet or strip metal and also during cleaning and washing of hides. In addition they find applications in the removal of stones from fruits, dehusking rice and in applying printing inks to paper etc. Such rollers may vary in hardness (IRHD) from 20 to 100 and from 0.3 to 5 m or more in length and 2 mm to 1 m in diameter.

Three experimental rollers were made at the RRI with special improved formulations at the request of Veyangoda textile mills and these are now examined for their performance under various conditions which they should withstand. Observations have to be made over a reasonable period of time before the final implementation.

Rubberised rollers are widely used in dehusking of rice in Sri Lanka and almost all of them are imported from abroad. Few experimental rollers were made here and tried out and found to be superior in quality to that of some imported rollers. Some trials are being carried out with the assistance of Hirani Industries Ltd.

(W.M.G. Seneviratne, H.N.K.K. Chandralal)

Improvement of colour of latex crepe

The colour of latex crepe can be improved by avoiding bleaching with thiol derivatives altogether. Optical brighteners can be used as alternative chemicals to brighten the colour of latex crepe. The effect of brighteners can be improved by other additives which have a complementary effect. Plans are afoot to patent this process.

(W.M.G. Seneviratne, L. Karunanayake, K.M.U. Mithrananda)

Industrial extension

Rubber Technology and Development Department assisted the following industries for product development and testing during the year 1990.

Jaipur Footwear programme	— low temperature vulcanising compound
State Engineering Corporation	— Compounded nitrile rubber
Ceyesta Co Ltd	— Quality improvements of coir mattresses
Messrs Jinasena Ltd	— Rubber diaphragms and generator mounts
Messrs Abdul Jabbar and Co Ltd	— O ring seals
Messrs Ansell Lanka Ltd	— Testing of gloves
Mr Chandra Gunasinghe	— Resting pads for table legs
Various individual small industrialists	— rubberised coir, castings, carpet backing, mud flaps etc.

REVIEW OF THE POLYMER CHEMISTRY DEPARTMENT

By

K. G. KARNIKA DE SILVA & S.A.F. PUSHPA SIRIMANNE

Work on commercial implementation of the Thermoplastic Natural Rubber (TPNR) was continued. Preliminary discussions were held with the interested parties regarding commercial scale manufacture of TPNR coagulating pans, tapping cups etc. There has been an increasing demand for the TPNR latex collecting cups from JEDB and SPC during this year as the experimental trials carried out with TPNR cups in the field have shown significant increase in collection of good quality latex while decreasing the amount of scrap.

A soluble form of cyclised rubber was successfully prepared from NR latex. This will be a better substitute for the imported, costly resins used by the paint industry. Several paint manufacturers have shown interest in this new product.

A sample of a new heat resistant rubber has been sent to Weber & Schear in West Germany on a request. Attempts have been made to reduce the cost of manufacture of heat resistant rubber and as a solution the earlier used tellurium compounds have been replaced by cheaper materials. The problem of discolouration on storage has also been overcome by using this new material. Weber & Schear has reported that the resistance of this rubber as superior when blended with DPNR and have suggested us to carry out a complete comparison study with the currently existing product from Malaysia and our product.

Large batches of MG 30 and MG 49 have been prepared by using our patented method and dispatched to an overseas buyer by C.W. Mackies, Horana. They know how of these experiments and the technical assistance to use the available facilities for the manufacture of these semi-commercial scale batches were provided by the Polymer Chemistry Department.

An improved can sealant was developed for Silver Rays Industries Ltd and supplied in semi-commercial batches, to seal galvanised tin cans. The natural rubber based sealant has found to give similar or better properties when compared with the earlier used expensive, synthetic rubber based material imported from Germany.

The method of preparation of low Po rubber has been perfected so as to get the necessary properties required for the modification reaction of NR latex. C. W. Mackies have shown interest in carrying and large scale production of low Po rubber for export.

DETAILED REVIEW

Staff

Dr K.G.Karnika de Silva in on her sabbatical leave in Canada since July 1990, She is attached to the Department of Chemical Engineering in the McMaster University, Canada.

Dr Pushpa Sirimanne and Mr S.M.C.E. Silva Asst. Rubber Chemist were on duty throughout the year.

Experimental Officers Mr H.N.K.K. Chandralal and Mrs Manel Nilaweera were on duty throughout the year.

Mrs Indra Denawaka, Senior Technical Officer, Mrs Chitra Kuruppu, Technical Officer and Mrs Lakshmi Dissanayake Technical Officer were on duty throughout the year.

Mrs Ranjini Bogahawatte Technical Officer was given one year no-pay leave with effect from November 1990 to undertake special training in laboratory techniques.

Mr Nihal Wickramasinghe Technical Officer resigned from his post in January 1990.

Mrs Renuka Wijyaratne Typist Clerk was on duty throughout the year.

Messers Sunil Weerasiri, P.G. Sigera, Laboratory Attendants were on duty throughout the year.

Meetings and Lecturers

Dr Karnika de Silva conducted lectures on Industrial Polymers for the Diploma in Rubber Technology course organised by PRI.

Dr Karnika de Silva and Dr Pushpa Sirimanne participated in several seminars including a seminar on centrifuged latex manufacture.

H.N.K.K. Chandralal participated in several committee meetings on Radiation Vulcanisation.

LABORATORY INVESTIGATIONS AND INDUSTRIAL EXTENSIONS

Thermoplastic Natural Rubber (TPNR)

Latex collecting pans made out of TPNR were tested for their acid resistance, impact strength and tensile strength. They were found to be satisfactory.

Samples of soft blends of PP/NR (60 : 40) were tested for the suitability in shoe soles. Initial attempts have been made to compression mould TPNR soft blends using the available laboratory facilities. Hard blends of TPNR could be processed using only injection moulding techniques where as soft blends could be found in ordinary rubber processing equipment.

Flow properties of PP/NR (80 : 20) blend cured with SP 1045 resin have been studied. It has been found that the processing of PP/NR blends would require less power consumption than that of virgin materials.

Test pieces of the same blend were injection moulded in order to test the properties such as impact strength, hardness and tensile strength.

TPNR latex collecting cups were supplied to some JEDB and SPC plantations. From the initial trials carried out at Elston estates it has been observed that the yield of latex can be increased by about 20% whereas the % scrap can be decreased by about 65% when the coconut shells were replaced by TPNR cups. When the durability is concerned the use of ordinary plastics cups were found to be unsatisfactory for the purpose.

(K.G. Karnika de Silva, Pushpa Sirimanne, H.N.K.K. Chandralal and S.M.C.E. Silva)

MG Rubber

Semi commercial scale batches of MG 30 and MG 49 rubber have been prepared at C.W. Mackies Horana Complex by using available facilities. Large scale trials were not attempted earlier without a proper reactor having cooling facilities because of the exothermic nature of the grafting reactions of monomers on to natural rubber using free radical initiators. The technical know how and assistance for this manufacture have been provided by our officers.

The rubber prepared has been dispatched to an overseas buyer by C.W. Mackies Ltd. (K.G. Karnika de Silva, Chitra Kuruppu & Lakshmi Dissanayake)

Initial studies on a computer model development for the grafting reaction of unsaturated monomers on to natural rubber have been initiated at McMaster University in Canada. This development is important in studying the details of the kinetics of these reactions and in designing a pilot in which the manufacturing of the grafted rubber is carried out in commercial scale.

(K.G. Karnika de Silva and A.E. Hamilelec)

Cyclised Rubber (CR)

Attempts have been made to prepare cyclised rubber from positex, low nitrogen latex and depolymerised latex using 98% H₂ SO₄ as the cyclising agent. The products obtained from these three latices were white fine powders which were fairly soluble in petroleum solvents with further improvements in the properties of latex type it was possible

to obtain an almost 100% soluble product. Softening point and glass transition temperatures were determined by Differential Thermal Analysis (DTA). It has been observed that the CR has a high softening point (about 200°C) and high glass transition temperature (about 90°C) due to high degree of cyclisation. The degree of cyclisation was determined by IR, NMR and by iodine value. Further experiments are in progress to determine the properties of CR. The rate of cyclisation was studied with the reaction time, type of latex etc. There is a marked influence by the non rubber substance on the efficiency of cyclisation.

Cyclised rubber can be used in paints, printing inks and as a reinforcing filler in applications where light coloured hard materials are required. Cyclised rubber has shown to have a very high demand recently as most of the imported synthetic substitutes are costly.

(Pushpa Sirimanne, S.M.C.E. Silva, K.G. Karnika de Silva, Indra Denawaka, Lakshmi Dissanayake)

Heat resistant rubbers

The samples of heat resistant rubbers prepared earlier by using tellurium compounds have shown some discolouration on storage. This problem was solved by removing the excess tellurium compounds after the prevulcanisation reaction is completed.

It was also attempted to use less expensive and non toxic materials in the manufacture of heat resistant rubber by replacing tellurium compounds with a new material. A sample of the new material has been tested at Weber & Schaer laboratories in West Germany and the results seem to be very encouraging. A second sample has also been dispatched to them on request.

Further testing of the material is in progress.

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

Can sealant

Semi commercial scale batches of the newly developed can sealant has been supplied to Silver Rays Industries Ltd to seal galvanised tin cans and the earlier used imported, synthetic material has been replaced completely by the material developed by us. Further applications of this can sealant are under consideration.

Initial steps have been taken to file a patent on this product.

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

Positex

Attempts have been made to study the effect of concentration of the cationic soaps which was used to prepare positex on the prevulcanisation. A vulcanisation recipe was developed for this process. Creaming seems to be quite predominant in maturation of

positex. Therefore a set of cationic soaps namely tetradenyl trimethyl ammonium bromide and cetyltrimethyl ammonium bromide which are different only by the number of carbon atoms in the alkyl chain were tried out. Samples were prepared with concentration of the soaps from 0.5% - 0.2% and left for 3 - 4 weeks. It has been observed that latex of about 60% total solid can be obtained by this method.

Further work is in progress to see the possibilities of using this product in the manufacture of household gloves.

(Pushpa Sirimanne, K. G. Karnika de Silva, Manel Nilaweera and Lakshmi Dissanayake)

Glove coating

Several samples containing MG latex prevulcanised latex, positex and blends of various types of latices have been tested to coat cotton gloves. These trials were carried out on a request made by the Chemanex, Ratmalana for one of their Korean buyers.

The samples containing MG latex have shown satisfactory results.

Further work on this study is in progress.

(K.G. Karnika de Silva, S.M.C.E. Silva & H.N.K.K. Chandrajai)

Epoxidised Natural Rubber (ENR)

The work on epoxidation of natural rubber latex was reinitiated. Attempts were made to epoxidise positex using performic acid. A set of experiments were carried out to find out a suitable latex type, concentration of the stabilising soap and the correct temperature at which the ring opening is minimised. Samples were analysed by NMR and IR spectroscopy. 15% ENR was prepared by using peracids as the reagent. The reaction was maintained at room temperature.

Further developments are in progress.

(Pushpa Sirimanne and Chithra Kuruppu)

Low Po Rubber

Ageing properties and gel content of the low Po rubber have been studied. Different antioxidants were tested for the efficiency in preventing possible crosslinking via free radicals present in the molecules. It has been found that the antioxidant plays a significant role during storage of latex and rubber after depolymerisation.

Low Po latex was used in the preparation of carbon black master batches and in modification reaction of NR latex.

(S.M.C.E. Silva, K.G. Karnika de Silva and Pushpa Sirimanne)

REVIEW OF THE RAW RUBBER & CHEMICAL ANALYSIS DEPARTMENT

By

L. M. K. TILLEKERATNE

SUMMARY

The Raw Rubber & Chemical Analysis Department has been engaged in the following duties during this 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 method of manufacturing of sole crepe and latex crepe rubber.
- (e) Conducting research on developing substitutes for chemicals used in the Rubber Industry based on locally available raw materials.

Experiments and surveys carried out to check the quality of Sri Lankan dry rubber field latex and centrifuged latex for export and for the manufacture of finished product, was one of the main projects of this department during this year.

It was possible to prove that local concentrated latex is even better than concentrated latex produced in other Asian countries. It was observed that some field latex samples contain Mg ions upto 200 ppm. But, the Mg level in Sri Lanka centrifuged latex on the average is below the Mg levels in latex from other Asian origins. Analysis of harmful metal ion levels in raw rubber produced in Sri Lanka, was shown to be below the internationally acceptable levels and hence Sri Lanka raw rubber is a very safe raw material to be used in making any rubber based products.

It has been possible to make a castor oil based soap, capable of improving the mechanical stability time of latex better than the lauric acid soap used at the moment.

A water sealing adhesive sealant for skirt type polythene rainguards was developed using a rubber and bitumen mixture. The new sealant undergoes partial vulcanisation

during use in the field thereby forming a gum which expands with the girth of the tree. It does not crack even during cold weather. Large scale trials of this new rainguard have shown very good performance.

Another important contribution made during this year was the introduction of improved method of manufacturing latex crepe and sole crepe rubber by aeration. In this new method, the removal of fraction takes very little time whereas in the conventional method, the fraction removal consumes lot of time.

DETAILED REVIEW

Staff

Dr. L.M.K. Tillekeratne Head, Raw Rubber and Chemical Analysis Department, was promoted to the post of Director, RRI. The Director attended the IRRDB meeting held in Cunming, China.

Mr. L. Karunanayake, Asst. Specifications Officer was on duty throughout the year. Mr. A.S. Dekumpitiya, Experimental Officer was on duty throughout the year, too. Mrs. S. Weeraman, Senior Technical Officer, resumed duties in March, 1990 after successfully completing a course on Rubber Technology, Quality Assurance, Chemical Analysis and Physical Testing at RAPRA Technology Ltd., UK. Mr. P.H. Sarath Kumara, Mrs. N. A. Baduge, Mrs. V. Gamage, Mrs. L. Wanigathunga and Miss C.S. Gallage, Technical Officers were on duty throughout the year. Mr. W.A.S. Wijesekera, Specifications Assistant (Special Grade) Messrs G. Wanigathunga, N. Karunathilake, K.K. Austin, B. Gunasiri, W. Nandasena and P.L. Perera, Specifications Assistants were on duty throughout the year. Mr. G.P. Lelwala, Instrument Technician was on duty throughout the year.

Publications

Tillekeratne, L.M.K., Derouet, D., and Brosse, J.C. (1990) Fixation of Methacrylic acid on to the ELNR, *J. nat Rubb. Res.*, 5. (4), 296-300.

Committees

Dr. L.M.K. Tillekeratne attended examiners committee meetings of NIPM. Mr. L. Karunanayake served as a member of the committee appointed by the Ministry of Plantation Industries to investigate the representations made against the Mawanella Natural Rubber Complex.

Training

Dr. L.M.K. Tillekeratne and Mr. L. Karunanayake delivered lectures to the trainee planters from SLSPC and JEDB sitting for the Diploma course organised by the NIPM. Mr. L. Karunanayake delivered lectures to the training programme organised by the Rubber Technology and Development Department for the low income group investors.

LABORATORY INVESTIGATIONS AND FIELD EXPERIMENTS

DRC Determination of Latex

In order to eliminate the problem of under estimation of the DRC of small holders latex by the factories and latex collecting centres by using various ready reckoner charts, a project was started to standardise the metrolac ready reckoner chart in collaboration with Sri Lanka Standards Institute.

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

Analysis of Harmful metal ions in NR

Following complaints received from the buyers of Sri Lanka rubbers, this project was initiated to detect the Iron(Fe), copper(Cu) and Manganese(Mn) contents in Sri Lanka rubbers. Results of this project indicated that the Fe, Mn & Cu contents in Sri Lanka rubbers are well within the internationally acceptable levels. Experiments are under way to study levels of Cu, Fe, Mn & Co ions present in all grades of rubber produced in Sri Lanka.

(L.M.K. Tillekeratne, L. Karunanayake, A.S. Dekumpitiya & L. Wanigatunga).

Magnesium levels in NR latex

Following complaints made against Sri Lanka latex, an investigation was carried out to probe Mg levels in centrifuged latex and field latex. It was observed that certain field latex samples contain Mg ions upto 200 ppm. But, the Mg levels in latex, on average, is below the Mg levels in latex from other origins. In some samples of latex Mg levels were found to be zero because of the addition of high dosage of DAHP. Based on our recommendations centrifuged latex factories have already reduced or completely eliminated the DAHP dosage.

A study was started to detect the variation of Mg levels in field latex samples collected from different rubber growing areas of the country.

(L.M.K. Tillekeratne, L. Karunanayake & W.W. Nandasena).

Sealant for skirt type rainguards

A water sealing adhesive sealant for skirt type polythene rainguard was developed using a rubber and bitumen mixture. The new sealant undergoes partial vulcanisation during use in the field thereby forming a gum which expands with the girth of the tree. It does not crack even during cold weather. Large scale trials of this new rainguard have shown very good performance in Kalutara District and Kegalle District. In collaboration with Statcon block rubber factory, large scale production of the adhesive commenced to supply the requirements of SLSPC Awissawella region.

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

Effect of defoliation during wintering on the quality of latex

In collaboration with the Colombo University this project was restarted to study the anomalous change taking place in the latex just before wintering. Number of samples from various clones were collected at different stages of wintering of the tree such as.

- (a) When the leaves are green prior to wintering.
- (b) When the leaves are yellow just before defoliation.
- (c) After complete defoliation.
- (d) When the tender leaves appear again.

The serum was separated from those samples by centrifuging and freezing in a deep freezer. Samples were analysed to separate amino acids by using TLC methods. Butanol acetic acid - H₂O mixture was used as the solvent. It was observed that when the polarity of solvent increases, separation was faster. Samples will be analysed by using electrophoresis techniques.

(L.M.K. Tillekeratne, L. Karunanayake, T. Warnakula & B.P. Weeraratne).

Improved method of manufacturing latex crepe and sole crepe rubber by aeration

In collaboration with C.W. Mackie & Co. Ltd., this project was started to improve the hardness of sole crepe while lowering the cost of production. In this new method removal of fraction is based on the principle of coagulation of the unstable non rubber constituents using a stream of air.

This method of fractionation has several advantages over the normal method of stirring to remove the fraction.

- (1) Saving on over time payments for fractionation.
- (2) Able to control the percentage of fraction removal more accurately.
- (3) Improve the colour of crepe because the real fraction is removed.
- (4) Hardness of the final product is 8 units higher than the hardness of ordinary crepe.
- (5) Excepted to reduce the pollution problem.
- (6) There is an uniformity in aeration of latex in the tank thereby removing the fraction from the whole bulk. This is the reason for the improved colour of the end product.
- (7) No additional chemicals used.

Application of latex, carbon black mixture on cadjans to improve the durability of cadjans

This project was started to improve the life time and the water sealing properties of cadjans. The latex and carbon black mixture used in this process was prepared to vulcanize by sunlight. Hence this mixture can be applied directly on cadjans roof by spraying. This new method may be useful specially in coastal areas where the life time of the cadjan roof is very short.

(L.M.K. Tillekeratne, H.S. Weeraman, L. Karunanayake & A.S. Dekumpitiya.)

Inspection visits

Inspection visits were made to almost all TSR factories in production at least once a quarter. Few special visits were made to some of the TSR factories to calibrate their testing equipments. Visits were also made to Dartonfield, Mawanella, RRI Kuruwita substation, C.W. Mackie & Co. Ltd., Horana, Warakapola and Atale estate, Kotiya-Kumbura for experimental purposes. Inspection of sole crepe packed in corrugated cardboard boxes was also carried out during this year.

Misellaneous

Table 1. *Number of samples tested from each TSR factory during 1990.*

Code	Producer	No. of Samples
AD	Statcon Block Rubber Factory, Getahetta	155
AF	Ceymac Block, Rubber Factory, Horana	8323
AE	Shermans Block Rubber Factory, Ingiriya	1419
AI	Associate Traders Ltd., Colombo 13	52

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

Rubber samples	1624
Latex samples	249
Chemicals	44
Water	19
Soil samples	3
Polythene samples	8
Fertilizer samples	6
Carbon Black master batch	272
Total	<hr/> 2225 <hr/>

REVIEW OF THE RAW RUBBER PROCESSING AND CHEMICAL ENGINEERING DEPARTMENT

By

S. W. KARUNARATNE

SUMMARY

The main area of research in this department has been the treatment of effluents from latex concentrate and raw rubber factories to reduce the pollutant levels to acceptable standards. An effluent treatment system similar to a ponding system was tested at Dartonfield. Both batch and continuous flow methods were tried out and it was found that the pollutant level of the effluents after treatment can be brought down to acceptable standards by adopting a continuous flow method. The initial COD and pH also has a role to play. The level of dissolved oxygen in the aeration pond is also a significant factor in this operation.

Raw rubber and factory development, drying and energy management continued to form an integral part of the activities of the department.

DETAILED REVIEW

Staff

Dr. E. D. I. H. Perera, Rubber Chemist, overlooked the activities of the Department throughout the year. He resigned from office at the end of the year.

Two cadre vacancies available for Research Officer/Research Assistant were not filled during the year. Experimental Officer, Mr. S.L. Weerasinghe and Technical Officers Messrs S. Siriwardena, C. Senanayake, Miss, Chintha Jayawardena and Miss. C.K. Nalini were on duty throughout the year. The department functioned with a depleted staff.

Reports

At the request of a prospective buyer a valuation and condition report for Srikandura Rubber factory manufacturing scrap crepe rubber was prepared and submitted by Dr. E.D.I.H. Perera.

Meetings/Seminars/Training Programmes

Dr. E.D.I.H. Perera attended the following meetings/seminars :—

Regional Scientific Committee Meeting – Awissawella.

Rubber Council meeting.

Two meetings on the implementation of Environmental Licensing procedure - organised by the Central Environmental Authority (CEA).

SAARC seminar on biomass gassification at NERD Centre - Ekala.

Colombo Rubber Traders Association Committee meeting.

Seminar on centrifuge latex at Institute of Engineers.

NIPM examiners' meeting - Fourth Rubber Manufacturers Examination.

Meeting on Laboratory Infrastructure Development for pollution control organised by Ministry of Environment and Parliamentary Affairs.

Dr. E.D.I.H. Perera conducted a seminar on the Research activities in the Raw Rubber Process Development and Chemical Engineering Department.

Dr. E.D.I.H. Perera organised a seminar for the Rubber Factory Officers attached to the SRMC. The lectures were delivered by Dr. E.D.I.H. Perera and Mr. S.L. Weerasinghe.

Dr. E.D.I.H. Perera attended two field day activities at Dartonfield organised by R.R.I. for Superintendents and Assistant Superintendents.

Dr. E.D.I.H. Perera served as a member of the panel of examiners in Rubber Manufacture Examination organised by the N.I.P.M.

Dr. E.D.I.H. Perera and Mr. S.L. Weerasinghe delivered a series of lectures for the participants of the 4th Rubber Manufacture Examination organised by the N.I.P.M.

Dr. E.D.I.H. Perera conducted a lecture on manufacture of rubber at factory officers seminar in the Awissawella Region.

FIELD AND LABORATORY INVESTIGATIONS

Drying tower efficiency

In many instances reduction in drying tower efficiency was traced to overloading of the drying chambers.

An electronic combustion analyser was used to check the efficiency of the boilers fixed to drying towers.

Surface of the radiator should be cleaned periodically to remove accumulated dirt, rubber etc. to facilitate efficient heat transfer.

Detailed studies on drying tower efficiencies were conducted in Lollupitiya, Kiriporuwa, Nakiyadeniya and Atale factories. (E.D.I.H. Perera and S. Weerasinghe).

Purchasing criteria of field grades for the production of brown crepe

During milling of field coagula consisting mainly of cup lumps and tree laces there is a considerable difference in weight between the field grades and the brown crepe which is produced from it. This difference can vary from 15% to 50% or even more.

The wastage factor as it is referred to is due to the loss of moisture and other impurities in the field grade material, mainly bark shavings and sand.

During sorting most of these impurities can be physically separated. Estate field coagulum as opposed to dealers field coagulum grades is generally cleaner. The moisture content will depend on the extent of drying involved.

A purchaser of field grades who wishes to buy relatively dry material would find the tree laces contain less water than cup lumps. The cup lumps even though the surface appearance may look dry would contain a fairly large quantity of moisture retained inside the lump and the quantity of moisture will depend on the size of the lump. If pre-coagulated lumps of field coagulum is also present then the moisture content will be even higher.

A 50/50 mixture of cup lumps and tree laces however dry it may look will contain about 20% moisture and the moisture content will increase with the increase in the amount of cup lumps in the mixture.

Any agreement regarding the purchase of field grades should take into consideration.

- (a) The moisture level of the field grade material dealt with.
- (b) The cleanliness of the field grade material, acknowledging the fact that there is a marked difference between the cleanliness of estate field grades and dealers field grades, estate field grades being much cleaner.

It must also be noted that drying of field grade material prior to milling will downgrade the rubber on colour and over drying can cause tackiness.

Taking everything into consideration a minimum wastage factor of 25% is a fair consideration in the calculation of costs. (S.W. Karunaratne and E.D.I.H. Perera).

Crepe rubber to suit end user requirements

Properties of different types of blanket crepes are given in Table 1.

Table 1. Properties of different types of blanket crepes

Rubber	Ash %	Nitrogen %	Acetone extract	P ₀	PRI	Mooney viscosity	Colour units	Gel content %	solution viscosity sec
FB	0.16	0.25	1.6	40	55	72	1.0	0.0	85
UFB	0.22	0.35	2.5	45	65	76	1.5	2.0	95
YF	0.32	0.50	3.9	55	78	70	3.5	17.3	140
FB ^a	—	—	—	45	65	—	1.0	—	—
UFB ^a	—	—	—	51	74	—	1.0	—	—
FUB	0.16	0.25	1.6	45	60	73	1.0	0.8	88
UFUB ^a	0.22	0.35	2.5	50	70	75	1.5	9.5	100

a. coagulated with oxalic acid.

UFUB — Unfractionated unbleached.

UFB — Unfractionated bleached.

FUB — Fractionated unbleached.

FB — Fractionated bleached.

YF — Yellow fraction.

Pale crepe can be prepared in a number of ways. Removal of a first fraction prior to coagulation gives a rubber with a low gel content which is ideal for the manufacture of adhesive. Fractionation with or without bleaching, using chemical bleaching agents, is resorted to give a very light coloured crepe suitable for the manufacture of bright coloured products. pharmaceutical and food grade crepe rubber is the cleanest grade and it need not necessarily be extremely light in colour.

Ebonite is used as a chemical lining in tanks and other utensils. An ebonite with a high softening point was obtained using Low Nitrogen Natural Rubber (LNNR) as the base material for ebonite manufacture. (E.D.I.H. Perera, Chintha Jayawardena and C.K. Nalini).

Advisory visits to crepe, R.S.S. and centrifuge factories

The following factories were visited during the year and advised on ways to overcome problems encountered in manufacture and reports were submitted.

Sole crepe, pale crepe and brown crepe :-

- (1) Raigama State Plantation.
- (2) Parambe Estate.
- (3) Talagaswela State Plantation.
- (4) Arapolakanda State Plantation.
- (5) Vc gan State Plantation.
- (6) Silverdale factory.
- (7) Millawa State Plantation.
- (8) Kiriporuwa Estate.
- (9) Muwankanda Estate.
- (10) Edurapola Estate.
- (11) Atale Estate.
- (12) Nakiyadeniya State Plantation.
- (13) Panawatte Estate.
- (14) Dewalakanda Estate.
- (15) Mahaoya Estate.
- (16) Halpe Estate.
- (17) Waharaka SRMC factory.
- (18) Baduraliya SRMC factory.
- (19) Kuruwita RRMC factory.
- (20) Damgampola Rubber Mills.
- (21) Wellandura State Plantation.
- (22) Godagampola Rubber Mills.
- (23) Peenkanda State Plantation.

R.S.S. :-

- (1) Niriella State Plantation.
- (2) Yatawatte State Plantation.
- (3) Bibile Estate.

Centrifuged latex :

- (1) Glenross rubber factory.
- (2) Lak latex centrifuge Ltd.
- (3) Hewij Rubber factory.
- (4) Vincit Estate.
- (5) Dipped Products Ltd.

(E.D.I.H. Perera, S. Weerasinghe, S. Siriwardena, C. Senanayake).

Factory subsidy visits

The following factories were visited during the year for inspection of items, prior to subsidy payments. Reports were submitted to the Rubber Controller with the recommendations.

- (1) Edna plantation.
- (2) Harwella Rubber factory.
- (3) Hewij Rubber factory.
- (4) Dipped Products Ltd.
- (5) Glenross Rubber factory.
- (6) Lak Latex centrifuge (Pvt.) Ltd.
- (7) Associated Traders Ltd.
- (8) Piliyandala Rubber Products.
- (9) Millagahawatte Estate.
- (10) Ranatunga Rubber Mills.
- (11) Block Rubber Factory - Mawanella.
- (12) C. W. Mackie Ltd., Horana.
- (13) Middalenamullahena Estate.

(E.D.I.H. Perera, S. Weerasinghe, S. Siriwardena and C. Senanayake).

Effluent treatment and disposal

A rubber effluent treatment plant was installed at Dartonfield for evaluation.

The plant consists of a set of rectangular sedimentation tanks having a total capacity of approximately 48 m³, a circular aeration and oxidation pond with a capacity of approximately 16 m³, a sand filter and a froth extractor. The civil construction work of the plant was done by the RRI and the aerator unit and froth extraction unit was supplied by Industrial Engineers. SANRA vacuum water circulating aerator used in the oxidation pond is an electric motor driven vacuum aerator.

OPERATIONAL PROCEDURE

The capacities of the tanks have been designed in such a way that the sedimentation tanks can hold effluent of three days and the aerator tank can hold effluent produced in one day. The sedimentation tank has been partitioned into 9 equal compartments and hence one row of 3 compartments can hold each days effluent. The compartments are

inter-connected through PVC pipes so that effluent can overflow from one compartment to the next one and finally from the 9th compartment to the aeration tank. This means that effluent has a hydraulic retention time of 3 days in the sedimentation tank and one day in the aeration tank.

In deciding the tank capacities only serum water and wash water from the process of maceration have been considered as the effluent to be treated. A separate drainage line has been laid down to carry the serum and wash water from the factory to the treatment plant.

Test Procedure

In order to obtain pollutant levels of effluent, basically the following chemical parameters were measured using standard test methods. (Table 2).

Table 2. *Basic tests for rubber effluents*

Property	Test Method	Reference
BOD	Permanganate - Sodium azide Modification of the Winkler Method.	1, 2
COD	Dichromate Reflux Method.	1, 2
pH	Electrode Method.	1, 2
Total Solids	Evaporation.	
Suspended solids.	Glass fibre filtration and Evaporation.	1, 2

- Ref. 1. Standard Methods for the Examination of water and waste water published by American Health Association, American Water Works Association and Water Pollution Control Federation, 15th Edition.
2. Manual and Lab Methods for chemical analysis of rubber effluent, R.R.I.M.

Effluent samples were withdrawn on the first day and after 3 days from the sedimentation tanks and were tested for pH, COD and BOD. After effluent was transferred into the aeration tank, samples were withdrawn for testing at every 2 hour intervals during the first 24 hours of aeration and less frequently afterwards.

Test Results

Plant Performance :

Four experimental trials were carried out on the effluent treatment plant and Table 3 summarises the results obtained during aeration.

Table 3. *Average values of COD and BOD of effluent before and after aeration*

Trials No.	COD		BOD		pH	
	Initial	After 24 hrs.	Initial	After 24 hrs.	Initial	After 24 hrs.
1	9090	2000	—	—	5.3	6.9
2	3200	1200	1092	832	6.5	7.5
3	3952	1600	2713	1188	5.3	5.9
4	2360	1680	1700	1175	5.6	6.5

Table 4. *Tolerance limits for effluents from rubber factories discharged into inland surface Waters*

No.	Determinant	Tolerance Limit	
		Type I Factories*	Type II Factories**
1.	pH value at ambient temperature	6.5 to 8.5	6.5 to 8.5
2.	Total suspended solids, mg/l, max.	100	100
3.	Total solids mg/l, max.	1500	1000
4.	Biochemical Oxygen Demand (BOD ₅) in 5 days at 20°C, mg/l, max.	60	50
5.	Chemical Oxygen Demand (COD) mg/l, max.	400	400
6.	Total Nitrogen, mg/l, max.	300	60
7.	Ammonical Nitrogen, mg/l, max.	300	40
8.	Sulfides, mg/l, max.	2.0	2.0

* Type I factories – Latex Concentrate.

** Type II factories – TSR : Crepe Rubber and Ribbed Smoked Sheets.

It was observed that during the first 3 days in the sedimentation tank there was only about 10% reduction in pollutant levels particularly the COD. A slight increase in pH was also observed in the sedimentation tanks.

When COD and BOD levels after 24 hours of aeration are compared with the tolerance limits for effluent from rubber factories, it can be seen that both COD and BOD levels are much higher than the maximum allowable limits.

It was also observed that COD and BOD levels of filtered effluent (through the sand filter), after 24 hours of aeration have not changed significantly. The filtration rate through the sand filter was observed to be significantly reduced, possibly due to clogging.

It was also noted that the COD levels of the effluent did not come down significantly even after 5 days of aeration followed by filtration through the sand filter.

Electricity Consumption

The electricity consumption of the aerator unit was found to be approximately 1 kwhr.

After first set of trials, a simple modification to the aerator unit was done in order to increase the air flow rate. This modification has enabled to approximately double the quantity of air injected.

With increased air flow three further trials were carried out following the same procedure. The results obtained are summarised in Table 5.

Table 5. Average values of COD of effluent before and after treatment

Trial No.	Initial pH	B COD				
		Initial	After 24 hrs. % red	After 48 hrs.	After 72 hrs.	
1	5.43	3880	3600	7.2	2800	—
2	5.20	1960	1400	28.6	1160	760
3	7.28	2700	2240	17.0	1440	1320

Above results indicate that even with increased airflow, there is no significant reduction in pollutant levels, if the initial COD is too high. However, if the initial COD level is maintained around 2000 there is a considerable decrease in pollutant levels with increased air flow. Further, it is evident that by adjusting the pH to about 7 and maintaining the initial COD level around 2000 before aeration, it is possible to bring the pollutant levels down at a much faster rate.

It was later found that the continuous feeding operation is more effective in reducing pollutant levels than the batch type operation. The results of preliminary continuous feeding trials are given in table 6(a) and (b) at two different flow-rates.

Table 6. Average values of COD of influent and effluent of the aerator tank
(a) At flow-rate of 5 litres/min.

Date	pH		Influent	COD mg/l	
	Influent	Effluent		before	after (4 hrs.)
24.09.90	5.39	8.05	6840	240	80
25.09.90	5.27	7.92	7000	360	80
26.09.90	5.25	7.84	6760	160	—

(b) At a flow-rate of 10 litre/min.

Date	pH		Influent	COD	
	Influent	Effluent		Effluent before settling	After settling (4 hrs.)
26.09.90	5.29	7.75	6880	1080	440
27.09.90	5.26	7.46	7320	3360	1160
28.09.90	5.27	7.33	6220	2240	2080

The above results indicate that the pollutant levels can be reduced to tolerable limits particularly at the influent flow-rate of 5 litres/min. It should be noted that prior to sending the influent to the aerator tank the Dissolved Oxygen levels in the aeration tank was increased to about 3 mg/l by continuous aeration. More detailed trials are now being carried out to find out the quantity of effluent that can be treated by this pilot plant.

Our rough calculations (theoretical) shows that the plant would be able to treat at least one fourth of the volume of effluent generated from the Dartonfield factory which manufactures approximately 1,200 kg of rubber per day.

Cost

The approximate total capital cost of a plant designed to treat effluent from a rubber factory producing about 1,000 kg per day would be Rs. 600,000.

Other methods of treatment of effluents

Technologies of other proven methods of rubber effluent treatment such as the ponding system and the oxidation ditch system etc. are available for recommendation for rubber plantations.

The other known method of disposal of rubber effluent is the pretreatment, lifting and distribution down the slopes of mature rubber plantations which are over 15 years old. The long term effects of such treatment on rubber soils in Sri Lanka have to be determined but the fertilizer value of rubber effluents is well known and there are several literature references of work done in Malaysia.

(E.D.I.H. Perera, M.T. Warnakula, S. Siriwardena, Chintha Jayawardena, W.K. C. Nalini).

REVIEW OF THE ADAPTIVE RESEARCH UNIT

By

N. YOGARATNAM

Staff

Dr. N. Yogaratnam, Assistant Director, coordinated the activities of this programme. Messrs F.P.W. Silva, P.P. Jayasinghe and Mr. W.C. Dayaratne joined this Unit as Assistant Development Officers. Other scientists and extension personnel involved in this programme are--

- (a) *Scientists* : Dr. N.E.M. Jayasekera, Head/Genetics & Plant Breeding Department, Dr. (Mrs.) A.C.I. Samaranyake, Head/Plant Science Department, Mrs. Lalani Samarappuli, Agronomist, Mr. Laxman Rodrigo, Research Assistant, Mr. L.S.S. Pathiratne, Assistant Botanist and Mr. Lalith Kariyawasam, Senior Technical Officer.
- (b) *Extension Personnel* : Mr. K. Meegahawatta, Head/Development Division, Advisory Services Department, Mr. P. Samaranyake, RAO, Kalutara, Mr. M.C. Samarasekera, RAO, Galle, Mr. A.J.L. Silva, RAO, Colombo, Mr. A.H. Kuliatne, RAO, Ratnapura, Mr. D.D. Dassanayake, RAO, Kegalle.

Research Programme

Most of the research work carried out at the RRISL was intended towards solving the problems of the estate sector. The experiments were conducted in the State-owned plantations because they were easy to manage and estates were more reliable. However, it has now been realised that most of the RRISL recommendations could not be implemented by the small holders due to various reasons. It has therefore been proposed to commence adaptive research programme on small holder fields in the Kalutara, Galle, Kegalle and Ratnapura regions to evaluate and refine or modify if necessary, the technologies developed at the research station and State-owned plantations to fit better small holder resource and risk situation and to meet their needs, on subjects that are of benefit to them.

The following programmes are being implemented :—

Programme I. Clone Evaluation (Dr. N.E.M. Jayasekera)

- Scope** : This programme evaluates the performance of newly developed vigorously growing and high yielding cultivars under small holder management practices with minimum inputs.
- Treatments** : RRIC 100, 102, 110 and 121 with provision for comparison of
(a) Small holder management practise (SMP).
(b) RRI Recommendation. (RRI)
- Plot size** : 1/3 to 3 acres with no. of plants per plot varying from 150 to 600
- Statistical techniques** : Student 't' test.

Location

KALUTARA RAO REGION

Name & Address of Smallholder	Extent Ac.R.P.	Clone	Treatment
01. G. Sunil, Pahala Millewa, Millewa	1.2.00	RRIC 121	SMP
02. M.A. Gunatilake, Halkolawatta Panagoda	1.1.21	RRIC 121	RRI
03. K.D. Premaratne, Kidelpitiya Kuda Uduwa, Uduwa	1.0.00	RRIC 102	SMP
04. D.T.L. Atapattu, 'Sandagiri', Samaranayake Place, Bandaragama	0.3.10	RRIC 102	RRI
05. C.K.D. Karunaratne, 'Karunawasa', Kuda Uduwa, Uduwa	0.3.35	RRIC 110	SMP
06. L.D. Babynona, Diyakaduwa, Mahagama	0.3.00	RRIC 110	RRI
07. M. Cyril de Silva, Waskaduwwatta, Kahatapitiya, Gonapola Junction.	1.0.00	RRIC 100	RRI
08. P.A.P. Perera, 253, Batadombatuduwa Rd., Alubomulla.	0.3.10	RRIC 100	SMP
09. A.A. Leelawathi, 25, Eduragala, Ingiriya.	2.2.00	RRIC 102	½SHP ½RRI
10. G.D. Balasooriya, Temple Road, Handapangoda.	2.3.00	RRIC 100	½SHP ½RRI
11. A.D. Rangith, 'Samudra', Millewa	3.0.00	RRIC 121	½SHP ½RRI
12. K.G. Gunadasa, Ratiyala, Govinna	2.2.00	RRIC 110	½SHP ½RRI

KEGALLE RAO REGION

Name & Address of Smallholder	Extent Ac.R.P.	Clone	Treatment
01. E.L. Abeywickrema, Halgahahena, Palleanugala, Amithirigala,.	1.0.00	RRIC 121	SMP
02. Mrs. Unambuwa, Thelijjagoda, Undugoda.	1.0.00	RRIC 121	RRI
03. Rev. Soratha, Tholangamuwa Temple, Tholangamuwa.	1.1.01	RRIC 110	SMP
04. Piyadasa Abeywickrema, Gonagala, Ruwanwella.	0.2.11	RRIC 110	RRI
05. H.E. Weeraratne, SPO, Yatapana, Via Kegalle.	1.0.00	RRIC 102	SMP
06. D.A. Piyadasa, Weragoda, Beligala	1.0.00	RRIC 102	RRI
07. H.A.P. Gunatilaka, Udugama, Atale	1.0.00	RRIC 100	SMP
08. M. Baalaya, Weragoda, Beligala, Alubomulla	1.0.00	RRIC 100	RRI
09. T.B. Kumarage, Alawala, Tuntota	2.2.00	RRIC 121	$\frac{1}{2}$ SHP $\frac{1}{2}$ RRI
10. H.H.S. Ranasinghe, 'Sinhagiri', Nawagamuwa, Dewalegama	2.0.00	RRIC 110	$\frac{1}{2}$ SHP $\frac{1}{2}$ RRI
11. M.W.M. Bandaratilake, Mawela, Hingula	2.0.00	RRIC 100	$\frac{1}{2}$ SHP $\frac{1}{2}$ RRI
12. K.B. Kiribanda, Arawpola, Galatura.	2.2.00	RRIC 102	$\frac{1}{2}$ SHP $\frac{1}{2}$ RRI

Programme II. *Intercropping* (Mr. L. Rodrigo & Mr. L.S. Kariyawasam)

Scope : The programme of Intercropping is to assess the feasibility of growing intercrops, in small holder fields with the objective of increasing small holders income during the unproductive period of 6 years from planting.

Treatments : Banana, vegetables, cinnamon and pepper with provision for comparison between small holder management practices (without intercrops) and RRI recommendation.

Plot size : 1 to 3 acres.

Statistical techniques : Student 't' test.

Location

KEGALLE DISTRICT

Name & Address of Smallholder	Extent	Clone	Treatment
01. M.W.M. Bandarathilake, Mawella, Hingula. Tel. 035-6267	2 Ac.	—	Banana & Pepper

GALLE DISTRICT

01. K. Aginona, C/o Premathunga Athukorala, Delpona, Pitigala	1½ Ac.	PB 86	Banana & vegetables.
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RATNAPURA DISTRICT

01. A. Ransonona, 'Sisila', Kuruwita	1 Ac.	RRIC 100	Banana & Pepper
02. R.P. Labuna, Udamatta, Thiranagoda	4 Ac.	RRIC 100 RRIC 102	Banana & Pepper

COLOMBO DISTRICT

01. N.G.K. Perera, Iridapola, Waga	1½ Ac.	—	Banana & Pineapple
02. Somalatha Wettasinghe, 225, 'Jayasiri', Oruwela, Athurugiriya	1½ Ac.	—	Banana & Pineapple

KALUTARA DISTRICT

01. L.D. Davidsingho Alviswatta, Palatota, Kalutara.	1 Ac.	—	Banana
02. A.S.A. Paize, 51/29, Sarikkanmulla, Galle Rd., Moratuwa.	1 Ac.	—	Banana & Pepper

Programme III. Soil & Moisture Conservation Practices (Mrs. L. Samarappuli)

Scope : This programme compares the effectiveness of growing bush/tree legumes such as Tephrosia, Croton, Gliricidia etc. with the current practice of growing creeping legumes on soil and moisture conservation in small holdings.

Treatments :

1. Tephrosia vogelli
2. Croton anagyroides
3. Gliricidia
4. Pueraria phaseoloides.

Plot size : ½ Acre

Location :

KALUTARA RAO RANGE

Name & Address of Smallholder	Extent	Date of Planting & Spacing
01. W. D. Gunaratne 'Somikelum' Warakamulla, Maha Induruwa	1 Ac.	May/June 1990 12' x 20'
02. K. Cyril de Silva, Parameegodawatte, Koholana, Kalutara	1 Ac.	Oct./Nov. 1990 11' x 8'
03. W.M. Tillekeratne, Totagama, Merigold Estate, Bombuwela, Kalutara	1 Ac.	Oct./Nov.
04. U.I. Wickremasinghe, Liarose Estate, Panwila, Kalutara.	1 Ac.	12' x 20'
05. Malini Subasinghe, 'Arundathi', Undugoda, Polgasowita.	1 Ac.	8' x 30'
06. Ranmanike Mangala Himi, Kongoda Buddhist Temple, Remunegoda.	1 Ac.	12' x 20'

KEGALLE RAO RANGE

01. M. Emanis, 187, Dickella, Hettimulla	1 Ac.	12' x 18'
02. Heen Warella Estate, Mawanella	1 Ac.	12' x 18'
03. Wijeratne Banda, Ekiriyagala, Kegalle	1 Ac.	12' x 18'

Programme IV *Tapping Systems* [Dr. (Mrs.) A.C.I. Samaranyake and Mr. L.S.S. Pathiratne]

- Scope** : With the introduction of high yielding clones it has become necessary to adopt tapping systems that are appropriate for a particular clone. This programme evaluates the effectiveness of these systems of tapping under small holder management levels in comparison with the small holder's current practice.
- Treatments** : $\frac{1}{2}$ S d/2, $\frac{1}{2}$ S d/3 and $\frac{1}{2}$ S d/1 with intermittent rest period (small holder practise)
- Plot Size** : 2 to 7 acres, 2 to 4 tapping blocks.
- Statistical techniques** : Student 't' test.
- Location** :

KEGALLE DISTRICT

Name & Address of Smallholder	Extent	Clone	Treatment
01. W. Pathiranadewa, Ganithapura, Warakapola.	2 Ac. 2 tapping blocks	RRIC 100	$\frac{1}{2}$ S d/2 or $\frac{1}{2}$ S d/3, & $\frac{1}{2}$ S d/1 with intermittent rest period. (Small Holder Practice)
02. Mahinda Meedeniya, Meedeniya Walawwa, Ruwanwella.	2 Ac. 2 tapping blocks	RRIC 100	do
03. P.K.B. Basnayake, 'Sisila', Ekiniyagala, Kegalle	2.5 Ac. 2 tapping blocks	RRIC 100	do
04. Mrs. S. Premaratne, Watta Kade, Paragahatenna, Puwakpitiya	4 Ac. 2 tapping blocks	RRIC 100	do
05. K.K. Wijesiri, Cicilia Watta, Hettimulla	2.25 Ac. 2 tapping blocks	RRIC 100	do
06. A. Amarajeewa, Kiriwita, Mahapallegama	2 Ac. 2 tapping blocks	RRIC 100	do
07. S.R.R.B. Senanayake, Udagama, Aranayake.	7 Ac. 4 tapping blocks	RRIC 121	do
08. K.P. Podisingho, Godigamuwa, Moronthota.	2.25 Ac.	RRIC 100	do

RATNAPURA DISTRICT

01. R.A. Piyasena, Napawala, Getahetta.	3 Ac. 2 tapping blocks	RRIC 100	do
02. H.G. Mary, Kaluwandura, Hewainna.	3/4 Ac. 1 tapping block	RRIC 100	do

Programme V. *Use of Yield stimulants* [Dr. (Mrs.) C. Samaranyake and Mr. L.S.S. Pathiratne]

Scope : The use of Yield Stimulants has been known to increase the flow of latex under optimum inputs. The response to yield stimulants under minimum or no inputs in small holdings is being assessed in this programme.

Treatments : Application of Ethrel vs no ethrel.

Plot size : 2 tapping blocks (approximately 250 trees per block)

Statistical techniques : Student 't' test.

Location :

KALUTARA DISTRICT

Name & Address of Smallholder	Extent	Clone	Treatment
01. Y.L. Somisena, Talgaskanda watta, Pahala welgama, Bulathsinhala	2 tapping blocks	PB 86	Ethrel treated & control
02. Shan Wijesekera, Walawwatta Estate, Bulathsinhala.	do	do	do
03. Sarath Gunasekera, Mahahoenatiyangala, Kalutara South	do	do	do
04. R.A. Wijeratne, Wijaya Rubber Mills, Govinna.	do	do	do
05. Wincent Kotalawala, 'Jayamina', Dodangoda.	do	do	do
06. Y.R.S. Piyasena, Holingborune Estate, Welipenna.	do	do	do
07. The Superintendent, Malaboda Estate, Malaboda.	do	do	do
08. P.K. Solaman, Thennahans, Mahagama.	do	do	do
09. S. Edirimanna, Goveinna Estate, Govinna.	do	do	do

KEGALLE DISTRICT

01. D.J. Bandara, 'Ratnagiri Walawwa', Napawala	2 tapping blocks	PB 86	One block treated & other control
02. K.B. Senanayake, Kehelwatta, Watura.	do	do	do
03. The Superintendent, Hinwerella Estate, Mawarella	do	do	do
04. N.P. Padmasiri, Wewila Rd., Wewila, Getahetta.	do	do	do
05. K.B.A. Somaratne, Vidyala Rd., Avissawella.	do	do	do
06. K.S. Fonseka, 48/4, Ward Place, Colombo 7.	do	do	do
07. T.S. Ratnayake, Warakapola	do	do	do
08. T. S. Ratnayake, Warakapola	do	do	do
09. The Superintendent, Ambanpitiya Estate, Galigamuwa.	do	do	do

Programme VI. *Use of Rainguards* [Dr. (Mrs.) C. Samaranayake] and Mr. L.S. S. Pathriatne

Scope : The use of rainguards is being tested with the objective of increasing the number of tappable days eventually leading to higher crop in smallholdings.

Treatments : Use of rainguards Vs without rain guards.

Plot size : 2 tapping blocks (approximately 250 trees per block).

Statistical techniques : Student 't' test.

Location :

KALUTARA DISTRICT

Name & Address of Smallholder	Extent	Clone	Treatment
01. Sunil Gunatilake, Gangalanga, Baduraliya.	2 tapping tasks	PB 86	One with r/guard & other without r/guard
02. S. Sooriyarachchi, Baddegama Store, No. 18, Malwatta Rd., Pettah	10	do	do
03. The Public Trustee, Public Trustee Dept. No. 2, Bullers Lane, Colombo 7.	do	do	do

RATNAPURA DISTRICT

01. K.V. Mudalihami, Medagama, Gheppanawa.	do	do	do
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KEGALLE DISTRICT

01. C. Jayasinghe, Bandarawatta, Tholangamuwa.	10	do	do
02. K.P. Piyadasa, Wele Kade, Karandupona, Molligoda.	do	do	do

Multicropping of Rubber with Tea

The effects of multicropping of Rubber lands with Tea on growth and production of Rubber and Tea is being studied with the objective of (a) utilization of interrow space in rubber plantations to grow crops that should give an income during the unproductive period of rubber for 5 to 6 year and also during the productive period on wet days when harvesting of rubber (tapping) is not possible and (b) to increase productivity per unit area of land by multicropping.

Three experiments were planned—

- (1) on RRI Sub Station, Kuruwita
- (2) Dartonfield, Agalawatta
- (3) Atherfield Estate, Avissawella.

Experiment 1 (RRI Sub Station, Kuruwita)

This experiment was started in June 1990, where the following treatments are being tested in plots 1/3 acre in size using a randomized block design replicated four times.

Treatments :

- (a) Rubber only, 12' × 18' (490 plants/ha, 100% stand)
- (b) Tea only, rehabilitated, 4' × 2' (12,500 plants/ha, 100% stand)
- (c) Rubber, 8' × 27' (490 plants, 100%) + Tea rehabilitated (4 rows 65%)
- (d) Rubber 8' × 27' (100%) + Tea unrehabilitated (65%)
- (e) Rubber 8' × 40' (340 plants/ha, 70%) + Tea rehabilitated 7 rows, 75%
- (f) Rubber 8' × 40' (70%) + Tea unrehabilitated (75%).

Experiment 2 & 3 (Dartonfield and Atherfield Estate, Avissawella)

This experiment is similar to experiment 1 with regard to experimental details such as plot size, design etc., but the following treatments will be tested :—

Treatments :

- (a) Rubber only, 12' × 8' (490 plants/ha, 100% stand).
- (b) Tea only (rehabilitated 4' × 2' .12,500 plants, 100%)
- (c) Rubber 8' × 27' (490 plants, 100%) + Tea (4 rows, 65%)
- (d) Rubber 8' × 32, (425 plants 85%) + Tea (5 rows, 70%)
- (e) Rubber 8' × 36' (378 plants, 75%) + Tea (6 rows, 73%)
- (f) Rubber 8' × 40' (340 plants, 70%) + Tea (7 rows, 75%)
- (g) Rubber, 8' × 44' (310 plants, 65%) + Tea (8 rows, 80%)

Experiments 2 and 3 will be started in May/June 1991. This programme is partially funded by the Council of Agricultural Research Policy under their contract research programme (N. Yogaratnam and Geetha de Mel).

REVIEW OF THE BIOMETRY SECTION

By

TERRENCE PEIRIS

SUMMARY

The section was busy throughout the year with the statistical analyses of data provided by the research departments of the Institute. In addition to this assistance was also given to most of the departments of the Institute to do various computing jobs.

Maintenance of the meteorological station at Dartonfield and the collection of data were continued, uninterrupted.

Two papers, one biometrical research, and one general were submitted for publication. Compilation of 'A handbook of statistical methods for biologists and agriculturists' was completed and copies were given to the research departments.

During the year under review, there was a significant reduction in the man power of the section due to the departures of Messrs W.N. Wickremasinghe, Biometrician; R.A.P. Abayapala, Senior Technical Officer and D.D. Albert, Office Peon.

DETAILED REPORT

Staff

Mr. W.N. Wickremasinghe, Biometrician and Mr. R.A.P. Abayapala, Senior Technical Officer resigned from their posts with effect from 14th of October and 21st of May respectively. Mr. D.D. Albert, Office Peon also retired from the service on 22nd of November. Mr. L.T. Peiris, Senior Technical Officer; Technical Officers Ms. J.D. Nandanie and Mr. L.P.P. Vitharane were on duty throughout the year. Since the resignation of Mr. W.N. Wickremasinghe, the writer overlooked the duties of Biometrician. Mr. L.P.P. Vitharane was promoted to higher grade with effect from 01.01.1990.

Publications

WICKREMASINGHE, W.N. (1990). A handbook of statistical methods for biologists and agriculturists.

Statistical services

More than 800 data sets were analysed and interpreted during the year. Most of these analyses are connected with the projects done by the Research Officers and Temporary Research Assistants who are doing studies leading to post graduate degrees. Statistical analysis and interpretation of results were completed in the following two major projects :—

1. Serum as a potential fertilizer substitute — CIDA project. (Mr. Susil Zoysa, Temporary Research Assistant, Biochemistry Department).
2. Effects of potassium and magnesium on rubber. (Mr. S.M.M. Iqbal Temporary Research Assistant, Soils & Plant Nutrition Department).

Data from the following four major projects were also analysed :—

1. Some aspects of moisture stress in *Havea brasiliensis* grown under Sri Lankan conditions. (Ms L. Samarappuli, Agronomist, Soils & Plant Nutrition Department).
2. Tropical Soil Biology and Fertility (TSBF) programme. (Mr. S. Jayawardene, Temporary Research Assistant, Soils & Plant Nutrition Department).
3. Nutrient cycling in tropical rain forests — part of TSBF programme (Mr. U. Senerath, Temporary Research Assistant, Soils & Plant Nutrition Department).
4. Phosphorus supplying power of soils and low solubility phosphatic materials. (Mr. D.M.A.P. Dissanayake, Assistant Soils Chemist, Soils & Plant Nutrition Department).

In addition to the above major projects, assistance was given to Research Officers to design their experiments, to analyse their experimental data and to interpret the results.

Observations made by the Plant Pathology Department on the effectiveness of various fungicides were also analysed and the results were interpreted.

Data from experiments conducted by the Plant Science Department were also analysed and the results were interpreted for presumption and annual review of this Department.

Computer services

Assistance was given to update the BASIC programme written for the Soil and Foliar Survey conducted by the Soils & Plant Nutrition Department and to process the data for recommendations.

GW-BASIC language together with DOS were used to make the EPSON PC AX computer system a user-friendly one so that it could be operated by the other operators too.

SAS was the main language used to write the programme needed for the statistical analyses done by the section. The high flexibility of this language was useful because a wide range of experimental designs, from fully randomized to split-plot-confounded are used in this Institute.

The section was able to install the SAS GRAPH module on EPSON PC AX hard disk, becoming the 6th national user of this latest module of SAS.

Compilation of the handbook was entirely processed by using the 'Word Star Professional Release 4' word processor. Word processing was done for the other departments also.

Meteorological services

The maintenance of meteorological station and the recording of observations twice daily were done throughout the year and the data were sent to those who requested and to the meteorological department.

Independent biometrical research

Whenever the analysis of variance (ANOVA) procedure is used, the testing for the homogeneity of variances of each treatment was implemented to ensure the validity of the analysis, as suggested by Peiris, Terrance (1990) in the article 'The importance and misuse of Biometry in agricultural research.'

REVIEW OF THE LIBRARY & PUBLICATIONS SECTION

By

KAMANI N. VITHANA

SUMMARY

Main functions of the Library and Publications Section such as maintaining processing and publishing of Institute's regular publications and collecting and disseminating of information on rubber and related areas have been carried out throughout the year 1990.

DETAILED REVIEW

Staff

Miss K.N. Vithana assumed duties as Librarian and Publications Officer with effect from 4th October 1990. Mr D.C. Thambawita, Library Assistant & Assistant Publications Officer, Mrs T. Dantanarayana, Library Assistant & Assistant Publications Officer, Colombo Office and Mrs R. Amaratunga, Clerk/Typist were on duty throughout the year.

Acquisitions

The collection of text books increased to 4282 and the bound volumes to 2658.

Meetings

The Librarian & Publications Officer attended the following Seminars regarding Library Science & Information Services.

- (i) Seminar on Libraries in 3rd world countries held at British Council, Colombo on 4th December 1990.
- (ii) SLSTINET Librarians meeting held at NARESA on 14th December 1990.

Publications

Processing and publishing of RRISL publications were continued. The following publications were published during the year.

- Annual Review 1989
- Annual Report 1988
- Annual Report (English Section) 1989
- Bulletin Vol. 24, 1987.

Information Services

Routing work on disseminating of information i.e. circulating contents pages of current scientific journals among the Institute's Scientific Staff were done regularly.

Agricultural Information Network (AGRINET)

The work of AGRINET was maintained throughout the year 1990 too. Contents pages requested by the AGRINET users were sent out without any delay and contents pages of Journals requested by our staff were circulated when received from NARESA.

REVIEW OF THE ESTATE DEPARTMENT

By

V. M. KATUGAHA

SUMMARY

Dartonfield Group which consist of three divisions namely Dartonfield and Gallewatte in the Agalawatte Electorate and Nivitigalakele division in the Matugama electorate belongs to the Rubber Research Institute of Sri Lanka.

The total extent of the estate is 331.02 ha, of which 107.98 ha, were in bearing and 143.60 ha, were under Immature extent during the year.

Dry weather prevailed at the beginning of the year and wet weather experienced thereafter except in the months of August and September. The overall weather pattern was conducive towards the crop harvest.

5.60 hectares have been planted out by the Plant Science Department and the Genetics and Plant Breeding Department for experimental purposes. The balance hectarage has been left out to be planted during the South West monsoon of 1991.

The seed fall during July/August was not satisfactory due to a severe attack of *Phytophthora* on the pods. However, incidences of *oidium* was not so serve. The nurseries specially the polybag plants were badly effected by *Oidium Gloeosporium* and *Corrynesyora*. Preventive measures were undertaken to stop the diseases from spreading.

Budwood of clones RRIC 100, RRIC 102 and RRIM 623 was made available to the Small Holders and the estates of JEDB/SLSPC, through-out the year.

All aspects of agricultural operations were carried out in all 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 Asst. Clerk, Mr. K.D. Sumanasena, Mrs. C. Dissanayake, Mr. A.K.A. Wickremasinghe, Junior Asst. 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, Asst. 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 Supervisors, Mrs. C.H. Hettiarachchi, Creche Attendant, M/s. H.W. Amaradasa, Tractor Driver, H.L. Sarath, Jeep Driver, Mr. A.K. Piyasena, Office Peon were on duty through-out the year.

The Dartonfield Group Cadre stood at 20 at the end of the year, made-up as follows :—

Senior Staff	—	01
Assistant Staff	—	15
Minor Staff	—	04
		—

Hectarage

A summary of the hectarage is given in Table 1.

Table. *Land distribution in Dartonfield Group*

	Dartonfield	Gallewatte	Nivitigalakele	Total
Mature Area	5.49	57.65	44.84	107.98
Immature Area	33.08	104.83	—	100.27
Nurseries	7.27	—	7.69	14.96
Paddy Fields/Deniya	—	3.05	—	3.05
Abandoned Area	3.83	—	8.06	11.89
Swamps	—	—	1.21	1.21
Waste Land	.19	—	—	.19
Earth Slip Area	1.65	1.40	2.62	5.67
Jungle	.80	—	.71	1.51
Roads	3.27	3.55	.32	7.14
Building/Garden	16.14	9.33	7.79	33.26
Rocks	.29	—	—	.29
State land taken-in	.27	—	—	.27
Reserved for Building Complex	—	5.69	—	5.69
Total	72.28	185.50	73.24	331.02

Weather

Rainfall figures (mm) for 1990 are given below in Table 2.

Table 2. *Rainfall distribution for 1990 and 1989*

	1990	1989
January	61.9	79.1
February	42.8	30.6
March	145.5	114.1
April	244.5	273.4
May	414.8	493.3
June	346.4	438.0
July	262.1	516.2
August	35.0	179.3
September	88.4	338.8
October	492.5	524.2
November	558.4	272.9
December	200.9	105.1
	<hr/>	<hr/>
Total No. of Wet Days	2893.2	3365.3
	164	166

The highest rainfall was recorded during the month of November, which was 558.4 mm. on 20 wet days.

Crop

The yield data for the last five years is given below in Table 3.

Table 3. *Yield records from 1986 - 1990 (kg/ha)*

	1990	1989	1988	1987	1986
Dartonfield	696	612	1094	1416	1015
Gallewatte	805	795	802	1229	1114
Nivitigalakele	929	706	1083	729	648
Average	866	738	1002	1128	1049
Estimated	740	700	1244	1213	870
Tapping Hectarage	108	107	148	177	196

A remarkable increase in yield was recorded during the season in comparison with the estimate as well as last year.

The crop secured during the season was 93,504 kgs. as against the estimate of 80,000 kgs.

107 days tapping was lost due to the rain and 22 days Recovery Tapping was carried out.

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 manufacture crop in Dartonfield Group*

	Total Kilos	Percentage
Pale Crepe No. 01	219790	87.92
Pale Crepe No. 03	30198	12.08
R.S.S. No. 01	10034	98.24
R.S.S. No. 03	180	1.76
Scrap Crepe No. 01	7438	72.61
Scrap Crepe No. 02	2590	25.37
Scrap Crepe No. 03	207	2.02

The estate continues to purchase latex from Small Holders and from the month of August onwards. Sirikandura State Plantation latex too were obtained on Bought Latex basis. The total purchase during the year 1990 is 148,831 kgs, as against 25821 kgs, in 1989 and the Small holders were paid and average price of Rs. 20/57. per kilo.

The total crop manufactured during the season was 270,446 kgs, inclusive of 148,831 kgs. of Bought Latex.

The produce of this estate were sold through M/s. H.W.J. Dias & Bros. (Pvt.) Ltd.

116,550 kgs. of Rubber were sold on forward Contracts, which were entered to, through the above mentioned Brokers.

Factory Machinery

On a visit made by the Hon. Minister of Plantation Services Mr. M.L.M. Aboosally, he initiated action to provide funds for the repairs which were badly due in the factory and quotations have already been called for after obtaining Board approval. A Tender Panel too has been appointed.

Factory Building

The condition of the building whilst needing certain renovations 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 was controlled.

Fertilizer

Application of fertilizer in Mature and Immature fields was carried out as per programme.

Replantings

The clearings which were estimated for planting in 1990, could not be completed due to the delay caused by the Contractors in uprooting old rubber. These have been programmed to be planted in 1991.

Nurseries

All nurseries were maintained in good order.

Field & 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 1/4 lb. Bread per day, per head.

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 1990.

Accounts

Final Accounts for the season 1990 is in progress.

Estimates

Estimates of Capital and Revenue expenditure for 1991, in respect of Dartonfield Group were submitted to the Rubber Research Board and awaiting approval of the Estate Committee.