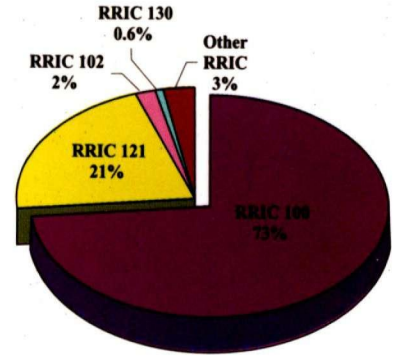
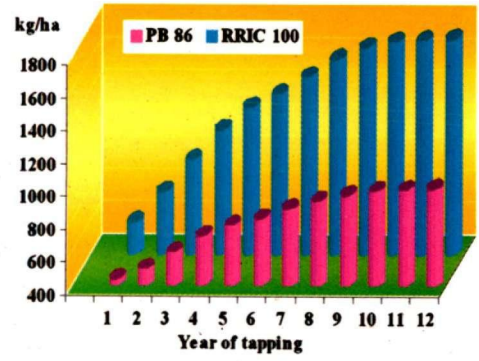
ISSN 1391-0043

RUBBER RESEARCH INSTITUTE OF SRI LANKA

RUBBER RESEARCH INSTITUTE OF SRI LANKA - ANNUAL REVIEW 2007



Distribution of RRIC 100 series clones in Sri Lanka



Commercial yields of a popular clone in the past (PB 86) and genetically improved RRIC 100

Annual Review 2007

Cover Story: Success causes concern

The clone RRIC 100 was the most prestigious genetic material bread by the Sri Lankan scientists during the 20th century. This outstanding clone having a yield potential of more than 2000 kg/ha/y was recommended to growers in 1970's to replace the then traditional clone PB 86 which had a yield potential of 1200 kg/ha/y. Tolerance to the common diseases and vigorous growth were the other outstanding characteristics of this much improved genetic material.

RRIC 100 emerged as the best performing clone in the second international multilateral clone trial carried out in Malaysia, Indonesia, Thailand and Sri Lanka. Today this clone has become very popular in all rubber growing countries including the African Continent. Genetic material of RRIC 100 is being used intensively in breeding programmes worldwide and the RRII 400 series consisting of high yielding and disease resistant clones is considered as a major break through by the Rubber Board of India.

In Sri Lanka, RRIC 100 became the most widely accepted clone by late 1980s and today more than 40% of the rubber lands are covered with this clone. With the realization of the danger of having a single clone covering a vast acreage a decision was taken in the year 2006 to ban planting of this outstanding clone in the traditional rubber growing areas in Sri Lanka.

Congratulations to all those involved in creating RRIC 100 which revolutionized the country's rubber productivity and build up the image of Sri Lanka among the natural rubber producing countries in the world.

Rubber Research Institute of Sri Lanka

Annual Review – 2007

1st January 2007 to 31st December 2007

Editors
R C W M R A Nugawela, PhD (Essex)
W M G Seneviratne, PhD (Sussex)
C K Jayasinghe, PhD (Sri Lanka)

Head Office & Laboratories
Dartonfield
Agalawatta

Board Office & Laboratories
Telewela Road
Ratmalana

CONTENTS

RUBBER RESEARCH BOARD OF SRI LANKA

BOARD OF MANAGEMENT

Members appointed by the Hon Minister of Plantation Industries

Mr J Y Peries, Chairman, Rubber Research Board
Mr A B Leelasena, Director/Planning, Ministry of Plantation Industries (upto 16.05.2007)
Mr R A D S Ranatunga, Asst. Secretary, Ministry of Plantation Industries (w.e.f. 18.05.2007)
Mr T M J Bandara, Asst. Director, National Planning, General Treasury
Mr S N Guneratne, CEO, Agalawatte Plantations Ltd.
Mr R C Peiris, Executive Director, Kotagala Plantatio;ns Ltd.
Mr J B L de Silva, Chairman, Colombo Rubber Traders Association (upto 02.03.2007)
Mr Anura Edirisinghe, Colombo Rubber Traders Association (w.e.f. 26.03.2007)
Mr Justin Seneviratne, Director, Lalan Rubbers (Pvt.) Ltd.
Prof H P M Gunasena, Executive Director, CARP (upto August 2007)
Mr K C Fernando, Hony President, Sri Lanka Nidahas Sewaka Sangamaya, RRI (upto 05.03.2007)
Mrs K Kapuge, Hony. Secretary, Ceylon State Corporations & General Employees Union, RRI (upto 05.03.2007)

Ex-Officio Members

Dr A Nugawela, Director, Rubber Research Institute
Mr W Rubasinghe, Director General, RDD
Mr Kavi Senevirtne, Chairman, Planter's Association of Ceylon

STANDING COMMITTEES

Estates Committee

Dr A Nugawela, Director, Rubber Research Institute
Dr C K Jayasinghe, Deputy Director – Research (Biology), RRI
Miss W K V de Silva, Deputy Director (Administration), RRI
Mr Jehan Perera, Estate Superintendent, Dartonfield Estate
Mr S A R Samarasekera, Assistant Superintendent, RRI Sub-station, Kuruwita
Mr S B Dissanayake, Manager, Dalkeith Estate, Baduraliya and Visiting Agent for Dartofield Estate
Mr Salinga Dissanayake, Deputy General Manager, Peenkanda Estate, Nivitigala and Visiting Superintendent for Kuruwita Sub-station
Mr N B Seneviratne, Manager, Eladuwa Estate, Matugama
Mr S Eriyagama, Director, Agalawatta Plantations Ltd., No.10, Gnanartha Pradeepa Mawatha, Colombo 8
Mr W Kularatne, Accountant, RRI (In attendance)

Audit and Management Committee

Mr A B Leelasena, Director/Planning, MPI (upto 16.05.2007)
Mr R A D S Ranatunga, Assistant Secretary, MPI (w.e.f. 18.05.2007)
Mr T M J Bandara, Asst. Director, National Planning, General Treasury
Mr W Rubasinghe, Director General, RDD
Dr A Nugawela, Director, Rubber Research Institute

Scientific Committee

Mr J Y Peries, Chairman, RRB
Dr A Nugawela, Director, RRI
Dr W M G Seneviratne, Deputy Director Research (Technology), RRI
Dr C K Jayasinghe, Deputy Director Research (Biology) RRI
Dr (Mrs) L Samarappuli, Head, Soils and Plant Nutrition Dept., RRI
Dr (Mrs) P Seneviratne, Head, Plant Science Dept., RRI
Dr Anura Dissanayake, Head Advisory Services Dept., RRI
Dr (Miss) W P K Silva, Plant Pathologist, RRI
Dr V H L Rodrigo, Head Biochemistry Dept., RRI
Dr R S Dharmakeerthi, Soils Chemist, RRI
Dr K E Jayasuriya, Plant Pathologist, RRI
Dr (Mrs) Wasana Wijesuriya, Biometrician, RRI
Dr Susantha Siriwardena, Head, Raw Rubber Process Development and Chemical Engineering Dept., RRI
Dr S M M Iqbal, Agronomist, RRI
Mrs M M Jayasuriya, Rubber Chemist, RRI
Mrs D G Edirisinghe, Acting Head, Rubber Technology and Development Dept., RRI
Mrs S P Withanage, Geneticist and Plant Breeder, RRI
Mr J Perera, Superintendent, Dartonfield Group, RRI
Dr N Yogaratnam, Consultant, NIPM, Athurugiriya
Mr R C Peries, Director (Plantations), Kotagala Plantations Ltd., Horana
Mr R V K S de Livera, Manager, Kotagala Plantations Ltd., Paiyagala Estate, Paiyagala
Mr N M Amarasekera, 37/9, Terrance Avenue, Mount Lavinia
Mr D G Wickramasinghe, Director/General Manager Low Country, Kelanivalley Plantations Ltd., Kiriporuwa Group, Yatiyantota
Mr Abeynande Dias, Director – Operations, Namunukula Plantations Ltd., 310, High Level Road, Nawinna, Maharagama
Mr N B Seneviratne, Superintendent, Manager, Eladuwa Estate, Matugama
Mr S B Dissanayake, Manager, Delkeith Estate, Baduraliya
Mr Gamini Jayasooriya, Director – Rubber, Lalan Rubber (Pvt.) Ltd., 198 B, Ganendra Mawatha, Nawala
Mr Sriyan Wijesekera, Coordinating Manager, Pussellawa Plantations Ltd., No.228, Havelock Road, Colombo 5

Mr S S Poholiyadda, Director - Operations, Kegalle Plantations Ltd., 310, High Level Road, Navinna, Maharagama

Mr A C Bertus, Superintendent, Atale Estate, Atale

Mr Dan Seevarathnam, Deputy Chairman, Kahawatta Plantations Ltd., 52, Maligawatta Road, Colombo 10

Mr Viren Ruberu, Group Director, Group Director's Office, Kahawatta Plantations Ltd., Rilhena Estate, Pelmadulla

Mr D P A Perera, Deputy General Manager, Balangoda Plantation Ltd., P.O. Box 8, Palm Garden, Ratnapura

Mr Carlyle Lascelles Perera, Director - Rubber, Malwatta Valley Plantation Ltd., 280, Dam Street, Colombo 12

Mr U H Bulugahapitiya, Superintendent, Vincit Estate, Waharaka

Mr Rohan Boudewyn, General Manager - Plantations, Watawala Plantations Ltd., No.60, Dharmapala Mawatha, Colombo 3

Mr S A Eriyagama, GM-Plantations (Rubber), Agalawatta Plantations Ltd., No.10, Gnanartha Pradeepa Mawatha, Colombo 8

Director General, Rubber Development Dept. P.O. Box 184, Colombo

Secretary, Ministry of Plantation Industries, 55/75, Vauxhall Lane, Colombo 2

Mr M R C Peries, 16/2, Charlimont Rd., Colombo 6

Mr Anusha Perera, Superintendent, Elston Estate, Puwakpitiya

Mr G B S de Silva, Deputy CEO, Horana Plantations Ltd., 8, Chittampalam A Gardiner Mawatha, Colombo 2

Mr A M A S Dharmasekera, Group Manager, Sirinivasa Estate, Waga

Mr Gunendra Sellahewa, Supplies Manager, Dipped Products, 400, Deans Road, Colombo 10

Mr Asoka Jayawickrema, The Colombo Brokers' Association, P.O. Box 101, 201, De Seram Place, Colombo 10

Dr M R N Fernando, Loadstar Ltd., 3/1, Police Park Terrace, Colombo 4

Mr Salinga Dissanayake, Manager, Doloswela Estate, Nivitigala

Mr D B S L Perera, Superintendent, Kumarawatta/Moneragala Estate, Moneragala

Mr M R Fernando, Superintendent, Malaboda Estate, Matugama

Mr A H Kularatne, RAO, Advisory Services Dept., Telewala Road, Ratmalana

Mr D D Dassanayake, RAO, Advisory Services Dept., Nivitigalakele Substation, Nivitigalakele

Mr U Prematilaka, Group Manager, Panawatta Estate, Yatiyantota

Mr K A Amarathunga, Superintendent, Talduwa Estate, Avissawella

Mr R A Alahakoon, Superitendent, Yatadola Estate, Matugama

Mr Bathiya Bulumulla, General Manager, Katandola Estate, Elpitiya

Mr Darrela Dharmarajah, Estate Manager, Pelmadulla Estate, Kahawatta Plantations Ltd., Kahawatta.

Mr A L W Goonewardena, CEO, Elpitiya Plantations Ltd., 52, Maligawatta Road, Colombo 10

Mr T H Gamage, Superintendent, Madampe Estate, Rakwana

Mr M P H Gunaratna, Manager, Bentota Estate, Elpitiya
Mr D I Gallearachchi, Deputy General Manager, Dehiowita
Mr J N Hettiarachchi, Manager, Padukka Estate, Padukka
Mr Dharshana Jayanetthi, Chairman, MRP Agro chemical Lanka (Pvt.) Ltd., 85/10A, Jawatte Gardens, Colombo 5
Mr S W Karunarathna, 36, Mallikarama Road, Ratmalana
Mr A G Geeth Kumara, General Manager, Talgaswella Estate, Talgaswella
Mr Dayan Madawala, CEO, Hapugastenna Plantations Ltd., P.O. Box 8, Palmgarden, Ratnapura
Mr N D Madawala, Nottinghill Estate, Mawathagama
Mr S Navaratne, Manager, Homadola Estate, Udugama
Mr G J K Nakandala, 375/26, Rathnarama Road, 4th Lane, Hokandara North
Mr S.Obeysekara, Superintendent, Galatura Estate, Kiriella
Mr A F Peries, Group General Manager, Pitiyakanda Group, Mawathagama
Mr S Y Pillai, Estate Manager, Hunuwala Estate, Kahawatta Plantations Ltd., Opanayake
Mr A K Padmawansa, Manager, Culloden Estate, Neboda
Mr C U Pallege, Manager, Rayigam Estate, Ingiriya
Mr Athula Rajasinghe, Superintendent, Rambukkanda Estate, Ratnapura
Mr A K D L Rukmal, Superintendent, Hapugastenna Estate, Ratnapura
Mr Prasanjith Ramachandra, Estate Manager, Opatha Estate, Kahawatta Plantations Ltd., Kahawatta
Mr N P Seneviratne, Manager, Udapola Estate, Deraniyagala
Mr I Senanayake, Group Senior Manager, Sapumalkanda Group, Deraniyagala
Mr S B Seneviratne, Senior Manager, Neuchatal Estate, Neboda, Horana
Mr R Seneviratne, Group Manager, Halpe Estate, Tummodera
Mr L P A N Senarathna, Group Manager, Moralioya Estate, Ruwanwella
Mr K G Tillakaratne, Group General Manager, Mahaoya Group, Dehiowita
Mr R Tennakoon, Manager, Eduragala Estate, Ingiriya
Mr I D Weerakoon, Manager, Poranuwa Estate, Kahawatta
Mr B H Weerakoon, Manager, Frocester Estate, Govinna

Provident Fund Committee

Dr A Nugawela, Director, Rubber Research Institute
Mrs L J C Perera, Secretary, Provident Fund Committee (upto 23.11.2007)
Miss K V de Silva, Secretary to the Board (w.e.f. 26.11.2007)
Mr W D Wimaladasa, Elected Committee Member
Mr H H Jayasinghe, Elected Committee Member
Mr W Kularatne Accountant, RRI (In-attendance)

Chairman's Office & Board Secretariat

Chairman	- Mr J Y Peiris
Secretary to the Board	- Mrs L J C Perera (upto 23.11.2007)
	- Miss K V de Silva (w.e.f. 26.11.2007)
Confidential Clerk/Stenographer	- Mrs B H P Balasooriya
Telephone Operator	- Mrs R S Wijeratne (w.e.f. 01.08.2007)

Lawyers

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

Auditors

Auditor General
Auditor General's Department
Independence Square
Colombo 7

Bankers

Bank of Ceylon
Corporate Branch
75, Janadhipathi Mawatha
Colombo 1

Bank of Ceylon
Agalawatta

Head Office and Laboratories

Dartonfield, Agalawatta

Telephones:	
Director	034 - 2248457
Deputy Director Research (Biology)	034 - 2248458
Deputy Director (Administration)	060 - 2346118
General	034 - 2247426
	034 - 2247383
	060 - 2349999
Fax:	034 - 2247427
E-mail	dirrri@sltnet.lk

Rubber Research Institute - Substation
Nivitigalakele, Matugama

Genetics and Plant Breeding Department
Telephone: 034 - 2247368, 034 - 2247199

Rubber Research Institute - Substation
Kuruwita, Ratnapura
Telephone: 045 - 2262115, 060 - 2460537

Board Office and Rubber Chemistry & Technology Laboratories
Telewela Road, Ratmalana

Telephones:	
Chairman	011 - 2635019
Director	011 - 2635142
Deputy Director Research (Technology)	011 - 2633351
General	011 - 2635851
	011 - 2635852
Fax:	011 - 2605171

RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

DIRECTORATE

Director	R C W M R A Nugawela, BSc (SL), MSc (Lond.), PhD (Essex)
Deputy Director - Research (Biology)	C K Jayasinghe, BSc (SL), MSc (SL.), MSc (Agric) (Aust.), PhD (SL)
Deputy Director – Research (Technology)	W M G Senevirante, BSc (SL), PhD (Sussex)
Deputy Director (Administration)	Miss W K V de Silva BA (SL), LLB, Attorney at Law

RESEARCH DEPARTMENTS

Genetics and Plant Breeding

Geneticist and Plant Breeder	*Mrs S P Withanage, BSc Agric (SL), MSc (India)
Assistant Geneticist and Plant Breeder	K K Liyanage, BSc Agric (SL)
Development Officer	K B A Karunasekera
Experimental Officers	K W Rupatunga
	I D M J Sarath Kumara
	L S Kariyawasam
Technical Officers	T M S K Gunasekera
	H P Peiris, Dip. Agric (Kundasale)
	Mrs A K Gamage, BSc (SL)
Clerk/Typist	Mrs S D P K L Peiris

Plant Science

Head of Department	Mrs G P W P P Seneviratne, BSc (SL), PhD (Bath)
Botanist	A M W K Senevirathna, BSc (SL), MSc (SL), PhD (Wales)
	N M C Nayanakantha, BSc (SL), MSc (India)
Assistant Botanists	*N A A D Wickramaratna, BSc Agric (SL)
	Mrs D S A Nakandala, BSc Agric (SL)

Experimental Officers	K A G B Amaratunga
	R P Karunasena
	Mrs G A S Wijesekera
	Mrs R K Samarasekera
	U S Weerakoon
	T U K Silva, BSc Agric (SL)
	M K P Perera, BSc (SL)
	**W D M N de Alwis, BSc (SL)
	D L N de Zoysa
Technical Officers	P D Pathirana, BSc (SL)
	P K W Karunathilake, Dip. Agric (Ratnapura)
Clerks	Mrs H D D E Jayawardena
	Mrs Aruni de Almeida

Plant Pathology and Microbiology

Head of Department	C K Jayasinghe, BSc (SL), MSc (SL), MSc (Agric) (Aust.), PhD (SL)
Plant Pathologists (Principal Research Officers)	K E Jayasuriya, MSc Agronomy (USSR), MPhil (Edinburgh), C Biol (SL) PhD (SL)
	Miss W P K Silva, BSc (SL), MSc (SL), MPhil (Aust.), PhD (SL)
Assistant Plant Pathologist	Mrs T H P S Fernando, BSc (SL), MPhil (SL)
Experimental Officers	E B Fernando
	Mrs B I Tennakoon, Dip. Agric (Kundasale)
	Mrs E A D D Siriwardene, BSc (SL)
Technical Officers	S C P Wijayaratne, NDT Agric (Hardy)
	Mrs N Jayawardene, Dip. Agric. (Bibile)
	S R D P C Peiris, BSc (SL)
	E A D N Nishantha, Dip. Agric. (Ratnapura)
Clerk	Mrs W S P Amarasekera

Audio Visual Aids and Photographic Unit

Audio Visual Aids Production Officer	L W Amaratunge

Soils and Plant Nutrition

Head of Department	Mrs M L A Samarappuli, BSc Agric (SL), MSc (California), PhD (SL)
Soils Chemist (Principal Research Officer)	R S Dharmakeerthi, BSc Agric (SL), MSc (SL), PhD (Canada)
Assistant Soils Chemist	Mrs R P Hettiarachchi, BSc (SL), MPhil (SL)

Experimental Officers	H D S P Perera, BSc (SL), MSc (SL)
	Mrs S D C K Maheepala
	S N Silva
	P Karunadasa, BSc (SL), MSc (SL), M I Biol. (SL)
	A H U Mitrasena
	A N Yakandawala
	T B Dissanayake
	Miss V U Edirimanne, BSc (SL)
	Miss A P Thewarapperuma
	P A C R Puhambugoda, NDT Agric (Hardy)
Technical Officers	J A Sarath Chandrasiri
	P D T C Gunatilleke
English Stenographer	Mrs K A D L Rupasinghe Perera

Biochemistry and Physiology

Head of Department	V H L Rodrigo, BSc Agric (SL), MSc (Essex), PhD (Wales)
Assistant Biochemists	* Mrs G V L Nilmini, BSc (SL)
	Mrs K V V S Kudaligama Wijesundera, BSc (SL), MPhil (SL)
Experimental Officers	D Ramawickrema
	P D J Rodrigo

Polymer Chemistry

Rubber Chemist	Mrs C J Wellappili, BSc (SL), MSc (SL), PhD (Cardiff)
Assistant Rubber Chemist	* Mrs A H L R Nilmini, BSc (SL)
Experimental Officers	H N K K Chandralal, BSc (SL), MSc (SL)
	Mrs D I R Denawaka, Dip. Rubber Tech. (PRI)
	Mrs W C M Kuruppu, Dip. Rubber Tech. (PRI), Certificate Rubber Tech. (Moratuwa)
	S S Warnapura
	S L G Ranjith, Dip. Rubber Tech. (PRI)
	S M A Samarakoon, Dip. Agric. (Kundasale)
	Miss D M S Wijesekera, Dip. Rubber Tech. (PRI)

Raw Rubber and Chemical Analysis

Assistant Rubber Chemist	Miss A P Attanayake, BSc (SL)

Experimental Officers	Mrs H S Weeraman, Certificate Rubber Tech. (PRI)
	Mrs L Wanigatunga
	Mrs H V K Gamage
	Mrs C S Lokuge
	L P P Vitharana
	K R N Karunatilleke, Dip. Rubber Tech. (PRI)
	B Gunasiri
	W D Wimaladasa
Research and Development Assistant	Miss G M Priyanthi Perera, BSc (SL), MSc (SL)
Clerk	Mrs I Wijesinghe

Electronic Instruments Repair Unit

Instrument Technician	L G P Lelwela

Rubber Technology and Development

Acting Head of Department	Mrs D G Edirisinghe, BSc (SL), MSc (SL), MPhil (UK)
Rubber Chemist	Mrs M M Jayasuriya, BSc (SL), MSc (SL), PhD (Loughborough)
Assistant Rubber Chemist	*Miss G D D Galpaya, BSc (SL)
Experimental Officers	Mrs M K Mahanama, Dip. Rubber Tech. (PRI)
	Mrs S I Yapa, Dip. Rubber Tech. (PRI)
	Mrs P C Wettasinghe
	P L Perera
Technical Officer	T A A I Siriwardene

Raw Rubber Process Development and Chemical Engineering

Head of Department	S Siriwardene, BSc (SL), MSc (Australia), PhD (Malaysia)
Rubber Chemist	R M U N Ratnayake, BSc (SL), PhD (Loughboorugh)
Assistant Rubber Chemist	P H Sarath Kumara, DPRI, MSc (SL)
Experimental Officers	Mrs W K C Nalinie, Dip. Rubber Tech. (PRI)
	T A S Siriwardene
	E C D Senanayake
	Mrs U M S Priyanka, BSc (SL), MSc (SL)
	Miss V C Rohanadeepa
	A K D W Prasad

Store Keeper	Mrs L Rukmanie
Clerk	Mrs S A Paranavithana

Biometry Section

Biometrician	Mrs B W Wijesuriya, BSc Agric (SL), MPhil (SL), PhD (SL)
Assistant Biometrician	*H M L K Herath, BSc Agric (SL), MSc (SL)
Experimental Officers	Mrs H K D C S Munasinghe, NCT Polymer (Moratuwa), Dip. Rubber Tech. (PRI), Dip. Computer Science (IDM)
	O V Abeyawardene, Dip. Agric. (Kundasale)

Adaptive Research Unit

Agronomist	S M M Iqbal, BSc Agric. (SL), MPhil (SL), PhD (Essex)
Research Assistants (Adaptive Research)	W A D D S Wettasinghe
	Mrs E S Munasinghe, BSc Agric (SL)
	Mrs B M D C Balasooriya, BSc Agric (SL)

Polgahawela Sub-Station

Experimental Officer	E A T Senadeera
Clerk/Typist	Mrs W A C Weeramanthrie

Library and Publications Unit

Librarian	S U Amarasinghe, BSc (SL), MA (SL), ASLLA
Library Assistant and Assistant Publications Officer	Mrs R M Amaratunga, Intermediate; Library Science, Documentation & Information (SL)
Clerk/Typist	P M P Jayantha

ADMINISTRATION DEPARTMENT

Assistant Medical Practitioner	M Subasinghe
Administrative Assistant	Mrs M D P Mandalawatta (w.e.f. 02.11.2007)
Clerks (Special Grade)	Mrs W Paul
Clerk	Mrs P W Neelamanie
	Mrs K P R Gunasekera
Clerk/Typists	Mrs J A D Wijayanthi
	Miss B D Niranjala
English Stenographer	Mrs J A H S Kumarie
Translator	Mrs D N Senevirathna, BSc (SL)

Telephone Operator	Mrs J A D C Preethika
Pharmacist	S Lankeshwara

Internal Audit Unit

Internal Auditor	Mrs M S I Senadheera, IFA, IPFA, IRCA
Internal Audit Officer	K C Fernando
Clerk/Typist	Mrs S N Munasinghe

Works Section

Resident Engineer	L S de Silva Weerasinghe, BSc (SL) (w.e.f. 26.11.2007)
Electrical Foreman	W D Ratnasinghe
Building Foreman	M A D K Jayasumana
Transport Officer	U L D R L Gunasinghe
Chief Clerk	Miss M Gunawathie Silva (w.e.f. 02.11.2007)
Clerk/Typists	Mrs J A S Dharshanie (Dip. in Management)
	Mrs K C S Wickremasinghe
Work Supervisor (Electrical)	T M R P Tennakoon

Accounts Section

Accountant	W Kularatne
Accounting Assistant	D D R Lankatilaka, BCom (SL)
Accounts Clerks	Mrs C C Silva
	Mrs Irene Perera
	Mrs M Gunawardene
	Mrs K Kapuge
	Mrs R Handungoda
	Miss G P Kukulewithana
Clerks	A V Nandasena
	Mrs K J M C R Fernando
Cashier Clerk	Mrs G A D D Jayawardena
Junior Assistant Clerks	Mrs C Dissanayake
	A K D A Wickremasinghe
Store-Keeper	D C P Pothmitiyage
Assistant Purchasing Officer	K D Sumanasena

DARTONFIELD GROUP

Estate Superintendent	Jehan Perera
Senior Clerk	K K P Gunawardena
Junior Assistant Clerks	Mrs S I K Pathirage
	Mrs O W D Namalie Udayanthi
Factory Officer	D S K Ranaweera
Assistant Factory Officer	W D D Senanayake
Field Officers	T Somaratne
	H M J Premalal (upto 26.09.2007)

Kuruwita Sub-Station

Visiting Superintendent	Salinga Dissanayake (w.e.f. September 2007)
Assistant Estate Superintendent	S A R Samarasekera
Junior Assistant Clerk	D S Jayasinghe

ADVISORY SERVICES DEPARTMENT

Head of Department	**D M A P Dissanayake, BSc Agric (SL), PhD (Aberdeen)
Regional Advisory Officers	D D Dasanayake, BA (SL), MSc (UK), MSc (SL)
	A H Kularatne, BSc Agric (SL), MSc (Reading), MSc (SL)
	R D D P Rajapaksha, BSc Agric (SL) (upto15.03.2007)
	P K K S Gunaratne, BSc Agric (SL)
	L P L Gunaratne, BSc Agric (SL)
Divisional Rubber Extension Officers	D Podimahathmaya
	R A D Ranawaka
	I Kiridena
	L L A Samarawickrama
	U L R A Perera
	R L R U S Bandara
	H H Jayasinghe
Rubber Extension Officers	D Weerasekera
	W D T C Muniratne
	K V Nandanakumara
	D R A M G Abeydissanayake
	R M S Ratnayake, NDT Agric (Hardy)
	D E P M Nanayakkara, Dip. Agric. (Aquinas)

Rubber Extension Officers	W D Chandrasiri
	M Dharmadasa, BSc (SL), MSc (SL)
	J A Jayaweera Perera
	E G U Dhanawardena
	Nihal Gamage, Dip. Agric. (Angunakolapelessa)
	U N Jayasuriya
	G D N Seneviratne
	K P Jayasinghe
	W C Siriwardena
	S G G Wijesinghe
	N G Yasaratne
	D M Mahindapala
	I P L Kithsiri
	W M A S L Wanigasuriya, Dip. Agric (Aquinas)
	S B S Silva
	M G N Gunaratne
	N L Dharmasena
Assistant Training Officer	P P S Perera
Clerk (Special Grade)	Mrs M A P P Seneviratne
Clerks	Miss M K Wijetilleke
	Mrs L Somawathi
	Miss Chitra Gunatilleke
	Mrs J N R Jayasinghe
	Mrs S K Hadunge
	Mrs S Nakandala
Clerk/Typist	Mrs S M Kaluarachchi

* On study leave overseas

** On no pay leave

RUBBER RESEARCH INSTITUTE OF SRI LANKA

DIRECTOR'S REVIEW

A Nugawela

The Rubber Research Institute of Sri Lanka continued its Research and Development programme successfully during the year. Some highlights of the said programme are briefly discussed below.

Rubber seeds have multiple uses and demand for it has further increased as it could also be used as a bio fuel in the light of high crude oil prices. Since this could have a negative impact on the seed availability for rubber nurseries extensive research is undertaken with the objective of further improving rubber seed production in the country.

Young buddings raised in biodegradable bags degrade after about 10 months from field planting making the recent recommendation on planting with the bag more feasible.

The push knife commonly used in the country was modified to remove the skill requirement of latex harvesting officers for technically correct rubber tapping. It has been proven that with the use of this modified push knife the tapping depth, thickness of shaving and slope of the cut surface are automatically controlled.

Recently conducted surveys further confirm that tapping at intensities higher than recommended results is increased incidence of TPD. A chemical recommended as a cure for TPD affected trees was tested but found to be ineffective is doing so.

Government, Regional Plantation Company and Private Commercial Nurseries were inspected and 2.3594 million plants were certified as quality plants for planting during the year.

Clones RRISL 203 and PB 260 were up-graded to Group I of the clone recommendation. Further clones RRISL 203 and RRISL 2001 were recommended to the smallholder sector.

Cockchafer grub attacks continued to be a threat to the young rubber plantations and extensive advisory programmes were under taken to assist the growers in controlling this pest attack. The pathogen responsible for the recently reported collar rot disease was identified as a *Pythium* sp. A chemical control method was recommended to eradicate this problem.

Planting of *Mucuna brateata, i.e.* a cover crop relatively tolerant to shade, two years prior to uprooting of the old rubber stand was found to be effective in controlling soil erosion during replanting and reducing weeding costs in the new clearings.

In young budding nurseries the commonly observed scion die- back condition was found to be not related to the soil moisture stress level. Anyhow it was observed that some roots die after the cut back of the stock plant and it is relatively less in vigorously growing seedlings.

The site specific fertilizer recommendation programme for mature rubber provided fertilizer recommendation for 6000 hectares in the estate sector. Further 100 ha in traditional and 75 ha in the non - traditional rubber growing areas were surveyed to find the suitability for rubber cultivation.

In the RRIMLOW technique, reduction of gassing frequency to once a month helped to sustain the yield levels that could be achieved. Tapping at d/4 frequency with stimulation is able to give yields harvested by conventional d/2 system of tapping.

Farmer training programmes, field demonstrations and awareness raising programmes were conducted with the aim of increasing the adoption rates of RRI recommendations in the smallholder sector. Further model rubber holdings were established in the REOO ranges for the same purpose.

Trials indicated that hardness of NR latex foam mattresses could be reduced by incorporation of a plasticizer. A latex coating suitable for food containers was developed. Weed control mats developed using rubber product wastes showed promising results. It was revealed that soybean oil is a suitable alternative for aromatic process oils used currently in rubber compounding.

A single day smoke drying unit (SS drying unit) was developed for drying sheet rubber in a single day and was introduced to the producers. Contamination with minute quantities of copper ions affected the quality of crepe rubber whilst standard for total iron in processing water, *i.e.* 1ppm was found to be too low.

A new preservative system for natural rubber latex was developed based on nitrosoamine free phenolic type bactericide.

The recently established Polgahawela Sub-Station is being used extensively to create awareness among the potential growers on the benefits of rubber cultivation and to educate the rubber growers on good agricultural practices.

Construction of the Monaragala Sub-Station laboratories is progressing at a slow rate due to various constraints. Anyhow it is expected to be completed by end of May 2008.

The Rubber Research Institute received Rs.25 million through the Rubber Cess Fund. These funds were utilized for purchasing of scientific equipment, rubber nursery monitoring activities and development activities in the Sub-Stations.

The rubber prices remained attractive during the year. Average price for RSS 1 ranged from Rs.268 to Rs.187 per kg. The same for latex crepe 1X was Rs. 276 to Rs.210 per kg.

Due to the prevailing attractive prices and high demand for natural rubber interest on new and replanting by the growers is currently at a very high level. As stated earlier in this report the institute revised its clone recommendation for the potential growers to have a better choice of high yielding clones. Further during the year more than 11,500 plants were distributed to establish budwood nurseries to popularize these clones among the rubber growers.

Availability of land in the traditional rubber growing areas is a constraint to increase the rubber extent in the country. Hence research and development work are being continued to expand rubber cultivations into other parts of the country.

Potential growers from Anuradapura, Polonnaruwa districts too have requested for advises from the institute regarding cultivation of rubber.

Even with the attractive rubber prices the productivity levels of both smallholder and plantation sectors seem to be increasing only at a very slow rate. Growers should endeavor to adopt the agronomic practices capable of giving high productivity levels to obtain the maximum benefits from the current attractive trading conditions.

Trends in the natural rubber industry

National:

The natural rubber production in the country has increased up to 117.6 thousand Metric Tonnes during the year. This is a 7.3% increase over the 2006 production of 109.6 thousand MT. As per the latest figure on the total rubber extent of the country, *i.e.* 120,070 ha and assuming 80% of the extent as mature rubber the national productivity level for the year is around 1225kg of rubber per hectare per annum. This is a 6.5% increase over the 2006 national productivity of 1150kg of rubber per hectare per annum. The national productivity is showing an increasing trend since the increase in natural rubber prices. There is further room for increasing national productivity level through improving quality of tapping, correct use of fertilizer and minimizing the negative impact of wet weather on harvesting.

The extent under rubber has increased upto 120,070 ha in 2007 from the figure of 116,050 ha in the previous year showing a 3.34% increase.

Global:

The world natural rubber production increased up to 9.893 million tonnes from the previous years production of 9.686 million tonnes. This is a 2.14% growth in the production and is lower than the national production increase of 7.3%. The world natural rubber consumption for the years 2006 and 2007 were 9.216 and 9.735 million tonnes respectively. Hence, the world natural rubber consumption in 2007 has increased by 5.6% than in the previous year. Further, during 2007 the world natural rubber consumption is about 98.4% of the total production.

The world synthetic rubber production increased up to 13.596 million tonnes from the previous years production of 12.733 million tonnes. This is a 6.778% growth in the production and is higher than the growth shown in the natural rubber production. The world synthetic rubber consumption increased up to 13. 197 million tonnes from the previous years consumption of 12.371 million tonnes. The growth is 6.68% and is higher than the growth shown in the natural rubber consumption.

OVERSEAS VISITORS

Mr Kwon Yung Dal, Korean Ambassador
Mr G R Durairaj, India

GENETICS AND PLANT BREEDING

P Seneviratne

SUMMARY

Clone recommendation was revised during the year under review (Annex.1). Clones RRISL 203 and RRISL 2001 were recommended for the smallholder sector farmers also with the restriction of planting only up to 10% of the area planted with other clones.

Yield data collected from Estate RRISL collaborative clone trials of clones RRISL 201, RRISL 203, RRISL 206, RRISL 208, RRISL 211, RRISL 216, RRISL 217, RRISL 219, RRISL 226, RRISL 2000 and RRISL 2001 continued to show promising yields.

A high fruit set of about 5.1% was achieved in the hand pollination programme this year. This is the highest fruit set reported so far. Out of 8,215 pollinations done 426 seedlings were raised.

Number of test tappings done in most of the trials was low due to rain interferences and also normal tapping being disturbed due to recovery tapping practices in many estates leading to daily tapping. This affected the collection of normal tapping data.

DETAILED REVIEW

Staff

Dr (Mrs) P Seneviratne Acting Head of the department, Assistant Geneticist and Plant Breeder Mr K K Liyanage, Research Assistant, Mr K B Karunasekera, Experimental Officers Mr K W Rupatunga, Mr L S Kariyawasam, Mr I D M J Sarath Kumara, Technical Officers Mrs A K Gamage, Mr T M S K Gunasekera, Mr H P Peiris, and Mrs S D P K L Peiris, Clerk/typist were on duty throughout the year.

Geneticist and Plant Breeder Mrs S P Withanage continued her postgraduate training abroad.

Prof. N E M Jayasekara of University of Wayamba, who was the Head of the, Genetics and Plant Breeding Department from 1984 to 1996 met the department staff as an advisor to assist on evaluation of new clones.

Meetings and Workshops

Officer	Subject	Organization
Mr K K Liyanage	Enhancing technology adoption rates and identifying future research and development needs, Rubber agronomy	RRISL for RPCs
Mr K K Liyanage	Short course on Statistical Analysis in Plant Breeding	PGIA

LABORATORY INVESTIGATIONS

Molecular biology of *Hevea* GPB/MM/97

Molecular biology work was not carried out during the year under review as the officer who was carrying out the work was reading for her PhD abroad.

FIELD EXPERIMENTS

Hand pollination (HP) programme – 2007(GPB/BST/HP/01)

The annual hand pollination programme was carried out at Dickhena division, Neuchatel estate. The parents were selected mainly to cross local and foreign clones with selected germplasm clones. The crosses attempted, the number of pollinations done in each cross, number of pods harvested and seedlings obtained in each cross are given in Table 1. The final fruit set this year was about 5.1% and it is about 2% increase with compared to that of the previous year.

Table 1. *Details of 2007 hand pollination programme*

Cross	No. of pollinations	No. of fruits collected	No. of seedlings
RRIC 130 × GP 22-137	1423	14	29
RRIC 130 × GP 21-163	901	17	40
RRIC 130 × GP 44-24	1284	03	-
RRIC 130 ×GP 1-2	804	02	01
RRIC 130 × (not known)	01	01	03
RRIC 130 × GP 10-154	14	01	03
IAN 45/710 × PB 260	1523	60	121
PB 260 × IAN 45/710	2266	100	229
Total	8215	198	426

(P Seneviratne, K K Liyanage, K B Karunasekera, K W Rupatunge, T M S K Gunasekera and I D M J Sarathkumara)

Evaluation of hand pollinated progenies

Small Scale Clone Trials

The list of the Small Scale Clone Trials monitored by the Department to-date is given in Table 2.

Table 2. *Details of small scale clone trials*

HP year	Site	Planting date	Current status
1986	Kuruwita	May 1990	9th year of tapping
1987	Clyde- Kethhena	May 1993	9th year of tapping
1988	Dartonfield	July 1993	7th year of tapping
1990	Kuruwita	July 2002	Immature
1991	Pallegoda	August 2000	1st year of tapping
	Vogan	November 2000	1st year of tapping
1995	Sorana	June 1998	3rd year of tapping
1996	Kuruwita – I & II	May 1999	2nd year of tapping
1997	Clyde – I & II	June 2000	2nd year of tapping
1998	N'kele I,II & III	June 2001	Tapping commenced at the end of the year
	Kuruwita I,II & III	July 2001	Immature
1999	Kuruwita I,II & III	June 2002	Immature
2000	Arappalakande I-III	May 2003	Immature
	Delkeith I & II	June 2003	Immature
	Elston I & II	July 2003	Immature
	Nivithigalakele I & II	July 2003	Immature
2001	Paiyagala I	June 2006	Immature
	Kuruwita sub station II	July 2006	Immature
2002	Pallegoda	July 2007	Immature

Evaluation of 1986 H.P. Selections - Kuruwita Sub station (GPB/BST/HPS/86)

Duncan multiple range test results of 16th year girth measurements and yield data relevant to the 9th year of tapping based on seven test tappings are given in Table 3a and 3b respectively. The highest girth was obtained from clone RRIC 121 and the highest yield was obtained from the clone 86-68.

Table 3a. *Mean girth (16th year) of promising 1986 H.P. clones*

Clone	Mean girth (cm) and DMRT grouping
RRIC 121	93.30 [a]
86- 87	82.52 [ab]
RRIC 100	76.94 [bc]
86-22	76.21 [bc]
86-32	75.60 [bc]
86-10	67.70 [bc]
86-17	66.55[c]

Table 3b. *Mean yield of promising 1986 H.P. clones*

Clone	Yield (g/t/t) and DMRT grouping
86-68	60.52 [a]
86-102	39.90[ab]
86-58	39.74 [abc]
RRIC 121	39.19 [abcd]
86-18	34.10 [abcde]
86-17	32.78 [abcde]
86-5	32.37 [abcde]
86-11	29.90 [abcde]
86-77	29.66 [abcde]

(P Senaviratne, K K Liyanage, H P Pieris and K B Karunasekera).

Evaluation of 1987 H.P. Selections - Clyde estate (GPB/BST/HPS/87/1)

Results of the Duncan's Multiple Range Test for 15th year girth and 9th year yield data based on three test tapings are given in Table 4a and Table 4b. Very high bark consumption rates were observed in this clearing due to the implementation of high intensity tapping. This affected the collection of normal tapping data throughout.

Table 4a. *Mean girth and the results of DMRT of the 1987 H.P. Selections*

Clone	Girth in cm and DMRT grouping
RRIC 121	85.90[a]
87-370	79.70[b]
RRIC 100	71.20[c]
87-364	71.0[c]
87-372	68.74[cd]
RRIC 102	66.48[cde]
87-386	65.18[de]
87-375	65.00[de]

Table 4b. *Mean yield and the results of DMRT of the 1987 H.P. selections*

Clone	Yield (g/t/t) and DMRT grouping
RRIC 121	60.11^{a}
87-364	53.44^{ab}
87-370	49.23^{abc}
87-372	46.08^{abc}
87-382	45.78^{abc}
87-386	44.35^{abcd}
RRIC 100	37.83^{bcd}

(P Senaviratne, K K Liyanage, I D M J Sarathkumara and K B Karunasekera)

Evaluation of 1988 H.P. Selections - Dartonfield estate (GPB/BST/HPS/88)

The 14th year girth measurements were taken and the mean girth of clones were grouped using the Duncan's Multiple Range Test. Clones that are better than the control clones are given in Table 5a. Mean yields and the DMRT grouping of some selected clones based on nine test tapings in the 7th year of tapping are given in Table 5b along with control clones.

Table 5a. *Mean girth in cm of the 1988 HP progeny*

Clone	Mean girth and DMRT grouping
88-28	74.50^{a}
88-31	73.83^{ab}
88-15	72.85^{abc}
88-16	70.75^{abcd}
88-36	69.70^{abcd}
88-14	69.58^{abcd}
88-32	69.58^{abcd}
88-20	68.00^{abcde}
88-11	67.85^{abcde}
88-26	65.81^{abcdef}
88-40	$64.67^{abcdefg}$
88-30	64.50^{bcdefg}
RRIC 100	64.16^{cdefg}

Table 5b. *Mean yield (g/t/t) of the 1988 HP progeny*

Clone	Mean yield and DMRT grouping
RRIC 121	46.66^{a}
RRIC 110	41.89^{ab}
88-14	39.44^{abc}
88-28	37.34^{abc}
88-8	37.19^{abc}
RRIC 102	36.86^{abc}
88-21	36.67^{abc}
88-36	36.19^{abc}
88-10	33.99^{abcd}
RRIC 100	33.36^{abcd}

(P Senaviratne, K K Liyanage and L S Kariyawasam)

Evaluation of 1990 H.P. clones at Kuruwita estate (GPB/BST/HPS/90/01)

HP entries and clones which performed well in growth were listed in the Table 6.

Table 6. *Mean girth of selected HP entries of the 1990 HP progeny planted at Kuruwita Sub station*

Clone	Mean girth (cm) and DMRT grouping
90-10	47.35^{a}
90-7	44.75^{ab}
90-20	44.62^{ab}
90-11	43.81^{ab}
90-21	42.68^{ab}
90-27	42.18^{ab}
90-23	40.68^{ab}
RRISL 205	32.06^{abc}
90-1	40.06^{abc}
90-6	39.68^{abc}
90-28	39.56^{abc}

(P Seneviratne, K K Liyanage, H P Peris and K B Karunasekera).

Evaluation of 1991 HP clones Pallegoda and Vogan estates (GPB/BST/HPS/91/01 & 91/2)

The seventh year girth measurements were taken from the two trials. Some of the HP entries and control clones from trail 1 and trial 2 are shown in Table 7a. Mean yields of Pallegoda estate trail and the DMRT grouping of some selected clones based on four test tapings in the first year tapping are given in Table 7b along with control clones.

Table 7a. *Mean girth of selected HP entries of the 1991 HP progeny planted at Pallegoda and Vogan estates*

Mean girth (cm) from 91-01 trial (Pallegoda)		Mean girth (cm) from 91-02 trial (Vogan)	
Clone	**Girth**	**Clone**	**Girth**
RRISL 205	69.8050^{a}	97-62	69.0^{a}
RRIC 121	65.69^{ab}	RRISL 205	65.65^{ab}
91-29	65.63^{ab}	RRIC 121	62.60^{abc}
91-19	63.77^{bc}	91-71	61.03^{bcd}
91-5	61.95^{bcd}	91- 63	60.90^{bcde}
91-13	61.32^{bcde}	91-79	58.95^{bcdef}
91-34	60.77^{bcde}	97-58	58.83^{bcdef}
91-2	60.17^{bcde}	91-58	58.36^{bcdefg}
91-1	60.00^{bcde}	91-73	$57.37^{bcdefgh}$

Table 7b. *Mean yield and the results of DMRT grouping of the 1991 H.P. selections planted at Pallegoda estate*

Clone	Mean yield and DMRT grouping
91-24	45.45^{a}
91-19	45.21^{a}
91-21	42.65^{ab}
91-13	42.46^{ab}
91-7	39.41^{abc}
91-36	37.07^{abcd}
91-8	35.84^{abcde}
91-4	34.69^{bcdef}
91-16	34.64^{bcdef}
91-17	34.06^{bcdefg}

(P Seneviratne, K K Liyanage, K W Rupatunge, L Kariyawasam and K B Karunasekera)

Evaluation of 1995 H.P. selections Sorana estate (GPB/BST/HPS/95)

The 9th year girth measurements and the third year yield data based on six test tappings are given in Table 8 and are grouped using Duncan's Multiple Range Test. This trail too was affected badly by the implementation of high intensity tapping.

Table 8. *Mean girth and yield of the 1995 HP progeny*

Clone	Mean girth (cm) and DMRT grouping	Clone	Mean yield and DMRT grouping (g/t/t)
RRIC 121	69.17^{a}	95-55	49.82^{a}
95-50	67.61^{ab}	95-23	49.35^{a}
95-55	67.06^{abc}	95-13	48.72^{a}
95-48	65.81^{abcd}	95-1	41.80^{ab}
95-26	64.62^{abcde}	RRIC 121	41.70^{ab}
95-47	64.48^{abcdf}	95-47	41.52^{ab}
95-11	64.03^{bcdefg}	95-12	41.26^{ab}
95-53	63.52^{bcdefg}	95-29	40.71^{abc}
95-51	63.41^{bcdefg}	95-21	40.30^{bc}
95-29	$62.38^{cdefghi}$	95-22	36.20^{bcd}
95-45	$62.25^{cdefghij}$	95-18	36.70^{bcde}

(P Seneviratne, K K Liyanage, I D M J Sarathkumara and K B Karunasekera)

Evaluation of 1996 H.P. seedlings - Kuruwita estate (GPB/BST/HPS/96 -1 and 96-2)

In both trials seventh year girth measurements are grouped using Duncan's multiple range test and some of the superior genotypes are given in table 9a. Mean yields and the DMRT grouping of some selected clones based on eight test tapings in the first year tapping are given in Table 9b along with control clones.

Table 9a. *Mean girth at 120 cm of the 1996 HP progeny*

Mean girth (cm) from 96-1 trial		Mean girth (cm) from 96-2 trial	
Clone	**Girth**	**Clone**	**Girth**
96-59	74.03^{a}	RRIC 121	68.00^{a}
96-14	66.9^{ab}	96-37	66.90^{ab}
96-15	65.85^{abc}	96-54	63.83^{abc}
RRIC 121	65.07^{abc}	96-47	63.53^{abc}
96-17	65.00^{abc}	96-44	63.42^{abc}
96-3	62.73^{bcd}	96-45	63.41^{abc}
96-58	62.23^{bcde}	96-40	59.62^{abcd}
96-31	61.53^{bcde}	96-26	59.15^{abcd}
RRISL 205	61.17^{bcdef}	96-39	59.14^{abcd}

Table 9b. *Mean yield and the DMRT grouping of some of the HP selections*

Mean yield (g/t/t) from 96-1 trial		Mean yield (g/t/t) from 96-2 trial	
Clone	**Girth**	**Clone**	**Girth**
96-58	57.5^{a}	96-57	56.1^{a}
96-24	47.0^{ab}	96-22	54.3^{a}
96-14	46.6^{abc}	96-33	39.4^{bc}
96-31	44.3^{abcd}	96-40	35.6^{cd}
96-65	43.5^{abcde}	96-39	35.1^{cd}
96-2	38.5^{bcdef}	RRIC 121	34.7^{cd}
96-57	38.0^{bcdef}	96-32	33.8^{cde}
96-7	37.4^{bcdef}	96-48	33.3^{cde}
96-56	37.0^{bcdef}	PB 260	33.2^{cde}
96-18	37.0^{bcdef}		
PB 260	35.7^{bcdef}		

(P Seneviratne, K K Liyanage, H P Peris and K B Karunasekera)

Evaluation of 1997 H.P. clones at Clyde estate (GPB/BST/HPS/97/01 & 91/2)

The seventh year girth measurements were taken in both trials. The best HP entries of both trials are shown in Table 10a. Mean yields and the DMRT grouping of some selected clones based on four test tapings done in the first year tapping are given in Table 10b along with control clones.

Table 10a. *Mean girth in cm of the 1997 HP progeny planted at Clyde estate*

Mean girth (cm) from 97-01 trial		Mean girth (cm) from 97-02 trial	
Clone	**Girth**	**Clone**	**Girth**
97-9	62.73^{a}	97-69	71.63^{a}
97-2	62.28^{ab}	97-55	61.64^{ab}
97-10	60.16^{abc}	RRISL 205	61.57^{ab}
RRISL 205	60.10^{abc}	97-67	60.30^{ab}
97-19	59.60^{abc}	97-61	59.75^{abc}
97-26	58.63^{abcd}	97-79	57.32^{bcd}
97-22	58.03^{abcd}	97-44	56.96^{bcd}

Table10b. *Mean yield of the 1997 HP progeny planted at Clyde estate*

Mean yield (g/t/t) from 97-01 trial		Mean yield (g/t/t) from 97-02 trial	
Clone	**Yield**	**Clone**	**Yield**
97-32	46.13^{a}	97-74	65.84^{a}
97-36	42.29^{ab}	97-60	48.23^{b}
97-26	41.36^{abc}	97-70	47.37^{b}
97-25	40.79^{abc}	97-66	45.40^{b}
97-19	38.46^{bcd}	97-55	44.74^{bc}
97-9	35.55^{bcd}	97-54	37.11^{cd}
97-43	35.51^{bcd}	97-51	36.29^{de}

(P Seneviratne, K K Liyanage, T M S K Gunasekera and K B Karunasekera).

Evaluation of 1998 H.P. clones at Nivithigalakele (GPB/BST/HPS/98/01,02,03) and Kuruwita substations (GPB/BST/HPS/98/04,05,06)

Sixth year girth measurements were taken from the above six trials. Girth data analysed using Duncan's multiple range test for each trial and some of the promising HP entries and control clones are given in Tables 11a and 11b.

Table 11a. *Mean girth of selected HP entries of the 1998 HP progeny planted at Nivitigalakele Sub station*

Trial 98-01 Mean girth(cm)		Trial 98-02 Mean girth(cm)		Trial 98-03 Mean girth(cm)	
Clone	**Girth**	**Clone**	**Girth**	**Clone**	**Girth**
98-88	62.31^{a}	98-132	62.50^{a}	RRISL 205	56.96^{a}
98-147	57.46^{b}	98-96	58.73^{b}	98-133	56.80^{a}
98-180	55.28^{bc}	98-159	55.84^{bc}	98-151	56.37^{ab}
98-134	55.16^{bc}	RRIC 121	54.33^{cd}	98-281	55.60^{ab}
RRIC 121	54.17^{bcd}	98-129	53.64^{cde}	RRIC 121	55.50^{ab}
98- 115	53.57^{bcd}	98-53	52.63^{cdef}	98-225	55.46^{ab}
RRISL 205	53.56^{bcd}	98-259	51.43^{defg}	98-197	55.12^{ab}
98-108	53.46^{bcd}	RRIC 130	50.10^{efgh}	98- 280	54.76^{abc}
98-112	53.09^{bcd}	98-85	50.19^{efgh}	98-204	53.75^{abcd}

Evaluation of 1999 HP clones at Kuruwita estate (GPB/BST/HPS/99/01, 02 & 03)

The fifth year girth measurements taken from each trial of the HP entries are shown in Table 12. Results of the best control clone and those performed better than the control clone are given in Table 12.

Table 11b. *Mean girth of selected HP entries of the 1998 HP progeny planted at Kuruwita Sub station*

Trial 98-04 Mean girth (cm)		Trial 98-05 Mean girth (cm)		Trial 98-06 Mean girth (cm)	
Clone	**Girth**	**Clone**	**Girth**	**Clone**	**Girth**
98-276	56.71^{a}	98-68	57.71^{a}	98-223	58.53^{a}
98- 230	56.40^{ab}	98-80	54.28^{ab}	RRISL 205	56.53^{ab}
98- 98	55.87^{ab}	98-58	54.00^{ab}	98-154	54.33^{abc}
98- 84	55.68^{ab}	98-51	53.37^{ab}	98- 19	53.35^{abcd}
98- 11	54.56^{abc}	98-62	53.00^{ab}	98-30	53.21^{bcd}
RRISL 205	53.09^{abcd}	98-41	49.90^{bc}	RRIC 121	52.50^{bcde}
98-219	52.53^{abcde}	98-50	49.50^{abc}	98-196	49.95^{cdef}
98- 164	51.13^{abcdef}	98-07	49.00^{bc}	98-278	49.61^{defg}
98- 89	51.00^{abcdef}	98-73	48.86^{bc}	98-23	48.15^{efgh}
		RRISL 205	48.75^{bc}	RRIC 130	48.03^{efgh}

(P Seneviratne, K K Liyanage, H P Peris and K B Karunasekera).

Table 12. *Mean girth of selected HP entries of the 1999 HP progeny planted at Kuruwita Sub station*

Trial 99-01 Mean girth (cm)		Trial 99-02 Mean girth (cm)		Trial 99-03 Mean girth (cm)	
Clone	**Girth**	**Clone**	**Girth**	**Clone**	**Girth**
99-55	41.93^{a}	99-157	51.83^{a}	99-189	52.57^{a}
99-61	41.68^{ab}	99-47	46.57^{ab}	99-216	48.12^{ab}
99-43	41.37^{abc}	99-167	44.31^{bc}	99-230	44.12^{bc}
99-67	40.75^{abc}	99-246	42.68^{bcd}	99-166	42.12^{bcd}
99-74	39.35^{abc}	99-272	42.62^{bcd}	99-63	41.50^{bcde}
99-73	39.33^{abc}	99-265	42.31^{bcde}	99-192	41.42^{bcde}
99-139	39.31^{abc}	99-178	41.93^{bcde}	99-133	41.31^{bcdef}
99-80	39.12^{abcd}	99-137	41.28^{bcdef}	RRISL 205	41.25^{bcdef}
99-48	38.75^{abcde}	99-159	41.18^{bcdef}	99-120	40.75^{bcdef}
99-71	38.43^{abcdef}	RRISL 205	99-159	RRIC 121	40.57^{bcdefg}
99-81	38.25^{abcdef}		RRISL 205		
99-58	$37.56^{abcdefg}$				
RRISL 205	$37.28^{abcdefg}$				

(P Seneviratne, K K Liyanage, H P Peris and K B Karunasekera).

Evaluation of 2000 H.P. clones at Arrapalakande estate (GPB/BST/HPS/00/01,02,03), Dalkeith estate (GPB/BST/HPS/00/04,05), Nivithigalakele substation (GPB/BST/HPS/00/06,07) at Elston estate (GPB/BST/HPS/00/08,09)

Arrapalakande Trial I (GPB/BST/HPS/00/01)

Each block contained 364 genotypes in completely randomized single tree plots, derived from 11 families. Forth year girth measurements are given with the families in Table 13.

Table 13. *Mean girth and DMRT grouping of families of 2000 HP progeny Trail I planted at Arrapalakande estate*

Family	Mean girth (cm) and DMRT grouping
PB 235 × PB 260	42.66^{a}
BPM 24 × PB 260	41.42^{ab}
RRIC 121× PB 235	41.19^{abc}
BPM 24 × PB 235	40.98^{abc}
PB 235 × RRIC 121	40.82^{abc}
BPM 24 × RRIC 121	39.36^{bcd}
PB 260 × RRIC 121	39.30^{bcd}
BPM 24 × GP 36-104	39.02^{bcd}
RRIC 121 × PB 260	38.38^{cde}
PB 260 × PB 260	37.09^{de}
RRIC 121 × GP 36-147	35.91^{e}

(P Seneviratne, K K Liyanage, T M S K Gunasekera and K B Karunasekera).

Arrapalakande Trial II (GPB/BST/HPS/00/02)

Total of 258 genotypes derived from eight families were tested in a completely randomized single tree plot design. Family means derived from forth year girth measurements are given in Table 14.

Arrapalakande Trial III (GPB/BST/HPS/00/03)

This trial contained 90 genotypes derived from a single family BPM 24 × PB 235 planted in a completely randomized design with four single tree plots per clone. Forth year girth measurements were taken and some of the genotypes and their DMRT ranking are shown in Table 15.

Table 14. *Mean girth of families of the 2000 HP progeny Trial II planted at Arrapalakande estate*

Family	Mean girth (cm)
BPM 24 × PB 235	41.00
RRIC 121 × PB 235	40.07
BPM 24 × PB 260	39.85
BPM 24 × RRIC 121	39.67
RRIC 121× PB 260	38.33
PB 235 × RRIC 121	37.74
PB 235 × PB 260	37.66
RRIC 121 × GP 36-147	36.16
PB 260 × RRIC 121	34.83
PB 260 × PB 260	34.12

(P Seneviratne, K K Liyanage, K W Rupatunge and K B Karunasekera).

Table 15. *Mean girth of vigorous genotypes and their DMRT ranking in 2000 HP progeny Trial III planted at Arrapalakande estate*

Clone	Girth (cm)
2000-103	49.66^{a}
2000-192	48.75^{ab}
2000-149	48.75^{ab}
2000-48	48.00^{abc}
2000-59	47.75^{abcd}
2000-121	47.37^{abcd}
2000-105	45.83^{abcde}
2000-101	45.62^{abcde}
2000-191	45.50^{abcde}
2000-42	45.50^{abcde}
2000-54	45.37^{abcde}

(P Seneviratne, K K Liyanage, I D M J Sarathkumara and K B Karunasekera).

Dalkeith estate Trial IV (GPB/BS/HPS/00/04)

In this trial, 112 genotypes derived from two families (RRIC 121 × PB 235 & PB 235 × RRIC 121) (56 from each family) were planted in a completely randomized design with three single tree plots per clone. Results of the forth year girth measurements showed that about 35 genotypes achieved over 35cm measured at 120cm above the bud union (P Seneviratne, K K Liyanage, K W Rupatunge and K B Karunasekera).

Dalkeith estate Trial V, GPB/BST/HPS/00/05

In this trial, 98 genotypes from two families [BPM 24 × PB 260 (53) & RRIC 121 × PB 260 (45)] were planted in a completely randomized design with three single tree plots per clone. Forth year girth measurements of the vigorous genotypes and their DMRT ranking are shown in Table 16.

Table 16. *Mean girth of vigorous genotypes and their DMRT ranking in 2000 HP progeny Trail V planted at Dalkeith estate*

Clone	Girth (cm)
2000-254	42.33^{a}
2000-208	41.00^{ab}
2000-333	40.50^{abc}
2000-198	40.16^{abcd}
2000-1199	40.00^{abcd}
2000-245	39.83^{abcd}
2000-229	39.33^{abcde}
2000-300	39.00^{abcdef}
2000-1324	$38.00^{abcdefg}$
2000-271	$38.00^{abcdefg}$

(P Seneviratne, K K Liyanage, I D M J Sarathkumara and K B Karunasekera).

Nivithigalakele substation - Trial VI and Trial VII (GPB/BS/HPS/00/06, GPB/BST/HPS/00/07)

In trial VI, 46 genotypes from one family with three single tree plots are being tested in a completely randomized design. In Trial VII, 193 genotypes are tested from a single family with three single tree plots, in a completely randomized design. Family mean, Variance, Minimum and Maximum derived from the forth year girth measurements are given in Table 17.

Table 17. *Mean, minimum, maximum and variance of two families planted at Nivitigalakele (2000 hand pollination progeny) trial VI and VII*

	Results of the trial VI (BPM 24 × RRIC 121)	**Results of the trial VII (PB 260 × RRIC 121)**
Mean (cm)	36.19	39.12
Minimum (cm)	14.50	21.00
Maximum (cm)	49.00	59.5
Variance	41.38	42.49

(P Senaviratne, K K Liyanage, T M S K Gunasekera and K B Karunasekera).

Elston Estate VIII and Trial IX (GPB/BS/HPS/00/08, GPB/BST/HPS/00/09)

In trial VIII, 103 genotypes from one family (PB 235 × RRIC 121) with three single tree plots are being tested in a completely randomized design. In Trial IX, 52 genotypes have been included from 11 families with six single tree plots per genotype in a completely randomized design. Results of the forth year girth measurements show that about 34 genotypes have achieved over 35cm in trial VIII. Table 18 shows the family means calculated from the third year girth measurements in trial IX.

Table 18. *Mean and variance of families planted at Elston estate trial IX*

Parentage (Family)	Mean girth (cm)	Variance
BPM 24 × GP 36-104	34.18	23.65
BPM 24 × PB 235	37.75	18.49
BPM 24 × PB 260	37.20	39.42
BPM 24 × RRIC 121	37.75	18.49
PB 235 × PB 260	37.66	37.43
PB 235 × RRIC 121	34.61	25.11
PB 260 × PB 260	33.83	31.36
PB 260 × RRIC 121	35.11	42.26
RRIC 121 × GP 36-147	34.57	28.16
RRIC 121 × PB 235	39.00	27.68
RRIC 121 × PB 260	37.14	37.20

(P Seneviratne, K K Liyanage, T M S K Gunasekera and K B Karunasekera).

Genotype environment interaction (G × E) studies (GPB/GE/98)

Annual girth measurements and yield data were collected during the year. Analysis of variance of the girth (ninth year) showed the presence of significant differences in growth between clones, sites and the presence of significant genotype × environment interaction effect. Table 19 shows the mean girth and the variance of the clones in the eight sites under study. The highest mean girth at all sites was recorded for RRISL 201, RRISL 205 and RRISL 206 and GPS 1 showed the lowest girth.

It was not possible to carry out test tappings of these trials regularly due to rain interferences and other unavoidable circumstances, especially high intensity tapping in most sites.

Table 19. *Mean girth and the variance of the clones in each site*

Clone	Gancpalla	Muwan Kanda	Atale	Palm garden	Pelma Dulla	Badde Gama	Bibile	Sorana	Clone Mean	Variance
RRISL 201	68.3	71.7	69.1	67.5	67.5	68.1	64.5	68.5	**68.1**	**3.47**
RRISL 205	70.2	75.2	71.3	62.8	62.8	70.8	66.1	74.4	**69.2**	**20.31**
RRISL 206	60.2	67.0	67.2	61.3	61.3	65.9	64.6	66.9	**64.3**	**7.49**
RRISL 210	60.8	56.9	63.1	55.3	55.3	58.1	56.4	63.5	**58.6**	**9.85**
RRISL 215	58.7	60.4	58.6	59.4	59.4	59.5	55.7	59.3	**58.8**	**1.70**
RRISL 217	56.5	57.2	59.8	57.3	57.3	58.5	58.5	61.0	**58.2**	**2.00**
RRISL 218	59.1	69.1	72.9	57.7	57.7	62.4	59.3	68.2	**63.3**	**30.87**
RRISL 220	56.3	58.3	54.0	53.7	53.7	60.7	47.2	48.7	**54.0**	**17.89**
GPS 1	45.0	46.2	39.5	38.0	38.0	42.1	44.0	48.5	**42.6**	**13.45**
RRII 105	56.3	56.1	60.6	55.2	55.2	59.2	54.3	53.7	**56.3**	**5.01**
RRIM 712	48.0	48.0	48.7	48.0	48.0	50.3	48.5	44.4	**47.9**	**2.37**
RRIC 130	55.0	51.0	54.2	60.2	60.2	54.5	49.3	53.5	**54.7**	**13.14**
Heiken 2	49.9	52.7	48.4	47.6	47.6	48.2	51.8	49.0	**49.4**	**3.24**
PB 260	52.6	54.2	62.0	56.8	56.8	54.7	50.9	53.7	**55.2**	**10.01**
Site Mean	56.9	58.8	59.2	55.7	55.7	58.07	55.07	58.09		

(P Seneviratne, K K Liyanage, K W Rupatunga, I D M J Sarathkumara, H P Peris and K B Karunasekera).

Performance of Multi-clonal stands (GPB/MCS/99/KU)

The seventh year girth measurements were taken during the year. Table 20a shows the mean girth of each treatments, *i.e.* control monoclonel plots and plots of Bi – and Tri - clonal mixtures. According to the girth data control monoclonal plot (RRIC 121) show high growth rate. First year yield data are given in Table 20b.

Open pollinated seedling progenies from commercial clones (GPB/BST/SP/00)

Seventh year girth measurements were recorded from this trial and shown in Table 21. Girth was measured 150 cm above the bud union in budded plants and 150 cm above the ground level in seedlings. As far as the girth is concerned there is no significant difference among selected and unselected seedlings.

Table 20a. *Mean girth of each treatment*

Treatment	Mean girth (cm)
RRIC 121	65.03
RRIC100/RRIC 133/RRIC 121	63.76
RRIC 121/RRIC 133	63.73
RRIC 133	63.46
RRIC 100/ RRIC 102	63.13
RRIC 102/ RRIC 121	61.11
RRIC 102/ RRIC 133	60.60
RRIC 100/RRIC 121	60.07
RRIC 100/RRIC 102/RRIC 121	59.73
RRIC 100/RRIC 133	59.52
RRIC 102/RRIC 121/RRIC 133	57.96
RRIC 102	57.87
RRIC 100/RRIC 102/RRIC 133	57.67
RRIC 100	55.87

Table 20b. *Mean yield (g/t/t) of each treatments*

Treatment	Mean yield (g/t/t)
RRIC102/RRIC 121	26.58
RRIC 102	25.54
RRIC 121	25.28
RRIC 100/RRIC 121	25.10
RRIC 100/RRIC 102/RRIC 121	24.16
RRIC 100/RRIC 102	24.15
RRIC 102/RRIC 121/RRIC 133	23.90
RRIC 100	23.65
RRIC 121/RRIC 133	23.12
RRIC 100/RRIC 121/RRIC 133	22.06
RRIC 100/RRIC 102/RRIC 133	19.91
RRIC 100/RRIC 133	18.44
RRIC 102/RRIC 133	18.30
RRIC 133	16.33

(P Seneviratne, K K Liyanage, K B Karunasekera and H P Peiris in collaboration with Plant Science Dept.)

Table 21. *Seventh year girth measurements obtained from seedlings and budded plants*

Budded plants	Girth (cm)	Selected seedlings	Girth (cm)	Unselected seedlings	Girth (cm)
PB 86	49.00	PB 86	57.87	PB 86	57.94
RRIC 121	58.39	RRIC 121	57.28	RRIC 121	59.38
PB 28/59	51.29	PB 28/59	52.91	PB 28/59	52.70
RRIC 100	55.67	RRIC 100	60.60	RRIC 100	60.48
PB 260	54.72	PB 260	61.17	PB 260	60.13

(P Seneviratne, K K Liyanage, K W Rupatunga and K B Karunasekera)

Estate/RRI collaborative clone trials (ECT's) GPB/BST/ECTs

Annual girth measurements were taken from all the trials. Table 22 shows the girth measurements of the current year and the previous two years with the information on planting sites.

Yields from ECTs

GPB/BST/ECT/95/01

The estate yields obtained from ECT trials are given in Table 23. Clone, year of tapping, DRC, g/t/t and yield/tree/annum are included.

Table 22. *Annual girth measurements of ECTs*

Clone	Site	Year of planting	Girth in cm		
			2005	2006	2007
RRISL 201	Tempo	1996	65.50	68.08	70.82
	Moralioya	1996	69.40	75.14	78.70
	Kuruwita	1994	67.00	69.87	
	Salawa	1999	58.80	64.11	
RRISL 203	Galewatta	1987	71.20	72.51	73.87
RRISL 205	Pallegoda	1995	67.90	69.40	72.58
	Vogan	1997	73.50	75.60	78.30
RRISL 206	Pallegoda	1995	61.80	63.50	66.42
	Vogan	1997	62.70	65.27	66.48
	Salawa	1999	53.90	55.50	
RRISL 207	Dosert division*	2004	9.90	14.50	21.86
RRISL 208	Dartonfield	1994	64.16	65.33	67.48
RRISL 211	Dartonfield	1994	63.70	64.53	65.59
	Siriniwasa*	2001	38.76	46.40	49.66
RRISL 214	Dosert division*	2004	9.18	12.79	21.16
RRISL 215	Salawa	1999	57.90	59.80	50.55
RRISL 216	Dartonfield	1994	60.80	62.48	64.21
RRISL 217	Kuruwita	1995	56.70	58.49	
	Vogan	1997	58.60	59.98	61.71
RRISL 219	Dartonfield	1994	63.50	65.16	67.20
RRISL 220	Salawa	1999	49.37	52.10	
RRISL 221	Salawa	1999	52.60	56.23	
RRISL 223	Galewatte	1994	63.10	64.25	64.77
RRISL 225	Nivitigalakele*	2002	34.50	47.20	52.10
RRISL 226	Salawa	1999	52.50	54.46	
	Siriniwasa*	2001	37.20	42.86	48.30
RRISL 2000	Pallegoda	1998	60.50	62.65	65.13
	Nivitagalakele*	2001	43.60	52.17	58.90
	Dosert division*	2004	8.68	15.32	24.28
RRISL 2001	Pallegoda	1995	61.00	63.10	65.34
	Nivitigalakele*	2001	36.90	46.60	55.13
	Dosert division*	2004	9.25	16.25	24.31
RRISL 2002	Dosert division*	2004	8.43	13.93	20.96
RRISL 2003	Dosert division*	2004	8.73	14.71	21.70
RRISL 2004	Dosert division*	2004	8.24	15.13	23.30
RRISL 2005	Dosert division*	2004	12.24	17.46	27.40
RRISL 2006	Dosert division*	2004	11.55	16.76	24.15
RRII 105	Pallegoda	1998	52.30	54.10	55.89

* Immature fields

Table 23. *Clone, year of tapping, number of tapping days, g/t/t and yield/tree/year of ECT trials*

Clone	Year of tapping	No. of tapping days	Average g/t/t	Yield/tree/year (Kg)
RRISL 201	4	154	30.40	4.68
RRISL 203	13	92	55.09	5.06
RRISL 205	6	121	32.75	3.96
RRISL 206	6	110	46.67	5.13
RRISL 208	5	123	53.95	6.63
RRISL 211	5	128	43.53	5.57
RRISL 216	5	121	37.75	4.56
RRISL 217	6	107	38.32	4.10
RRISL 219	5	117	31.42	3.67
RRISL 223	3	152	29.93	4.54
RRISL 2000	1	126	36.06	4.54
RRISL 2001	6	104	32.53	3.38

(P Seneviratne, K K Liyanage, K W Rupatunga, K B Karunasekera, I D M J Sarath Kumara, H P Peries, T M S K Gunasekera and L S Kariyawasam).

Smallholder/RRI collaborative clone trials - GPB/BST/SRT/01/01-03

Sixth year girth measurements were taken from these trials (Table 24). All three clones planted under this programme showed vigorous growth.

Table 24. *Mean girth (cm) of the SRT trials planted in 2001*

Clone	Site/Expt. No.	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
RRISL 201	Kegalle (SRT/01/01)	10.5	20.2	31.7	43.5	53.78	59.96
	Homagama (SRT/01/03)	10.4	20.1	31.6	43.9	53.3	59.98
RRISL 203	Kegalle (SRT/01/01)	10.8	19.4	30.03	42.45	51.73	57.0
	Homagama (SRT/01/03)	8.58	16.85	26.6	37.1	46.19	52.8
RRISL 205	Kegalle (SRT/01/01)	8.95	15.7	23.8	34.14	44.13	50.08
	Homagama (SRT/01/02)	10.3	19.9	32.50	45.60	54.79	62.41

(P Seneviratne, K K Liyanage, K B Karunasekera, H P Peries and L S Kariyawasam).

CARP Project 12/478/973 - Testing of new *Hevea* clones for rubber smallholders

Fifth year mean girth of the four clones obtained from three sites planted in year 2002 and forth year girth of clones planted in year 2003 are given in Table 25. Required fertilizer applications for the period were completed.

Table 25. *Mean girth cm of the trials planted in 2002 and 2003*

Clone	Site/Expt. No.	Year 1	Year 2	Year 3	Year 4	Year 5
RRIC 201	Kalutara (SRT/02/02)	6.98	17.80	26.38	40.48	49.50
	Kalutara (SRT/02/03)	6.04	13.50	20.18	29.86	41.13
	Ratnapura (SRT/02/04)	6.98	11.30	17.92	33.90	40.80
	Kaburupitiya (SRT/03/01)	10.00	20.70	33.75	48.55	
	Radawela (SRT/03/02)	7.30	16.00	30.12	43.67	
RRIC 205	Kalutara (SRT/02/02)	5.90	16.60	27.34	42.07	51.75
	Kalutara (SRT/02/03)	6.44	14.70	22.06	31.59	40.64
	Ratnapura (SRT/02/04)	6.17	12.30	20.90	31.21	43.75
	Kaburupitiya (SRT/03/01)	8.80	18.20	30.81	44.80	
	Radawela (SRT/03/02)	7.70	15.60	29.00	43.96	
RRIC 206	Kalutara (SRT/02/02)	6.82	19.00	30.03	42.98	51.76
	Kalutara (SRT/02/03)	6.69	15.98	26.22	35.71	44.81
	Ratnapura (SRT/02/04)	6.20	12.15	20.76	33.7	41.4
	Kaburupitiya (SRT/03/01)	9.18	19.75	31.86	42.30	
	Radawela (SRT/03/02)	8.51	16.90	30.37	44.17	
RRIC 121	Kalutara (SRT/02/02)	5.21	12.90	20.16	30.91	38.23
	Kalutara (SRT/02/03)	6.19	12.60	18.67	27.07	36.60
	Ratnapura (SRT/02/04)	6.18	9.60	16.70	27.12	35.00
	Kaburupitiya (SRT/03/01)	9.91	17.90	27.98	41.40	
	Radawela (SRT/03/02)	8.10	17.20	29.50	42.60	

Conservation and evaluation of the IRRDB germplasm (GPB/GP/85/2)

Renewing of all the genotype numbers was continued but other maintenance work was kept to minimum possible due to lack of funds (P Seneviratne, K K Liyanage and I D M J Sarathkumara).

New plantings

A small scale clone trial was established at Pallegoda Estate to test 26 selected genotypes from 2002 hand pollination progeny.

Estate/RRI collaborative clone trials were established at Kuruwita sub station and Pallegoda estate to test the following clones (Table 26).

Table 26. *Details of Estate/RRI collaborative clone trials*

Clone	Site
RRISL 208	Pallegoda estate
RRISL 216	,,
RRISL 219	,,
PB 260	,,
92-124	Kuruwita substation
92-129	,,
92-132	,,

Annexure 1

1. ***Clone Recommendation for the Plantation Sector***

Group I - Each clone to be planted up to a maximum of 10% of the total extend of the plantation to minimize the risk from conditions disastrous to rubber such as *Corynespora* leaf disease

RRIC 102, RRIC 121, RRIC 130*, RRISL 203, PB 260*

Group II - Each clone to be planted up to 3% of the total extent of the plantation.

RRIC 133	***RRISL 201***	***RRISL***	***BPM 24***
	RRISL 205	***2001***	***PB 217****
	RRISL 206	***RRISL***	***PB 235****
	RRISL 210	***2003***	***PB 28/59****
	RRISL 211		
	RRISL 215		
	RRISL 216		
	RRISL 217*		
	RRISL 219		

Group III - Each clone to be planted up to two hectares in a plantation. (Estate/RRI collaborative clone trials)

RRISL 208	***RRISL 2000***	***GPS 1***
RRISL 220	***RRISL 2002***	***PB 255***
RRISL 221	***RRISL 2004***	***PR 255***
RRISL 222	***RRISL 2005***	***PR 305***
RRISL 223	***RRISL 2006***	***RRII 105***
RRISL 225		***RRIM 712***
RRISL 226		

* Clones to be tapped at 67%, *i.e.* $\frac{1}{2}$ S d/3

2. ***Clone recommendation for the smallholder Sector***

Group (a.) RRIC 100 - This clone is recommended only for non traditional areas.
Group (b.) RRIC 102, RRIC 121, RRISL 203
Group (c.) RRISL 2001 - This clone is recommended for holdings more than 5 ha. in extent and area planted should not exceed 10% of the total extent of the holding

3. ***Clone recommendation for planting at high elevations***
(above 300 m up to 900m)
Group (a.) RRIC 100, RRIC 130
Group (b.) RRIC 102, RRIC 133, RRISL 206
Each of the Group (b.) clones should not exceed 5 ha. in a plantation.

Note :

- RRIC 121 should not be planted in humid pockets.
- RRIC 130 is prone to wind damage and should not be planted in areas prone to strong wind.
- Clones RRIC 130, RRISL 217, PB 217, PB 235, PB 28/59 and PB 260 should be tapped at 67% intensity *i.e.* $\frac{1}{2}Sd_3$ until intensification
- In the intermediate zone, planting may be extended to areas beyond 900m elevation on trial basis with the collaboration of RRISL.

PLANT SCIENCE

P Seneviratne

SUMMARY

Rubber seed production continues to be uneven in all agro-climatic regions. The clone RRIC 100 produced rubber seeds in Kalutara district also but about two months after the normal seed fall season. However, widely planted RRIC 100, covering more than 60% of the rubber extent in the country, is producing about 40,000 seeds per hectare indicating no shortage of seeds for the nurseries in the near future. Studies are continued to gain more knowledge on the flowering and seed production of new clones recommended for planting in Sri Lanka.

Re-instating of juvenile characteristics in mature clonal plants by successive grafting show promising results measured by the angle of the scion shoot and the growth rate of the plant. The root system of young buddings in the cone shape containers grow without coiling at the base. The biodegradable bags degrade after about 10 months making planting with the bag more effective. Soil type show minimum effect on the growth of the young buddings.

Yield of crown budded plants seems to be affected to a greater extent when the crown is from a different species. Control un-budded trees continue to give higher girth and yield values due to uninterrupted growth.

Correlation exists between the initial girth and the girth of the trees in the field. Any how, effect of the soil type seems to decrease with the increase of the age of the trees. Branch induction through leaf cap method, shows best girthing though not significant among treatments. The growth parameters of rubber have significantly decreased with the increase of planting density. Though not significant, yield per hectare (YPH) was higher in higher densities. In the low density trial, the girth of the trees was highest in the lowest density of 350 trees/ha in all clones. However, the YPH is highest in the highest density, *i.e.* 575 trees per hectare for all clones.

The tapping knife invented demands less skill due to its bark control facility. The percentage TPD of ten sites show that high values of the incidence are mainly due to the high intensity of tapping. Some chemical formulations were tested to see the effectiveness of them on the recovery of TPD. Data so far does not indicate positive effect. Light response curves of the rubber × oil palm trial showed slightly different rates of photosynthesis and quantum yield in two crops whilst, soil moisture levels within 1m depth were low in areas planted with oil palm compared to that with rubber.

Mean tree girth of rubber planted with tea and cinnamon was comparatively higher than that of rubber grown with other intercrops, *i.e.* durian, jak, rambutan and sole rubber. In rubber × cinnamon trial, with widest inter row spacing and paired rows of rubber, the cinnamon bark yields were higher.

Authentic plants were distributed for NE season. Rubber nurseries of government, RPC and private, were inspected regularly and the reports were sent to the relevant authorities certifying 2.3594 million plants for the year 2007.

DETAILED REVIEW

Staff

Dr (Mrs) Priyani Seneviratne, Head of the Department, Dr A M W K Seneviratne, Botanist, Mr N M C Nayanakantha, and Mrs S A Nakandala, Assistant Botanists, Mr K A G B Amaratunga, Mr R P Karunasena, Mrs G A S Wijesekera, Mr U S Weerakoon, Mrs R K Samarasekera, Mr T U K Silva, and Mr M K P Perera, Experimental Officers, Mr D L N de Zoysa, Mr P D Pathirana and Mr P K W Karunatilaka, Technical Officers, Mrs D E Jayawardena and Mrs P D A H M A de Almeda, Clerks were on duty throughout the year.

Mr A Wickramaratne, Assistant Botanist continued his postgraduate studies abroad. Mr N M C Nayanakantha, Assistant Botanist assumed duties on 14.02.2007 after completing his post graduate studies and obtaining his Masters degree from G.B. Pant University of Agriculture and Technology, India. He got his promotion as a Botanist with effect from 02nd July, 2007. Mr M N de Alwis continued his post graduate studies in the UK. Mrs G A S Wijesekera returned to work on 03.05.2007 after successfully completing her short term training course in Rubber Research Institute of India.

Research students

- Miss W W L L Sandamali, from University of Ruhuna started her final year project on "Possible causes for the variation in yield among individuals of clonal rubber" under the supervision of Dr (Mrs) P Seneviratne.

- Mrs N A Amali Shurmila Nallaperuma, from University of Peradeniya completed her final year project on "Yield determination through growth and physiological parameters" under the supervision of Dr W Seneviratne.

- Mrs K M D Prasadhi Jayathilaka, from University of Ruhuna completed her final year project on "*In vitro* micrografting and culture of immature inflorescence of *Hevea* for direct or indirect organogenesis" under the supervision of Mr N M C Nayanakantha.

- Mr Amila Madushanka, Mr H L Kasun Chandimal and Mr K W Lalith Indika students of Advance Technological Institute at Naiwala started their 4 months training in the Plant Science Department.

- Mr R H L L Chathurange, from University of Peradeniya started his final year project on "Screening of rubber clones based on physiological, growth and anatomical characteristics at the immature stage" under the supervision of Dr W Seneviratne.

Seminars/Conferences/Meetings/Workshop attended

Officer	Subject	Organization
Dr (Mrs) P Seneviratne and Dr W Senevirathna	Scientific Committee Meetings	RRISL
Dr (Mrs) P Seneviratne and Dr W Senevirathna	Enhancing Technology Adoption and identifying R & D needs	RRISL
Dr (Mrs) P Seneviratne	A workshops on Rubber agronomy	Planters' Association
Dr (Mrs) P Seneviratne and Dr W Senevirathna	A work shop on Harvesting rubber	RRISL
Dr W Senevirathna	Workshop on GIS	University of Peradeniya
Dr W Senevirathna	A workshop on Research grants	NFS
Dr W Senevirathna	A workshop on Innovations	NERD Centre
Dr W Senevirathna	A workshop on Research management	CARP
Dr W Senevirathna	International Forestry Symposium	University of Sri Jayawardhanapura
Mrs S Nakandala	Workshop on Professional skills	NASTEC

Training programmes

Client	Subject	No. of programmes
Plantation Sector	Tapping	27
Plantation Sector	Planting	03
Plantation Sector	Ethrel stimulation	01
Plantation Sector	Budgrafting	03
Plantation Sector	Nursery Management	09
RDD	Nursery Management	4

Advisory visits

Client	No. of visits
Plantations	30
Smallholders	05

Exhibitions

The department staff actively involved in four national level exhibitions organized by other government organizations for the general public.

LABORATORY INVESTIGATIONS

Tissue culture

***Micro - propagation of clonal* Hevea**

Callus induction was achieved by culturing female florets of RRIC 100 and RRIC 121 in different media. However, somatic embryogenesis was not achieved after culturing the resulting calli on to different media for induction of somatic embryos (N M C Nayanakantha, P Seneviratne and G A S Wijesekera).

FIELD EXPERIMENTS

Rubber seed production

The objective of this study was to get a better knowledge on the seed production of different clones in different agro-climatic regions with special emphasis to the time of seed production. The rubber planting material production seems to have affected with the change in the pattern of seed production already. Also, the nursery men seem to believe that the seed production is low in high yielding RRIC and RRISL series clones. This year, the seed production of PB 260, RRIC 100 and RRIC 121 was estimated in some estates in Kalutara District. In Malaboda estate, PB 260 produced 17,868 seeds per hectare while it was 8,862 in Payagala estate. The seed production of RRIC 100 in Payagala estate was the highest in this study while RRIC 121 showed the lowest (Fig. 1). The peak seed fall of the three clones also varied (Fig. 2).

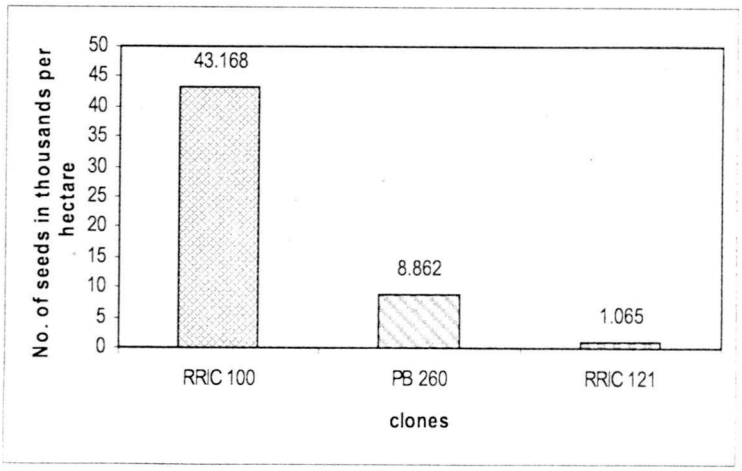


Fig. 1. Total seed production (thousands) per hectare in different clones in Payagala Estate (Kalutara district).

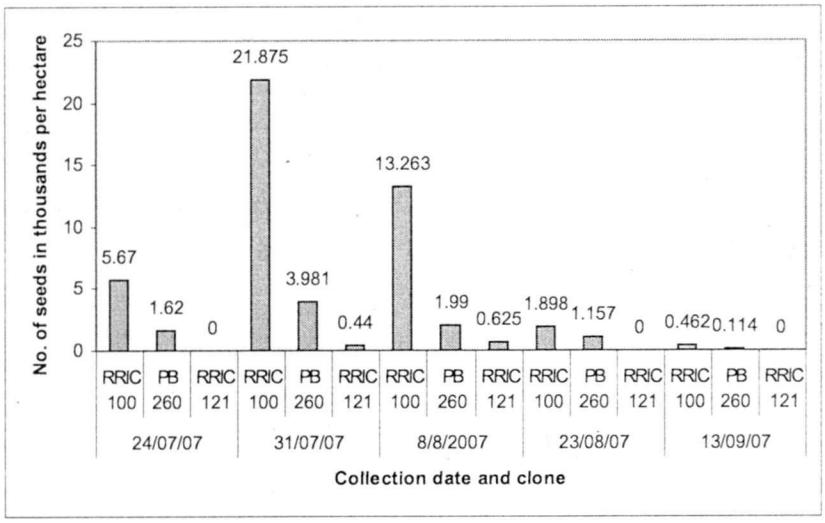


Fig. 2. Total seed production (thousands) per hectare in different clones at weekly intervals in Payagala Estate (Kalutara district).

Seed germination

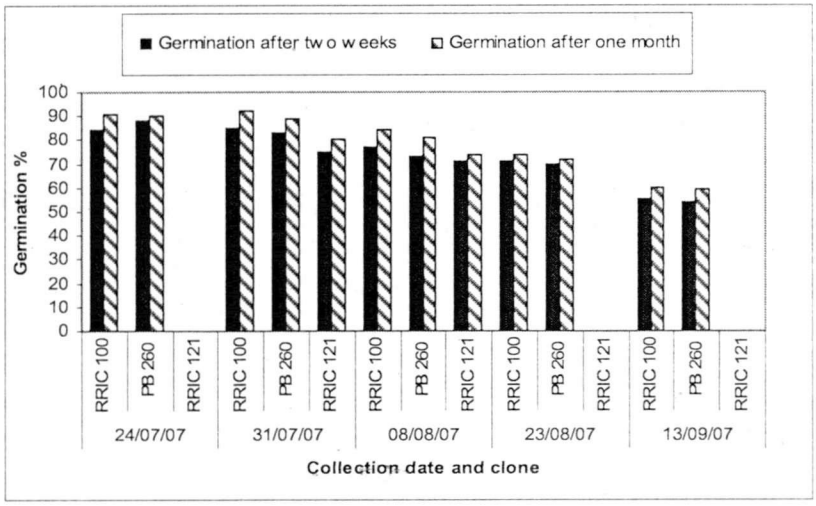


Fig. 3. Germination percentage of seeds of different clones at weekly intervals in Payagala Estate (Kalutara district)

Germination percentage of the seeds collected from Payagala estate was satisfactory irrespective of the clone (Fig. 3) (N M C Nayanakantha and P Seneviratne).

Unusual seed fall

Although the major seed fall in the Wet Zone occurs during July-August, a considerable seed production was observed in November-December in some estates in Kegalle and Kalutara districts. A mixed clearing of both RRIC 100 and RRIC 121 in Pallegama estate in Kegalle district had a seed production of 8,620 seeds per hectare and their germination percentage was 78% after two weeks of sowing. Similarly, a mixed clonal field of BPM 24 and RRIC 121 in Payagala estate yielded 3,400 seeds per hectare and the germination percentage was 76%. Moreover, a considerable amount of seeds from PB 260 was also observed during this period (N M C Nayanakantha and P Seneviratne).

Wintering and flowering of rubber

This project was initiated to conduct a survey on wintering pattern and flowering of *Hevea* clones in all the rubber growing regions of Sri Lanka in order to study the factors governing the rubber seed production. Twenty clones, including RRISL 200 and 2000 series clones were chosen, and 10 trees per clone are monitored at weekly intervals to record all the morphological events taking place during main wintering and flowering periods. A survey is also planned to identify the natural pollinators of rubber and to study their population dynamics in relation to floral biology of different clones which influence seed production (N M C Nayanakantha and P Seneviratne).

Clonal propagation

Rooting of cuttings (mist propagation) - CP/2001/1 – Dartonfield

Rooted cuttings of clones RRIC 130, 100 and 121 planted and maintained in the field at 8' × 7' distance have reached an average girth of 42 cm after 5 years. The yield will be monitored to see if the true-to-type nature can impress the yield of those clones (P Seneviratne and G A S Wijesekera).

Vegetative propagation of elite mature individuals - CP/2001/2 – Dartonfield

As the propagation of plants of the high yielding individuals through rooted cuttings was unsuccessful, some bud grafted plants were produced to rejuvenate the plants through successive grafting. Plants are maintained in budwood nurseries while grafting successfully. Rejuvenated material will be used to induce roots on them (P Seneviratne, G A S Wijesekera and R K Samarasekara).

Phase change of* Hevea *(CP/1991-1/DF)

Wintering was observed in seedlings planted from year 1991 to 2001 while flowering was observed only in the seedlings of year 1993-1995, of the plants which were planted consecutively from year 1991 (P Seneviratne and G A S Wijesekera).

Root system of* Hevea *(CP/1999/1 - NK)

Girth measurements of the plants with different root systems, *i.e.* tap root and fibrous root, but with the some genetic make up are given in Table 1.

Table 1. *Girth measurements of the plants of the same genetic make up but with different root systems*

Plant No.	Girth of seedling (cm)	Girth of corresponding cuttings (cm)
1	77.5	59.5
2	66.0	51.0
3	34.5	59.5
4	57.0	21.0
5	30.0	21.0
6	23.0	60.0
7	38.0	50.0
8	67.0	86.0
9	46.0	20.0
10	46.0	60.0
11	79.0	45.0
12	54.0	58.0
Average	**51.5**	**49.3**
SEM	**5.3**	**5.7**

50% of the cuttings have girthed better than their corresponding seedling, while seedlings have shown a higher girth in the balance pairs (P Seneviratne and G A S Wijesekera).

Effect of the rootstock on growth and yield of rubber (YB/2005/DF)

The objective of this study was to see if the rootstock affects the growth and the yield of high yielding clones recommended for planting. Two of the popular clones in Sri Lanka, RRIC 100 and 102, were selected to use as rootstocks and the seedling nursery was established in August 2005. Seedlings of these were bud grafted with clone RRISL 217. Growth of seedlings, percentage of buddable plants, bud grafting success and growth of the scion were monitored. Budded plants of this experiment were field planted for further monitoring. Girth values measured up to four months in the bags showed that generally the girth is lower in late germinated seeds. As far as the height is concerned, it was very clear from the data that late germinated seedlings were shorter.

The buddable percentages of the seedlings were 100% and 91% for RRIC 100 and RRIC 102, respectively for the early germinated seeds, *i.e.* those germinated within 12 days of seed sowing. The germination % decreased gradually with the increasing number of days taken to germinate. They were 28% and 45% for RRIC 100 and RRIC 121 for the seeds germinated after the 28th day of seed sowing. Bud grafting success too showed the same trend. The growth of the scion of the two clones measured by height and diameter showed a similar pattern but the differences were smaller with compared to those of the seedlings (P Seneviratne and G A S Wijesekera).

Budgrafting

Successive grafting - BG/1999/1 - Dartonfield

Another bud grafting passage was completed using the budwood of last generation. Nine successive grafting passages have been produced by now (P Seneviratne and G A S Wijesekera).

Rejuvenation of budwood plants - Egaloya Rubber Nursery

Clones RRIC 100, RRIC 102 and RRIC 121 were used in this and seedlings were repeatedly grafted with the budwood of the plants of the previous passage, to obtain successive generations. Seven generations have been raised since 2004 up to now. Budgrafting success, sprouting time, shoot length and diameter were assessed for plants of different generations.

Sprouting percentage showed an increase with the generation number from G1 to G5 for all three clones as given in Table 2.

Table 2. *Sprouting percentage after two weeks in plants of different generations and of three clones*

	RRIC 100 (%)	RRIC 102 (%)	RRIC 121 (%)
G_1	61	58	49
G_2	46	51	36
G_3	-	51	43
G_4	56	58	64
G_5	76	95	96

The angle between the stock plant and the scion shoot of the budded plant indicates the physiological state of the plant. In other words, the seedlings grow straight up while mature clonal shoots grow with an angle to the stock. The mature the plant, the higher the angle. Data gathered so far support this theory for all three clones (Table 3).

Table 3. *The angle between the stock plant and the scion shoot of the budded plant*

	RRIC 100	RRIC 102	RRIC 121
G_1	24.8°	35.4°	31.2°
G_2	24.7°	37.8°	30.0°
G_3	-	25.4°	24.8°
G_4	15.7°	22.2°	27.0°
G_5	18.0°	31.0°	27.0°
G_6	17.0°	24.6°	22.0°

Root trainers

The objective of this was to find the best container for young buddings specially to see the growth of young buddings in the 'root trainers' experimented in India to grow bare root budded plants (Plate 1). This was initiated with 2007 August seeds. Two sizes of cone shape containers were prepared with black polythene. Proprietary 'root trainer' samples received from a local manufacture were also used (Table 4). They were 30 cm long and 9 cm diameter at the brim (the same size and the shape used in India to grow bare root budded stumps). Normal young budding polythene bags were used as the control. Different types of potting mixtures were also tested at the same time.

Table 4. *Root trainer sizes and the holding capacity*

Type	Size	Material	Volume (ml)
1	32 × 9 cm (diameter at the top)	Black polythene	1160
2	40 × 15 cm (- do -)	Black polythene	2000
3	30 × 9 cm (root trainer)	Black plastic	1000
4	33 × 17 cm	Normal YB bags	2350

Eight types of potting media were used for filling bags.

A. Coir Pith + sand (1:1 ratio)
B. Coir Pith + Sand + Top soil (1:1:1 ratio)
C. Saw dust + Sand (1:1 ratio)
D. Saw dust + Sand + Top soil (1:1:1 ratio)
E. Sand + Soil (1:1 ratio)
F. Compost + Sand + Soil (1:2:1 ratio)
G. Top Soil
H. Coir Pith only

There were 24 replicates for each polythene container while only six replicates were there for plastic root trainers. Germinated seeds were planted in bags and root trainers and height and diameter of the plants were recorded monthly. Survival percentage was also monitored after three months and is presented in Table 5.

Table 5. *Survival percentage of plants after three months*

	A	B	C	D	E	F	G	H
1	96	100	96	100	96	100	96	96
2	100	100	88	96	100	100	100	96
3	100	100	100	100	100	100	100	86
4	100	100	96	100	100	100	100	100
Mean	**99**	**100**	**95**	**99**	**99**	**100**	**99**	**95**

As far as the survival rate of the seedlings was concerned, potting mixtures C & H had a few casualties. Growth of the seedlings too was slightly stunted in those media (P Seneviratne and G A S Wijesekera).

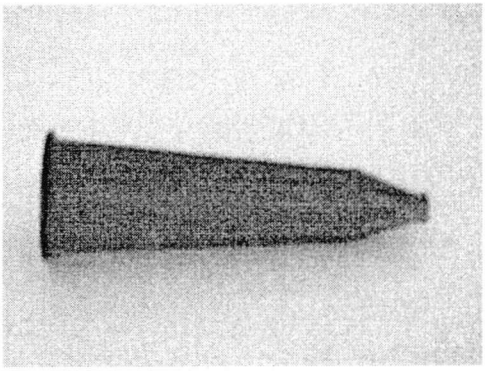


Plate 1. The root trainer being experimented in India to bare root budded stumps

Medium for young buddings

Objective of this experiment was to find a suitable medium for filling poly bags to raise young buddings as the large scale young budding nurseries can no longer depend on top soil for this purpose. The following different media were tested. Results obtained during the year under review are given in Table 6. As it can be seen from the Table 6, no significant effect of the medium on any of the parameters tested could be seen; so far the growth of the plants in sub soil is as good as that in top soil. The seeds used were all early germinators and therefore they might not have depended on the medium for initial growth.

A similar trial was done with biodegradable polybags also. In this trial cone shape containers were also prepared with biodegradable polythene. Following media and bag types were used. Results obtained on growth, grafting success and the condition of the bag are shown in Table 7.

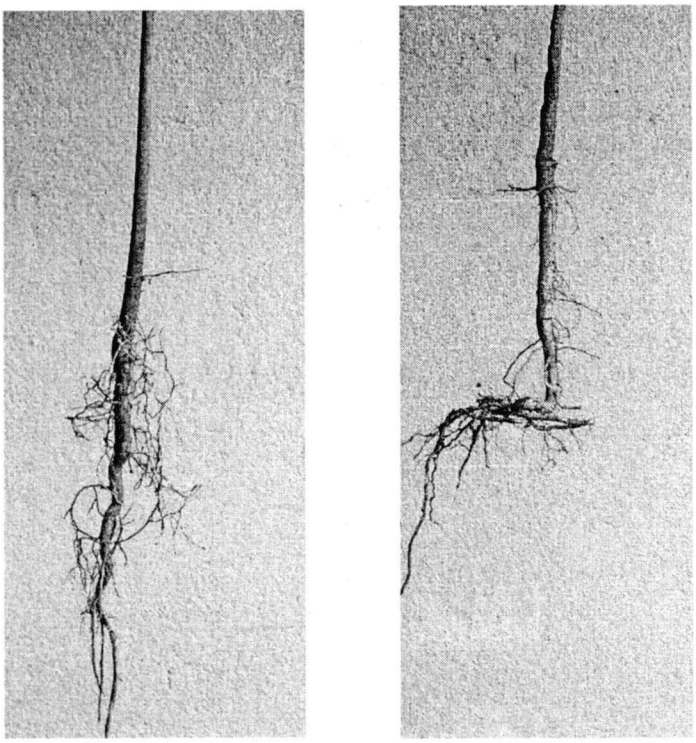
Table 6. *Growth of the seedlings, bud grafting success and the growth of budded plants in different potting mixtures*

Medium	Number of replicates	Mean diameter of the seedling (mm)	Mean Height of the seedling (cm)	% grafted plants	% graftin success	Mean diameter of the scion	Mean height of the scion
Sandy soil + IRP	17	0.6	83	52.9	66.7	0.6	29
Compost + Sandy soil + IRP	20	0.7	79	70	71.4	0.6	27
Compost + Sub soil + IRP	05	0.7	74	60	66.7	0.7	39
Compost + Top soil + Gravel Soil +IRP	09	0.5	60	44.4	75	0.9	53
Compost only	15	0.7	56	40	83.3	0.7	37
Compost + Top soil + IRP	11	0.8	59	45.4	60	0.7	30
Top soil + IRP	17	0.8	72	47	75	0.7	35
Gravel soil + IRP	16	0.9	77	93.7	40	0.6	31
Sub soil + IRP	22	0.9	73	68.1	73.3	0.7	37
Sub soil only	17	0.9	72	58.8	80	0.7	32
Top soil only	66	0.7	62	36.4	83.3	0.6	32

Table 7. *Growth of the seedlings, bud grafting success and the growth of budded plants in different potting mixtures*

Medium	Container type	No.of replicates	Mean stock plant diameter (mm)	Mean height of stock (cm)	Grafted %	Success %	Damaged bag %	Mean diameter of the scion	Mean height of the scion
Top soil only	Normal bag	30	0.9	86	40	91.7	0.0	0.9	56
Sub soil: saw dust	Normal bag	30	1.0	76	33.3	100	0.0	0.7	45
Top soil only	Biodegradable	506	0.8	73	31.4	78	68.2	0.6	29
Top soil only	Biodegradable	417	0.8	63	21.3	68.5	45.8	0.6	24
Sub soil: saw dust (3:1)		28	1.0	88	35.7	80	0.0	0.8	44
Sub soil only		23	1.3	108	34.8	50	100.0	0.4	30
Monaragala soil only		16	0.9	76	12.5	50	0.0	-	-

The growth of the plants was comparable in many potting mixtures and in different containers. The root system in the cone shape containers grew down without coiling at the base as shown in the plate 2. The tap root of the plants grew in normal polybags coiled at the base prior to penetrate the base. This can be avoided by allowing a central hole at the base of the bag prior to planting.



a. Tap root in the cone shape bag

b. Tap root in the normal poly bag

Plate 2. Growth of the tap root in (a) cone shape containers (b) normal poly bags (P Seneviratne and M K P Perera)

Irrigation systems for rubber nurseries

The sprinkler irrigation system established in the government rubber nursery at Moneragala performed at the maximum capacity after minor alteration done to the water pump. A design was done and all arrangements were made to enhance the performance of the existing sprinkler system while expanding the area for another 4 ha. in the year 2008.

A sprinkler irrigation system was successfully installed in the rubber nursery of the Genetics and Plant Breeding Department, Nivithigalakele Sub Station. Preliminary work was done to establish a sprinkler irrigation system for the rubber nursery at Kuruwita sub station too (P Seneviratne, S A Nakandala and D Pathirana).

Crown budding

RRIC 110 (1994 and 1996 replanting) - CB/1998/1 – Padukka

Details of the experiment have been given in the Annual Review for 1996. Numbering, colour banding and girth measurements were done in both clearings in Menerigama and Main Divisions (Table 8).

Table 8. *Mean girth and the brown bast percentage of RRIC 110 trees crown budded with different clones (The SEM is given within brackets)*

Clearing	Crown	No. of trees	Average girth (cm)	% of BB trees
1995 RRIC 110	RRIC 100	133	64.43 (± 0.72)	30
Menerigama	RRIC 102	93	68.83 (± 0.96)	23
Division	RRIC 117	87	67.72 (± 0.96)	31.4
	RRIC 121	34	81.17 (± 1.40)	30
	RRIC 130	39	63.91 (± 1.37)	40
	H. spruciana	41	51.0 (± 1.13)	63
1993 RRIC 110	RRIC 100	105	56.4 (± 0.81)	16
Main Division	RRIC 102	58	56.09 (± 1.1)	19
	RRIC 117	73	57.63 (± 0.9)	16
	RRIC 110 (control)	44	*72.1* (± 2.4)	25.4
	H. spruciana	8	*56.7* (± 3.08)	50

In Menerigama Division, *Hevea spruciana* continued to show the lowest girth. RRIC 121 crowns on RRIC 110 trunks are showing a remarkably high growth. Yield monitoring was not possible in the year under review due to lack of staff.

In the main division, RRIC 110 trees show the highest growth due to continuous growth. The number of trees affected with brown bast was high in *H. spruciana* in both clearings probably due to poor yield potential which cannot stand the tapping frequency of ½Sd/2. Generally a high rate of brown bast is observed in both clearings which could be due to the higher number of recovery tappings practiced on the estate (P Seneviratne, R K Samarasekera and L Zoysa).

RRISL 224 trunk with different crowns (1992 replanting of G & PB Dept) - CB/1999/1 – Galewatta

Details of the experiment were given in the Annual Review for 1999. Numbering, colour banding and girth measurements were done during the year. Mean girth of trees with different crowns are given in Table 9.

Table 9. *Mean girth of trees with different crown clones*

Crown	No. of trees	Mean girth cm (± SEM)
RRIC 100	41	69.73 (±) 1.49
RRIC 121	40	75.16 (±) 1.74
H. pauciflora	7	51.27 (±) 3.07
RRIC 100 + RRIC 121	6	79.65 (±) 2.32
RRIC 100 + 121 + 102	2	80.45 (±) 3.55

Trees crown budded with RRIC 100 + RRIC 121+ RRIC 102 show the best growth, whereas those budgrafted with *Hevea pauciflora* show the lowest. RRISL 224 trees which failed crown budding eventually died due to repeated attacks of *Corynespora*. Average yield for a period of one month during the year 2007 is given in Table 10.

Table 10. *Average yield (g/t/t) of trees of RRISL 224 with different crown clones*

Crown	Number of tapping days	Number of trees in tapping	Average g/t/t
RRIC 100	10	42	39.26
RRIC 121	10	38	38.8
H. pauciflora	10	5	32.7
RRIC 100 + RRIC 121	10	6	52.2
RRIC 100 + 121 + 102	10	2	33.85

The highest yield has been given from trees crown budded with RRIC 100 + RRIC 121. The lowest yield was obtained from trees crown budded with *Hevea pauciflora*. This could be attributed either to the lowest girth of those trees or to *Hevea pauciflora* being a different species which has a low yielding capacity (P Seneviratne, R K Samarasekera and L Zoysa).

RRIC 130, RRIC 121, RRISL 217, PB 260, BPM 24, RRIM 717 and PR 305 - CB/1998/2 - Nivithigalakale

Details of the experiment have been given in the Annual Review for 2001. Numbering, colour banding and girth measurements were done during the year under review. Mean girth of the trees are given in Table 11.

Table 11. *Mean girth of trees with different crown/trunk combinations*

Treatment	Trunk	Crown	No. of trees	Mean girth (cm)
1	PR 305	Control	27	50.24 ± 1.14
	PR 305	RRIM 717	15	41.7 ± 2.42
	PR 305	Pollarded	14	49.76 ± 1.15
2	RRIM 717	Control	28	51.36 ± 0.97
	RRIM 717	PR 305	21	39.99 ± 1.77
	RRIM 717	Pollarded	8	46.83 ± 2.09
3	BPM 24	Control	9	48.19 ± 1.76
	BPM 24	PB 260	1	47.00 - -
	BPM 24	Pollarded	8	43.43 ± 1.91
4	PB 260	Control	6	55.07 ± 1.55
	PB 260	BPM 24	6	45.17 ± 2.28
	PB 260	Pollarded	1	52.00 ± -
5	RRIC 121	Control	8	55.29 ± 1.81
	RRIC 121	RRISL 217	7	46.86 ± 1.20
	RRIC 121	Pollarded	9	49.14 ± 1.05
6	RRISL 217	Control	11	60.37 ± 1.19
	RRISL 217	RRIC 121	5	47.42 ± 2.50
	RRISL 217	Pollarded	4	57.02 ± 1.89
7	RRIC 121	Control	17	55.76 ± 1.52
	RRIC 121	RRIC 130	2	51.10 ± 2.70
	RRIC 121	Pollarded	16	53.51 ± 1.35
8	RRIC 130	Control	15	57.22 ± 1.09
	RRIC 130	RRIC 121	3	42.73 ± 8.63
	RRIC 130	Pollarded	10	62.24 ± 2.57

The clone RRIC 130 shows the highest girth whilst it is lowest in clone PR 305. As far as trunk and crown combinations are concerned RRIC 130 crown on RRIC 121 trunk shows the highest girth.

Generally all trunk and crown combinations show lower girth values than unbudded or pollarded trees except for PB 260 on BPM 24 trunk. Yield data could not be collected during the year (P Seneviratne, L Zoysa and R K Samarasekera).

RRIC 130 crown budded with RRIC 133, BPM 24 and RRII 105 -1999 – N'kele

Details of the experiment were given in the Annual Review for 2000. Identification, numbering, colour banding and girth measurements were done during the year.

Table 12. *Girth of RRIC 130 trees crown budded with RRIC 133, BPM 24, RRII 105 and RRIC 102 control trees*

Clearing	Crown	No. of trees	Mean girth (cm)	% of BB trees
1999	RRIC 133	18	54.0 ± 1.71	-
	BPM 24	35	48.87 ± 1.63	-
	RRII 105	39	51.83 ± 1.65	-
	Control (RRIC 102)	22	60.76 ± 3.11	4

Mean girth is highest with control RRIC 102 trees while the lowest mean girth is for the clone BPM 24. The high growth of clone RRIC 102 is due to continues growth of the trees while the other clones had a set back due to crown budding (P Seneviratne, R K Samarasekera and L Zoysa).

Budwood nurseries

Budwood availability

BN/2000/DF, BN/2001/Olikanda, BN/2002/Olikanda

Regular visits were made to the budwood nurseries at Dartonfield and Olikanda. Weeding, manuring, pollarding and application of fungicides were done according to the schedule.

219 plants of the following clones were established in a new nursery at Dolahena in September 2007 and fertilizer application, weeding and application of fungicides were done.

RRIC 100 series

RRIC 100, RRIC 102, RRIC 121, RRIC 130, RRIC 133,

RRISL 200 Series

RRISL 201, RRISL 203, RRISL 206, RRISL 211, RRISL 216, RRISL 217, RRISL 219, RRISL 223, RRISL 225, RRISL 226,

RRISL 2000 series

RRISL 2000, RRISL 2001, RRISL 2003, RRISL 2005

Other clones

BPM 24, PB 86, PB 28/59, PB 260 and PB 235

Plants of the budwood nursery at Olikanda were pollarded and budwood was harvested as given in Table 13.

Table 13. *Budwood harvested from Olikanda nursery during the year under review*

Clone	Amount (meters)	User
RRISL 217	177	Soils & Plant Nutrition Dept., RRISL
RRISL 2001	205	Egaloya Government Nursery
RRISL 203	20	- do -
RRISL 2000	14	- do -

(P Seneviratne and M K P Perera)

Authentic plants for budwood nurseries

Budded plants of new RRISL clones were issued for plantation sector nurseries and private nursery owners to establish budwood nurseries. Details of the plants issued from both Neuchatle and N'kele nurseries for this purpose are given in Tables 14 and 15.

Table 14. *Budded plants issued for the estates under regional plantation companies to establish budwood nurseries*

Clone	Agalawatte	Balangoda	Horana	Kegalle	Kelanivally	Kotagala	Lalan	Malwattavally	Maturata	Namunukula	Pussellawa	Watawal	Wellassa	Total
RRISL 200	-	-	20	-	50	25	-	-	-	25	125	25	-	**270**
RRISL 201	75	25	75	60	100	160	-	100	50	100	75	-	100	**920**
RRISL 203	95	50	95	115	250	110	-	100	25	175	175	25		**1215**
RRISL 206	25	-	75	25	100	25	50	100	25	75	175	25	25	**725**
RRISL 211	50	50	75	25	175	130	50	200	50	150	125			**1080**
RRISL 215	50	66	25	-	50	80	-	200	-	-	125	25	25	**646**
RRISL 216	55	-	25	-	-	57	-	100	-	15	-	-	-	**252**
RRISL 217	50	50	25	50	25	-	-	60	-	-	25	-	-	**285**
RRISL 219	25	-	45	50	50	175	-	25	-	50	50	-	-	**470**
RRISL 223	50	-	50	25	200	25	-	100	25	100	50	-	-	**625**
RRISL 226	-	-	-	-	50		50	100	50	50	50	-	-	**350**
RRISL 2000	25	150	25	-	50	100	50	100	25	75	225	-	100	**925**
RRISL 2001	50	101	20	25	50	75		150	50		50	25	-	**596**
RRISL 2002	50	125	75	-	25	50	50	50		125	75		25	**650**
RRISL 2004	50	150	70	-	100	75	50	75	25	90	200	25	100	**1010**
RRISL 2005	50	50	-	-	-	50	-	-	-	10	-	-	50	**210**
RRISL 2006	-	25		25	75		50	50	-	38	75	-	-	**338**
RRII 105	-	-	25	-	-	-	-		-	-	25	-	-	**50**
PB 217	-	-	25	-	-	-	-	90	-	-	75	-	-	**190**
PB 260	25	31		-	50	-	-	-	25	25	-	-	-	**156**
Total	**725**	**873**	**750**	**400**	**1400**	**1137**	**350**	**1600**	**350**	**1103**	**1700**	**150**	**425**	**10963**

For the private nursery owners, only an amount equal to 10% of the total number of budwood plants in the nursery were issued from clones RRISL 203 and 2001, in order to maintain the same ratio in the small holder plantations.

Table 15. *Budded plants issued for private sector nursery owners*

Clone	No. of plants
PB 260	25
RRISL 203	203
RRISL 204	25
RRISL 2005	25
RRISL 211	25
RRISL 2001	84
Total	**387**

(P Seneviratna, G A S Wijesekera, D E Jayawardena and L Zoysa)

Moneragala Substation - Budwood nursery

Plants were bud grafted at the Kumbukkana government rubber nursery in order to raise plants for this. Planting of 1530 plants was completed in the nursery with the on set of rain during the mid year, 2006 (Table 16). A temporary fence was put up until the fence around the substation was done. Manuring, weeding etc were supervised by the temporary technical assistant appointed for the project of development of rubber in the eastern province. Growth was satisfactory once the fertilizer was applied according to the recommended schedule.

Table 16. *The clonal composition of the budwood nursery at Moneragala substation*

Clone planted	Number of plants in the nursery
RRISL 201	245
RRISL 203	404
RRISL 2001	595
Total	**1244**

Trenching was done during the year in order to minimize the problem of water logging. Sprinkler irrigation system was designed for this nursery. Hydrological survey was carried out by the Water Resource Board and had found a suitable place for the proposed Agro-well for the nursery as well as for the other uses of the sub station (P Seneviratne, S A Nakandala and D Pathirana).

Monitoring and certification of rubber plants

Table 17. *RPC nurseries (established in 2006 Aug. & 2007 Jan. and Aug. nurseries)*

Company	Number of estates	Number of nurseries	No. of plants establish 2007	Plants certification (2006 Aug. & Jan. nurseries)	
				Young budding	Total
Agalawatta	08	10	127,900	83,950	83,950
Balangoda	06	06	79,000	69,500	69,500
Elpitiya	02	02	50,000	-	-
Hapugastenna	02	02	64,500	-	-
Horana	05	05	103,200	48,800	48,800
Kahawatta	01	01	130,000	107,000	107,000
Kegalla	11	14	102,700	74,300	74,300
Kelani Valley	09	11	262,800	152,250	152,250
Kotagala	10	12	144,600	105,900	105,900
Lalan	01	01	200,000	-	-
Malwatta Velly	04	04	110,000	51,500	51,500
Maturata	01	01	18,000	5,000	5,000
Namunukula	01	01	60,000	43,000	43,000
Pussellawa	05	06	147,600	54,050	54,050
Total	66	76	1,600,300	795,250	795,250

Table 18. *Government nurseries (established in 2006 August, 2007 January, and 2007 August nurseries)*

Name of the nursery	Nurseries inspected	No. of plants established 2007	Number of plants certified in 2007		
			Number	%	Total
Egaloya	2006 Aug - YB	265,000	144,000	54.34	144,000
	2007 Jan - YB	150,000	-	-	-
	2007 Aug - YB	250,000	-	-	-
Gurugoda	2006 Aug - YB	300,000	120,000	40	120,000
	2007 Jan - YB	276,200	-	-	-
	2007 Aug - YB	275,000	-	-	-
Karapinche	2006 Aug - YB	200,000	80,000	40	80,000
	2007 Jan - YB	147,000	-	-	-
	2007 Aug - YB	N.A	N.A.	-	-
Meerigama	2006 Aug - YB	350,000	148,000	42.29	148,000
	2007 Jan - YB	225,000	-	-	-
	2007 Aug - YB	330,000	-	-	-
Walikadamulla	2006 Aug - YB	360,000	240,000	66.67	240,000
	2006 Aug - GN	130,000	-	-	-
	2007 Jan - YB	275,000	-	-	-
Ttotal		**3,533,200**	**732,000**	**-**	**732,000**

Table 19. *Private nurseries (established in 2006 Aug., 2007 Jan. and 2007 August nurseries)*

Region	Number of nurseries	No. of nurseries established 2007	Number of plants certified 2006 Aug & 2007 Jan. Nurseries
Kegalle	17	527,750	167,400
Ratnapura	10	277,400	165,000
Kalutara	07	130,500	10,000
Total	**34**	**935,650**	**342,400**

Table 20. *Moneragala nurseries (established in 2006 August & 2007 January and August nurseries)*

Nursery	Nursery inspected	No. of plants established	Number of plants certified 2006 Aug & 2007 Jan. nurseries		
			YB	BR	Total
Government nursery	06 Aug YB	396,900	200,000	-	200,000
Moneragala	06 Aug BR	100,000	-	40,000	40,000
	07 Jan YB	245,000	110,000	-	110,000
	07 Aug YB	398,000	-	-	-
Private	08	253,000	44,000	-	44,000
Wellassa	01	500,000	190,000	-	190,000
Hapugastenna Pl.	02	50,000	10,250	-	10,250
Balangoda Pl.	02	17,000	-	-	-
Malwattavally Pl.	01	12,000	6,300	-	6,300
Total	**18**	**1,971,900**	**560,500**	**40,000**	**600,550**

(P Seneviratne, A M W K Senevirathna, U S Weerakoon, L Zoysa, D Pathirana and M K P Perera)

Planting techniques

Field planting with polybags - PT/1998/1 - Nivithigalakele

Mean girth and the girth increments are shown in the Table 21 for the two types of planting materials and for the five different treatments tested. As it is shown in the Table 21, there aren't any significant differences among treatments in RRIC 121 young buddings. However, the polybag plants of PB 260 planted with the bag show a little lower girth with compared to the girth of the trees of other treatments. One reason for this is that other treatments have more number of trees in the borders where the girth is higher. Girth increment is higher in the young buddings with compared to that of the polybag plants. This is due to the fact that both clearings are in tapping and the post harvest girth of RRIC 121 is very high with compared to that of PB 260.

Table 21. *Mean girth, girth increment and SEM of the plants (RRI 121 and PB 260) of different treatments*

Treatment	Young budding RRIC 121 1999N/E		Poly bag PB 260 1999 S/W	
	Mean girth (cm)	Girth increment (cm)	Mean girth (cm)	Girth increment (cm)
T1 - With the poly bags	56.775 (±1.208)	2.305 (±0.199)	51.41 (±1.311)	0.79 (±0.185)
T2 - Base of the bag removed	56.937 (±1.674)	2.574 (±0.202)	55.644 (±2.010)	1.404 (±0.543)
T3 - Base of the bag removed + four silts	58.4 (±1.315)	2.50 (±0.215)	56.456 (±1.862)	1.267 (±0.278)
T4 - four silts only	60.118 (±1.645)	2.65 (±0.340)	55.943 (±1.536)	1.793 (±0.293)
T5 - bag removed as recommended	59.693 (±1.362)	2.544 (±0.154)	60.211 (±2.147)	1.491 (±0.201)

(P Seneviratne and U S Weerakoon)

Selecting plants at the nursery - PT/2001/1 – Nivithigalakele

Details of the experiment were given in Annual Review for 2001. Girth and the girth increment of the plants are given in the Table 22. Girth of the plants in good, moderate and bad soil conditions is not significantly different. A correlation exists between the initial girth and the girth measured up to the year under review. As it can be seen from the data given, the correlation is high with moderate soil conditions (Table 23).

Some trees were damaged by wind and some other trees had purposely been damaged and altogether 13 trees were lost during the year.

Table 22. *Girth of plants grown in three types of planting holes*

Soil condition	Girth (cm)	Girth increment
Bad	49.45 (± 0.518)	4.02
Moderate	50.21 (± 0.785)	4.21
Good	50.77 (± 0.424)	3.80

Table 23. *Correlation of girth increment & initial girth*

	Girth (cm)		
	Bad	**Moderate**	**Good**
Correlation coefficient (r)	0.18978	0.38694	0.24357
P value	< 0.0001	< 0.0001	< 0.0001
Sample size (n)	135	80	248
STDEV	5.418	6.149	6.023
SEM	0.466	0.383	0.688

(P Seneviratne and L Zoysa)

Comparison of planting material-PT/Galewatta /2007

Young buddings and bare roots of the clone RRIC 121 were planted to compare the performance. Bare roots of PB 260 and Young buddings of RRISL 201 were also planted in the same field. RRISL recommended agro-management practices such as mulching was done along with manuaring in correct doses in correct time. The casualty rates for the two clones planted with bare roots were 40% and 30% for RRIC 121 and PB 260, respectively. No casualties were found in young buddings of the two clones. Height measurements up to the end of the year are given in Table 24

Table 24. *Mean height of the different planting materials (cm)*

Clone and the type of the plant	**June**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Increment**
RRIC 121 young budding	47.2	57.9	77.0	91.1	118.6	147.3	100.1
RRISL 201 young budding	-	-	-	-	23.0	32.0	90.0
RRIC 121 bare roots	-	-	-	-	31.0	35.0	4.0
PB 260 bare roots	-	-	-	-	46.0	59.5	13.5

(P Seneviratne and M K P Perera)

Cultural practices during immature phase

Branch induction – CP/2001/1 – Pallegoda

Different branching treatments were tested in this experiment to see the most effective one. The leaf cap method continued to give the highest girthing in both mixed clonal and RRIC 121 blocks, though the differences were not significant (Table 25). Yield data were also collected but the number of tappings that could be done was only five. However, the number of trees, average DRC and the average g/t/t are given in the Table 26 for four treatments.

Table 25. *Girth of the trees of different branch induction treatments*

Treatment	Girth (cm)	
	RRIC 121	Mixed clones
T1 - Leaf cap	76.729 (±1.718)	65.340 (±1.796)
T2 - Leaves cut	73.722 (±1.484)	59.794 (±2.646)
T3 - 3" long apex removed	76.642 (±1.592)	61.316 (±2.045)
T4 - Control	75.370 (±1.169)	56.593 (±2.316)

Table 26. *Number of trees, average DRC and the average g/t/t, for the trees of the four branch induction treatments*

Treatment	Number of trees	Average DRC	g/t/t (Avg.)
T1 - Leaf cap	29	1.572	54.89
T2 - Leaves cut	27	1.330	49.26
T3 - 3" long apex removed	24	1.330	55.42
T4 - Control	33	1.718	52.06

(P Seneviratne, U S Weerakoon and L Zoysa)

Planting at high density (PT/1992/1/Kuruwita)

Details of the experiment were given in the Annual Review for 1992. Growth and yield parameters of the clones tested under four different densities are given in Table 27. The growth parameters of rubber as indicated in Table 27(a) have significantly decreased with the increase of planting density ($p<.0.05$) and subsequently affected individual tree yield (g/t/t) Table 27(b). Though not significant, yield per hectare (YPH) was higher in higher densities. The overall performance of 600 trees per hectare in RRIC 100 was superior to that of other densities since 2005. The clone RRIC 110 affected by *Corynespora* leaf disease showed the poorest performance irrespective to the plant density.

Planting at low density (PT/1996/Gallewatta & Nivitigalakele)

Objective of this experiment was to study the effect of density on the growth and yield of rubber. Daily volumes and metrolac readings were recorded. Girth measurements at 5' height from grafted union were recorded at the end of the year. Current tapping panel is BO-1. Estimated yields were calculated according to the total tapping days of the year 2007. The mean girth, g/t/t and the yield per hectare (YPH) are given in Table 28.

The girth of the trees was highest in the lowest density of 350 trees/ha in all clones. The g/t/t decreases with the increase of the density though the differences are different for four clones. However, the YPH is highest in the highest density, *i.e.* 575 trees per hectare for all clones.

Table 27. *Effect of planting density on growth and yield parameters of rubber. In (a) plant girth (cm) and bark thickness (mm) at 150cm height and % trees in tapping in (b) tree yield (g/t/t) and estimated YPH (kg/ha/year)*

(a)

Density	RRIC 100				RRIC 110				RRIC 121			
	Girth (cm)	Bark thickness (mm)	% Trees in tapping	Tappable trees/ha	Girth (cm)	BT (mm)	% Trees in tapping	Tappable trees/ha	Girth (cm)	BT (mm)	% Trees in tapping	Tappable trees/ha
500	64.74	7.75	71.27	356	59.55	6.70	67.53	338	74.49	7.48	79.01	395
600	63.90	7.84	75.02	450	54.92	6.36	52.44	315	70.56	7.46	82.84	497
700	59.25	7.65	7254	508	51.35	6.34	41.04	287	68.71	6.99	76.98	539
800	59.45	7.52	73.70	590	51.80	6.21	46.05	368	66.30	9.82	83.02	664

(b)

Density (tree/ha)	RRIC 100		RRIC 110		RRIC 121	
	Yield (g/t/t)	Yield (kg/ha/yr)	Yield (g/t/t)	Yield (kg/ha/yr)	Yield (g/t/t)	Yield (kg/ha/yr)
500	19.87	905	18.96	830	35.84	1825
600	20.17	1134	18.80	773	31.31	2014
700	16.26	1077	14.09	512	32.21	2287
800	16.54	1288	14.68	703	27.44	2370

(V H L Rodrigo, A Nugawela, T U K Silva in collaboration with the departments of Genetics and Plant Breeding and Plant Pathology and Microbiology)

Table 28. *Effect of planting density on growth and yield parameters of rubber*

Density /ha	RRIC 100			RRIC 121			RRIC 133			PB 260		
	Girth (cm)	g/t/t	YPH (kg)	Girth	g/t/t	YPH (kg)	Girth	g/t/t	YPH (kg)	Girth	g/t/t	YPH (kg)
350	82.50	38.5	1522	82.92	39.78	1573	84.92	38.01	1503	79.21	37.18	1470
425	79.40	38.09	1848	74.98	39.77	1909	81.30	33.36	1602	75.24	36.56	1755
500	76.57	33.68	1898	74.75	34.55	1952	76.21	33.42	1888	68.60	35.10	1983
575	68.31	30.75	1981	73.95	33.66	2187	69.42	31.13	2022	68.00	32.31	2099

(A Nugawela, P Seneviratne and K A G B Amaratunga)

Exploitation

Girth at opening (TG/99/1)

The objective of this trial was to develop tapping systems to harvest optimum yields of new clones while minimizing the immature period and cost of tapping. Details of the experiment were given in Annual Review for 2001. The clearing was tapped under ½S d/3 + 2.5 ethrel by the estate. The girth and the girth increment of the trees of different girth classes at the commencement of tapping are shown in Table 29. The girth increment of the untapped trees is comparable in both clones. However, the girth increment in the trees in tapping is low in the clone RRIC 102 with compared to that of the clone RRIC 121 as the post harvest girthing is high in clone RRIC 121.

Table 29. *The mean girth and the girth increment of the two clones and the three girth classes along with those of untapped trees*

	Mean girth increment (cm)				Mean girth (cm)			
Clone	**G40**	**G45**	**G50**	**Untapped**	**G40**	**G45**	**G50**	**Untapped**
RRIC 102	0.69	0.76	1.01	1.38	61.03	60.26	69.21	83.02
RRIC 121	1.07	1.49	1.26	1.37	69.92	69.00	68.93	77.63

The yield of the trees was tested by taking samples of the trees for a short period during the month of February. The data are shown in the Table30.Yield of clone RRIC 102 is higher in all three girth classes and also in the untapped trees.

Table 30. *The yield data of the two clones and three girth classes at the time of opening*

Clone	Band 1 G40	Band 2 G45	Band 3 G50	Block Un tapped
RRIC 102	37.36	44.32	43.76	76.19
RRIC 121	34.41	33.09	30.99	47.79

(P Seneviratne and R P Karunasena)

Shorter replanting cycles - SRP/2007

This experiment was started in July 2007 to see the effectiveness of daily tapping on sustainable yields of commonly planted clones. One tapping block of clone RRIC 121 planted in 1996 at Dartonfield which is tapped on panel A was selected for the experiment. Three treatments were introduced and for each treatment twenty (20) trees were allocated from the selected tapping block.

Treatments are as follows;
T1 - ¼ S d/1 + 2.5% Ethrel + Rainguard + Fertilizer double dose.
T2 - ½ S d/3 + 2.5% Ethrel + Rainguard + Fertilizer double dose.
T3 - ¼ S d/1 + 2.5% Ethrel + No Rainguard + Fertilizer double dose.
T4 - ¼ S d/1 + No Ethrel + Rainguard.

Daily latex yields were collected and volumetric measurements of latex and metrolac measurements for %DRC were taken. Daily amount of scrap was also recorded.

Experiment was started on 8th of July 2007 and pre-treatment data were recorded for a period of one month. Ethrel application was done on 07.08.2007 and continued to take yield records Data for a period of 6 months are given in Table 31.

Table 31. *Average yield (g/t/t) for different treatments*

Treatments	No. of tapping days	No. of trees	Average g/t/t	Estimated No. of tapping days	Crop per month (g)	Crop per year (kg)
T_1	26	19	13.27	30	398.1	4.7
T_2	7	20	31.47	10	314.4	3.7
T_3	10	20	17.9	30	538.5	6.4
T_4	24	20	8.74	30	262.2	3.1

Highest g/t/t is given in T_2 whilst it is lowest in T_4. Highest crop for the year can be expected in T_3 if the estimated number of tapping days are tapped. Crop for the year is very low in T_4 due to no application of ethrel (P Seneviratne and R K Samarasekera).

Tapping Panel Dryness

Continuous monitoring of TPD (TPD/2002/03)

Summary of the percentage TPD by the end of 2007 of ten sites monitored in RRIC 100, 102, 121 and RRIC 130 clones are given in the Table 32. Sites AM-1995 and AR-1996 showed higher % TPD of 28.9% and 28.3%, respectively in RRIC 100 and RRIC 130 clones. The lowest % TPD of 3.6% showed in the site CY-1997 of RRIC 130. Higher values are mainly due to the high intensity of tapping over the recommendation in some sites.

Table 32. *Percentage fully, partial and total dry trees in clone and site wise at the end of the reporting year*

Clone	Site	% fully dry	% partial dry	%Total TPD
RRIC 100	CL-1998	8.9	0.3	9.2
	CL-1997	7.0	1.4	8.4
	AM-1995	25.0	3.9	28.9
RRIC 102	AM-1992	17.2	2.3	19.5
RRIC 121	CL-1997	7.5	0.3	7.8
	US-1997	13.8	1.9	15.7
	AM-1996	13.7	0.7	14.4
RRIC 130	CL-1997	12.9	0.3	13.2
	CY-1997	3.6	0	3.6
	AR-1996	26.8	1.5	28.3

(A M W K Senevirathna and K A G B Amaratunga)

Treatments for TPD trees

Testing of Siva's Formulation (SF) - (TPD/2006/01)

Experimental details have been given in the Annual Review for 2006. Yield data are summarized as shown in the Table 33. Yield of *SF* treated TPD trees was rapidly decreased compared to the non-treated TPD trees; whereas healthy trees were continued to give increased yields.

Table 33. *Daily latex volume (ml) and yield per tree per tapping (g/t/t) of TPD trees treated with the Siva's Formulation (SF) against non-treated TPD and healthy trees*

	During the period of treatment (3months)		After the treatment (3 months)		Second treatment (3 months)	
	Volume/ tree/tap	Yield (g/t/t)	Volume/ tree/tap	Yield (g/t/t)	Volume/ tree/tap	Yield (g/t/t)
Treated	39.2 ± 3.7	14.2 ±1.5	9.0 ± 0.8	4.2 ± 0.3	12.2 ±6.8	4.2±2.6
Non-treated	38.6 ± 2.1	14.4 ±1.2	26.2 ± 1.1	10.1 ±0.6	20.4 ±7.4	9.2±3.4
Healthy	95.2 ± 3.4	35.0 ±1.5	73.0 ± 2.4	45.2±10.2	117.1 ±23.7	51.8±10.8

This experiment was terminated as the yield response to the chemical formula was rapidly declined (A M W K Senevirathna and A Nugawela).

Application of VITEX-PLUS (TPD/2007/01)

To test the effectiveness of this chemical in recovering TPD affected trees, samples provided by the MRP Agro Chemy Lanka Pvt. Ltd. were tested with RRIC 100 and 121 clones at the Dartonfield estate, Agalawatta according to the following protocol (Table 34).

Table 34. *Treatment layout and number of trees per treatment in each clone*

Treatments	No. of trees	
	RRIC 100	RRIC 121
Fully dry - Vitex treated (FT)	06	08
Fully dry - non treated (FN)	05	08
Partial dry - Vitex treated (PT)	06	07
Partial dry - non treated (PN)	06	06
Healthy - non treated (HE)	05	05

Rested TPD trees were selected and sieved for a week and a half of each partial (70-75% cut length-dry) and fully dry (>90% cut length-dry) trees were treated with Vitex - Plus @ 2.5g per tree at 10 days intervals for initial 6 applications; thereafter 1g at 10 days intervals. 2.5g of the chemical was applied at the base of the tree only with the first application. Trees were tapped at ½ Sd_2 system and daily latex volume in each tree and DRC for each treatment were measured while demarcating the latex producing area of each tree (Experiment was started in June 2007). Results are summarized in the Table 35.

Ethrel and Vitex – Plus (TPD/2007/02)

To find the effectiveness in enhancing the productivity of TPD trees, fully and partial dry trees of RRIC 100 planted in 1987 were treated with ethrel (ET) @ 2.5g per tree every three months, and tapped as per the treatment layout given below. To compare the effects of ethrel and Vitex-Plus in enhancing yield of healthy trees, two treatments (T_6 & T_7) were included while applying Vitex-Plus @ 1g/tree at 10 days intervals. Each treatment consisted 10 replicate trees. Daily latex volume in each tree and DRC for each treatment were measured (Experiment was started in September 2007). Results are summarized in the Table 36.

Treatments

T_1	FD. ½ S d_2 ↓ 2.5 ET.	FD – Fully dry trees
T_2	FD. ½ S d_2 ↓	
T_3	PD. ½ S d_2 ↓ 2.5 ET.	PD – Partial dry trees
T_4	PD. ½ S d_2 ↓	
T_5	HE. ½ S d_2 ↓	HE – Healthy trees
T_6	HE. ½ S d_2 ↓ 2.5 ET.	
T_7	HE. ½ S d_2 ↓ 1g Vitex-Plus	

Table 35. *Summary of the yield (g/t/t) in RRIC 100 and RRIC 121 clones after each application of Vitex-Plus (1-20).*

RRIC 100

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean
FT	19.1	26.6	36.4	30.0	28.7	28.1	26.2	18.5	14.5	6.7	4.5	2.0	4.6	5.1	7.7	8.4	6.2	4.5	2.9	2.4	14.2
FN	5.9	16.5	23.6	24.1	19.8	17.3	13.9	16.0	11.5	8.7	7.7	4.6	3.5	1.4	4.9	6.0	2.7	1.5	0.1	0.0	9.5
PT	44.0	44.2	40.4	20.4	20.6	12.7	14.3	11.6	8.6	7.7	8.8	9.9	14.6	15.0	11.6	4.0	8.4	12.0	7.4	7.7	16.2
PN	16.0	25.3	44.7	36.2	33.2	29.7	30.8	30.0	31.8	29.2	20.0	16.4	14.7	8.6	19.4	18.3	13.1	12.1	9.4	7.0	22.3
HE	57.3	56.8	58.2	52.4	51.0	52.6	48.7	47.2	38.9	33.6	25.3	33.4	22.7	27.5	30.5	33.0	39.5	40.4	34.9	28.9	40.6

RRIC 121

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Mean
FT	16.9	21.6	20.9	16.0	8.4	7.1	7.0	3.2	1.9	0.4	0.1	0.2	0.0	0.0	0.0	0.6	0.1	0.0	1.9	1.2	5.4
FN	2.4	4.0	4.1	4.9	2.0	3.1	4.1	2.6	1.3	0.8	0.7	3.7	5.3	2.7	2.3	1.7	0.2	0.0	0.0	0.4	2.3
PT	45.5	28.4	29.6	24.8	20.4	20.0	22.9	19.3	19.6	13.5	14.2	16.8	14.6	14.5	22.4	20.9	23.1	24.2	26.0	19.4	22.0
PN	11.7	12.0	10.9	9.9	7.0	5.9	6.0	5.5	5.5	3.0	3.1	6.8	9.0	6.2	7.9	9.0	5.2	8.4	6.2	5.9	7.3
HE	41.7	49.0	38.9	33.5	31.9	36.1	37.7	36.6	38.7	33.1	25.5	40.0	45.6	40.7	52.0	64.9	54.8	56.5	51.1	52.7	43.0

(A M W K Senevirathna and A Nugawela)

Table 36. *Monthly average yield per tree per tapping (g/t/t) in each treatment with compared to the yield (g/t/t) prior to treatments*

Treatment	Pre-treatment	Month after treatment			
		1	2	3	4
T1	0.4 ± 0.2	22.8 ±4.5	34.7±8.8	29.6±9.4	20.6±6.6
T2	1.1±0.4	37.3±9.0	68.8±13.2	51.8±11.8	31.1±8.6
T3	30.8 ± 7.8	72.3 ± 12.2	64.8 ± 8.9	55.9 ± 9.0	44.8 ± 7.9
T4	23.9 ± 14.3	77.0 ± 18.4	80.9 ± 14.6	57.6 ± 11.1	35.9 ± 9.6
T5	72.5 ± 7.3	59.1 ± 6.6	64.9 ± 7.6	64.7 ± 6.4	54.7 ± 7.2
T6	100.3 ± 6.6	103.3 ± 10.8	82.9 ± 13.4	93.5 ± 14.5	91.5 ± 9.3
T7	61.8 ± 11.0	79.3 ± 10.9	82.9 ± 11.7	82.7 ± 12.7	74.2 ± 14.4

(A M W K Senevirathna, A Nugawela and K A G B Amaratunga)

Growth the yield of trees in mature fields

The objective of the study was to see the effect of presence of under girth trees in a clearing on the total crop of that field and also to see whether it could be more economical to remove those trees allowing more space for the remaining trees. The preliminary data gathered are shown in Table 37 and in Figure 4. The field is of clone RRIC 100 and is tapped on panel B (11^{th} year of tapping). As it can be seen from the figure the contribution of a higher percentage of low girth trees for the total production is low.

Table 37. *Contribution of the yield of trees of different girth classes to the final yield*

Girth range	No. of trees	% of the total stand	Mean girth (cm)	g/t/t	Yield (g)	% contribution to the final yield
50-53	27	15-88	52.91	18.94	511.4	11.43
54-57	30	17.65	55.55	21.25	637.5	14.25
58-61	22	12.94	56.92	22.16	487.5	10.90
65-68	33	19.41	67.79	26.30	867.9	19.40
69-71	29	17.06	69.92	33.29	965.4	21.58
72-75	29	17.06	72.50	34.61	1003.6	22.44
Total	170				4473.4	

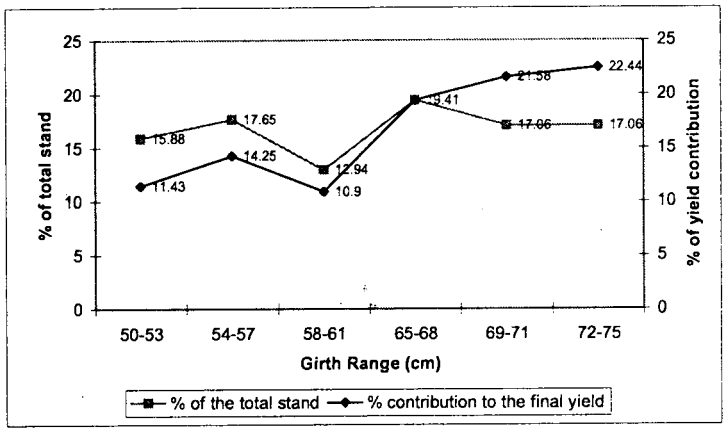


Fig. 4. Contribution of the yield of trees of different girth classes to the final yield

(P Seneviratne, S A Nakandala and R P Karunasena)

Rubber and Oil palm (2006) – NSF/RG/2005/AG/13

Experimental details of this are given in the annual review for 2006. Girth and girth increment of rubber and leaf emergence rate of oil palm were measured regularly. Weather data were recorded hourly using the Davis Vantage-Pro Plus weather station (Davis Instruments, USA) installed at the experimental site. Soil moisture at 10 cm intervals from the ground level up to a depth of 1-1.5 metres was measured through the access tubes installed at each treatment, using a Neutron Probe. Three sets of measurements after heavy rainy periods were done (Table 38). Light and Carbondioxide Response Curves of photosynthesis were developed for both crops.

Light response curves showed slightly different rates of photosynthesis and quantum yield of photosynthesis in two crops as shown in the Table 39.

Table 38. *Three sets of soil moisture measurements during a wet season*

Treatment	Soil moisture (by volume – m^3/m^3)		
	1	2	3
Rubber 2005	0.24	0.23	0.18
Oil Palm 2001	0.05	0.07	0.04
Oil Palm 2003	0.18	0.17	0.15
Oil Palm 2004	0.24	*	0.21

* Measurement was abandoned due to a technical fault

Table 39. *Photosynthetic parameters of rubber and oil palm of different ages*

Crop	Quantum yield (μ mol CO_2 fixed per μ mol quanta m^{-2} s^{-1})	Maximum photosynthetic rate (μ mol m^{-2} s^{-1})
Oil Palm (2001)	0.033 ± 0.001	13.77 ± 0.98
Oil Palm (2003)	0.034 ± 0.004	10.46 ± 1.47
Oil Palm (2004)	0.041 ± 0.003	14.25 ± 1.36
Rubber (2005)	0.040 ± 0.002	16.55 ± 1.27

Girth increment of 2.3 cm (± 0.1) for a three month period was observed in rubber. Leaf emergence rate of oil palm was 1.4 (± 0.1), 1.5 (± 0.1) and 1.4 (± 0.1) leaves per month respectively in fields planted in 2001, 2003 and 2004 (A M W K Senevirathna, W Karunathilake and N A A S Nallaperuma).

Early selection of clones by physiology and growth (PH/2007)

An experimental site was established at the Dartonfield estate using six new RRISL clones from RRISL 2000 to 2005 aiming to use growth and physiological parameters at early stages in determining yield at mature stage. Trees were planted in a randomized block design with 18-20 plants per clone. Stem diameter, plant height, number of leaves and photosynthetic parameters were taken at the nursery stage and after planting. All the parameters were initially correlated with the previous growth and yield data of the same clones gathered from the Genetics and Plant Breeding Dept. Results are presented in Nallaperuma *et al.* (2007) given in the list of publications at the end. Photosynthetic parameters did not show strong correlations with rate of girthing or yield of mature trees (A M W K Senevirathna, N A A S Nallaperuma, W Karunathilake and P D Pathirana).

New system for stimulation

This was a short term trial established in August 2007 at Gallewatta Division to compare four stimulation systems.

Treatments:

1. ½ S d/3 + 2.5 Eth. diluted in coconut oil. (1.25 cm × 1.95 cm coconut husk brush was used for stimulation)
2. ½ S d/2 + 2.5 Eth. diluted in water (1.25 cm × 1.95 cm coconut husk brush was used for stimulation)
3. ½ S d/3 + 2.5 Eth. diluted in coconut oil (1.25 cm × 1.25 cm coconut husk brush was used for stimulation)
4. ½ S d/3 + 2.5 Eth. diluted in water (1.25 cm × 1.25 cm coconut husk brush was used for stimulation)

Two applications were done in end of September and middle of December. Data were collected one month before the application and after the application (Table 40).

Table 40. *The effect of the method of stimulation on the yield of rubber (g/t/t)*

Treatment	Task 1		Task 2		Date of stimulation
	½ S d/3 + 2.5 Eth. Coconut oil 1.25 cm × 1.95 cm	½ S d/3 + 2.5 Eth. Water 1.25 cm × 1.95 cm	½ S d/3 + 2.5 Eth. Coconut oil 1.25 cm × 1.25 cm	½ S d/3 + 2.5 Eth. Water 1.25 cm × 1.25 cm	
Before treatment	39.45 g	30.29 g	36.13 g	33.42 g	Before Stimulation
After 1st Stimulation	25.94 g	29.59 g	42.32 g	32.93 g	27.09.2007
After 2nd Stimulation	40.09 g	32.32 g	43.42 g	42.05 g	11.12.2007

(P Seneviratne and R P Karunasena).

Tapping knives

Knife with bark control facility

Attempts were made to develop tapping knives especially with the objective of minimizing the skill requirement in tapping. One knife developed with a small modification to the existing knife was tested in the fields of Dartofnfield group. Mr R P Karunasena, an Experimental Officer of the Plant Science Department invented this and it has the bark control facility and less wounding of the tree (Fig. 4).

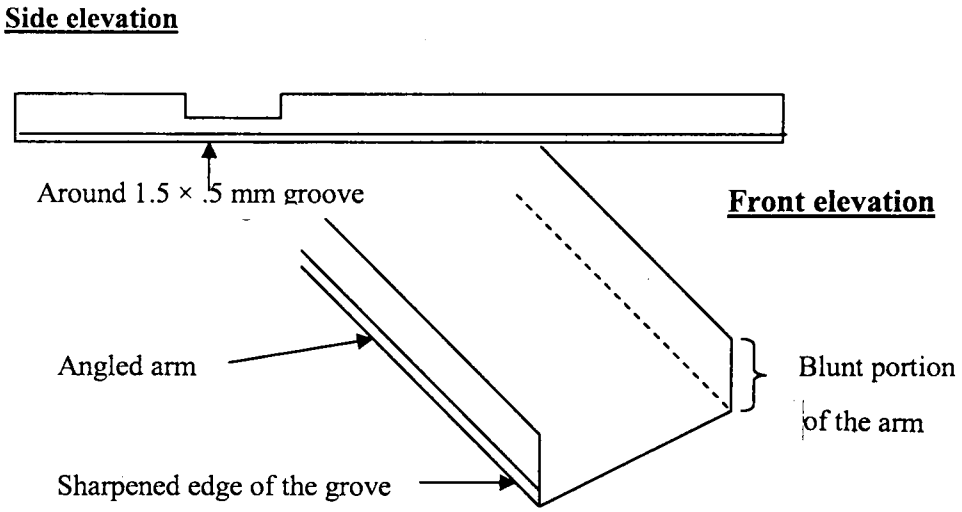


Fig. 4. Side and front elevation of the modified tapping knife

Specifications

1. Two arms of the tapping knife are slightly angled.
2. Two grooves at the tapping knife are sharpened well.

The performance of this knife was tested with that of the normal Michigolege knife at the Dartonfield estate. Semi skilled tappers were employed to test this. Only the number of wounds and bark consumption were recorded. Data collection was done for a period of 3 months and the results are shown in Table 41. As it can be seen in the table 41, while the number of wounds due to deep tapping is controlled, bark consumption too is lower with this new knife. This knife is currently being tested by about 75 more tappers in various estates.

Table 41. *The performance of the new tapping knife with compared to that of the conventional knife*

	Tapper A		Tapper B	
	Normal knife	**New knife**	**Normal knife**	**New knife**
No. of wounds/tree	10.9	3.5	5.3	2.6
Bark con./tree	1.59 mm	1.389 mm	1.485 mm	1.245 mm

(P Seneviratne and R P Karunasena)

A modified tapping knife

To develop an efficient and cost effective tapping knife which minimizes the skill requirement, a design was made in collaboration with the Mechanical Engineering Department of the University of Moratuwa (A M W K Senevirathna in collaboration with the University of Moratuwa)

Intercropping

Growing long term perennial crops on rubber lands - IC/S/2001/1 -Kuruwita

Details of experimental layout were reported in the annual report for 2002. Growth measurements of all crops were taken at six month intervals. Growth of rubber with respect to the girth measured at 150 cm height was assessed (Table 42). Out of the four planting arrangements of rubber, wider within raw systems, *i.e.*, T3 and T4 recorded a higher girth than the other two systems. Mean tree girth of rubber planted with tea and cinnamon was comparatively higher than that of rubber grown with other intercrops, *i.e.* durian, jak, rambutan and sole rubber, probably due to higher amount of fertilizer applied on tea and cinnamon. Thickness of virgin bark of rubber was comparable among treatments (Table 43). Also, growth of tea, cinnamon and rambutan was comparable among treatments (Table 44). Establishment of durian [both bud grafted (bg) and seedling (s)] was successful with proper watering and shading (Table 45). Growth of jak in planting system T_3, *i.e.* (3.5m×3.5m) -15m was lower than that in the other three systems due to presence of 2 weak jak plants in that block (*). In general, rambutan yield has increased with the age of the trees (Table 46). Total of Rs.54512.50 was obtained from selling rambutan at the rate of Rs.2.50 per fruit in year 2007.

Table 42. *Summary of the mean girth (cm tree^{-1}) of rubber. Measurements were made at 150cm height*

Main treatments	Sub treatments				
	Tea	Cinnamon	Durian/Jak	Rambutan	Sole rubber
T_1 (3m×3m)-15m	52.29	52.51	51.70	50.86	53.62
T_2 (3m×3m)-18m	55.31	53.75	49.93	50.16	50.54
T_3 (3.5m×3.5m)-15m	57.19	54.97	54.37	52.27	51.84
T_4 (3.5m×3.5m)-18m	57.90	55.54	52.80	53.27	55.78

Table 43. *Summary of the bark thickness of rubber (mm tree^{-1}). Measurements were made at 150 cm height*

Main treatments	Sub treatments				
	Tea	Cinnamon	Durian	Rambutan	Sole rubber
(3m×3m) -15m	5.27	5.12	4.92	4.95	5.43
(3m×3m) -18m	5.13	5.18	4.94	5.00	5.16
(3.5m×3.5m) -15m	5.27	5.53	5.21	5.57	5.08
(3.5m×3.5m) -18m	5.10	5.25	5.18	5.00	5.12

Table 44. *Summary of the growth performance of rehabilitated & unrehabilitated Tea, Rambutan and Cinnamon under different planting arrangements of rubber*

Treatment	Basal girth (cm)		Rambutan		Cinnamon
	Tea (unrehab)	Tea (rehab)	Girth (cm)	Canopy width (m)	Basal diameter (mm)
(3m×3m)-15m	14.91	12.56	39.42	4.89	9.34
(3m×3m)-18m	14.98	12.80	36.87	4.76	10.74
(3.5m×3.5m)-15m	14.38	12.15	37.40	4.75	10.59
(3.5m×3.5m)-18m	15.16	12.19	34.67	5.31	9.70

Table 45. *Summary of the growth performance of Jak, bud grafted Durian (bg) and Durian seedlings(s) under different planting arrangements of rubber*

Treatment	Basal diameter (mm) at 10 cm height			Plants available (%)		
	Jak	Durian(bg)	Durian(s)	Jak	Durian(bg)	Durian (s)
(3m×3m)-15m	43.78	11.17	8.60	100	100	56
(3m×3m)-18m	59.47	15.28	16.14	100	89	88
(3.5m×3.5m)-15m	22.43*	34.40	12.79	100	83	93
(3.5m×3.5m)-18m	32.45	3.60	29.57	100	83	88

Table 46. *Rambutan fruits harvested under different planting systems of rubber from 2005-2007*

Treatment	2005		2006		2007	
	Total fruits	Fruits/ tree	Total fruits	Fruits/ tree	Total fruits	Fruits/ Tree
(3m×3m) -15m	7728	145.22	4851	129.48	12110	265.36
(3m×3m) -18m	726	26.67	2333	129.14	2266	82.92
(3.5m×3.5m) -15m	979	43.85	2334	149.53	2559	117.74
(3.5m×3.5m) -18m	3042	144.78	1576	98.82	5757	266.35

(V H L Rodrigo and T U K Silva)

Rubber - Rattan intercropping trial - IC/RR/1996 - Kuruwita Sub-station

This rubber/rattan intercropping trial was established in October 1996 and comprised of three indigenous species of rattan (Annual Review, 1996). The growth of rattan seems to be rapid but measurements could not be taken due to the highest, sprawling of canes and inaccessibility. Some of these canes can be harvested in about a year (P Seneviratne and M K P Perera).

***Possibilities of intercropping Cinnamon under Rubber IC/RC/1998* - Kuruwita Sub-station**

The experimental details were given in Annual Review for 1998. The growth of rubber trees was highest in the treatment with the widest inter row spacing with single trees. The growth in all treatments with paired rows was comparable with the 8.4 m inter-row spacing treatment.

Treatments with widest inter row spacing and paired rows of rubber gave the highest cinnamon bark yields. Those treatments with narrow inter row spacing gave low yields.

Tapping of rubber commenced in January 2005 and tapping in the first three months were on a d_3 frequency and was later increased to d_2. The g/t/t yield of rubber was highest in wider inter row spacing treatments with single rows of rubber. Paired row treatments and the treatment with the 7.2 m inter row spacing had the lowest yield. But was comparable with the 8.4 m inter row spacing treatment.

Table 47. *Cinnamon bark yield kg/ha under different inter row spacing*

	Inter row spacing treatments (m)										
	7.2 S	**8.4 S**	**9.6 S**	**10.8 S**	**12.0 S**	**13.2 S**	**13.2 P**	**14.4 P**	**15.6 P**	**16.8 P**	**18.0 P**
Bark yield	586.1	492.0	709.5	816.5	683.8	807.1	793.8	777.7	1200.2	1063.5	1530.6

S- Single rubber row treatments, P- paired rubber row treatments

Table 48. *The growth of rubber measured as girth in the 9th year*

	Inter row spacing treatments (m)										
	7.2 S	**8.4 S**	**9.6 S**	**10.8 S**	**12.0 S**	**13.2 S**	**13.2 P**	**14.4 P**	**15.6 P**	**16.8 P**	**18.0 P**
Girth(cm) *	59.3	59.1	61.3	64.2	66.9	70.2	61.8	58.4	59.9	60.4	61.1

(Values with the same letter are not significantly different)

Table 49. *Rubber yield in grams /tree/tapping under different inter row spacing*

	Inter row spacing treatments (m)										
	7.2 S	**8.4 S**	**9.6 S**	**10.8 S**	**12.0 S**	**13.2 S**	**13.2 P**	**14.4 P**	**15.6 P**	**16.8 P**	**18.0 P**
Rubber yield g/t/t	26.7	25.7	29.3	31.3	33.9	39.9	23.9	27.4	27.0	27.4	27.3

(Values with the same letter are not significantly different)

(CARP funded Project – Project no 12/463/349) (P.Seneviratne and M K P Perera)

PLANT PATHOLOGY AND MICROBIOLOGY

W P K Silva and K E Jayasuriya

SUMMARY

The abnormal leaf fall caused by *Phytophthora* spp. was mild during the South West monsoon. An island-wide survey revealed that the *Corynespora* leaf fall disease incidence was very low in all the rubber growing districts. Cockchafer grub attacks were continued to be a threat to the young clearings in several rubber growing areas particularly in Avissawella region. The pathogen responsible for the collar rot was identified as a *Pythium* sp. and therefore, immediate steps were taken to identify a chemical to control the pathogen and interim circular was sent to chief executives of plantation companies.

DETAILED REVIEW

Staff

Dr C K Jayasinghe, the Head of the Plant Pathology & Microbiology Department was appointed as the Deputy Director Research (Biology) with effect from 1st January 2007. Principal Research Officers, Dr (Miss) W P K Silva, Dr K E Jayasuriya, Assistant Plant Pathologist, Mrs T H P S Fernando and the Audio Visual Production Officer, Mr W Amaratunge, were on duty throughout the year.

Experimental Officers Mr E B Fernando, Mrs B I Tennakoon, Mrs D Siriwardena and Mr C Wijeratne, Technical Officers Mr P Pieris, Mrs N Jayawardene and Mr E A D N Nishantha, Clerk Typist, Mrs P Amarasekera continued to work in the Department.

Research students and other temporary staff

Mr B A C de Silva and Ms W M P Weerakkody, undergraduate students from the University of Kelaniya, completed their final year industrial training programme by 22nd October under the supervision of Dr (Miss) W P K Silva and Dr C K Jayasinghe respectively.

Ms A N S Thambugala and Ms J V Rathnasinghe worked in the Department as Technical Assistants in the project funded by CFC, The Netherlands up to March 2007 and July 2007 respectively. Ms U L H S Perera worked in the same project as a Technical Assistant from July 2007.

Seminars/Training programs conducted

Dr (Miss) W P K Silva, Dr K E Jayasuriya and Mrs T H P S Fernando served as resource personnel in training estate Managers, Asst. Superintendents and Field Officers. Mr E B Fernando, Mrs B I Tennakoon, Mrs D Siriwardana, C Wijeratne

and N Nishantha covered the practical aspects of above programs while all the staff members extended their fullest cooperation in educating students from Universities, Technical Colleges and Schools on department activities.

Seminars/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
W P K Silva	Strategies for management of *Corynespora* leaf disease	RRII, India
K E Jayasuriya	IRRDB-Michelin - CFC-SALB workshop	Michelin Plantation, Bahia, Brazil

GENERAL

Since the *Corynespora* leaf fall disease severity on the clone RRISL 201 was reported to be very mild for the last three years, a decision was taken to upgrade the clone to Group II.

All canopy diseases were mild throughout the year. The incidence of *Phytophthora* leaf fall was mild during this year except in highly susceptible clones. The project on the management of the white root disease in rubber holdings was completed and a new advisory leaflet for the disease management was published.

The disorder causing exudation of latex at the collar region of the rubber trees was found to be caused by the fungus "*Pythium*". Flutolanil was found to be a promising fungicide against *Rigidoporus microporus*, under laboratory conditions.

Cockchafer grub attack was continued to be a problem in new rubber clearings planted in Avissawella region. New attacks were reported from Galle, Kalutara and Ratnapura districts as well.

Visits

The Department staff made 80 advisory, 242 experimental and 93 other visits during the year.

LABORATORY AND FIELD INVESTIGATIONS

Chemical control of *Hevea* diseases (CC/89/1)

***Screening of fungicides against* Rigidoporus microporus**

Flutolanil, a new fungicide was tested in the laboratory as well as in the field. Preliminary results showed good performances. Integration of sulphur application around lateral roots along with treatments of systemic fungicides on the collar was found to be effective in controlling the white root disease infection in lateral root

system while suppressing further spread (K E Jayasuriya, B I Tennakoon and E B Fernando).

A critical trial was conducted to test the translocation of 1% hexaconozole applied onto collar against the white root disease. Results indicated that the systemic chemical had no profound effect on the disease causing pathogen established far away from the collar on lateral roots (K E Jayasuriya and D Siriwardene).

Screening of fungicides against* Corynespora *leaf fall disease (CLFD) under nursery conditions

Fungicides efficiently checking the growth and conidial germination of *Corynespora cassiicola* were selected from preliminary laboratory experiments. Their efficacy in controlling the disease under nursery conditions was tested at Egaloya nursery, Bulathsinhala.

Six fungicides, two fungicide mixtures and two resistance inducers were sprayed. During the experimental period, the weather conditions were conducive for the development of the disease. The experiment will be repeated to identify the most effective fungicides to control CLFD under nursery conditions (T H P S Fernando, C K Jayasinghe, D Siriwardene and J V Ratnasinghe: Project funded by CFC, The Netherland).

Biology of common pathogens (BCP/90/1)

***Studies on cell wall degrading enzymes produced by* Cylindrocladium quinqueseptatum**

Four samples of enzyme were prepared and freeze dried. Sephadex column was prepared to determine the molecular weights (W P K Silva, C K Jayasinghe and N Nishantha).

Susceptibility of different leaf stages to CLFD

An experiment was designed to find the leaf maturity stages vulnerable to CLFD. Following leaf stages of two clones, RRISL 201 (susceptible) and RRIC 121 (resistant) were artificially inoculated and developmental stages of the lesions were closely studied for 5 days. The observations revealed that the mature leaves from both resistant and susceptible leaves could not be artificially infected under laboratory conditions. Observations made are given in Table 1 (T H P S Fernando, C K Jayasinghe, R L C Wijesundera and D Siriwardena).

***Cultural, reproductive and physiological variations of* Hevea *isolates of* Corynespora cassiicola**

Experiments were initiated to study the variability of new *Corynespora* population, a decade after the second epidemic in Sri Lanka. Seventy *C. cassiicola* isolates were obtained from different rubber clones and based on the colony morphology and clone, fifteen were selected for further studies. Variability in cultural and reproductive morphology, pathogenicity, sensitivity towards the fungicide

mancozeb and toxin production were being studied. Pathogenicity studies based on detached leaf technique revealed that 3 major groups existed among the 15 isolates under investigation (Fig.1) (T H P S Fernando, C K Jayasinghe, R L C Wijesundera and D Siriwardena).

Table 1. *Leaf maturity stages vulnerable to* Corynespora *infections in clones RRISL 201 and RRIC 121*

	Sizes of the lesions produced*									
	Day-1		**Day-2**		**Day-3**		**Day-4**		**Day-5**	
Maturity stage	**R 121**	**R 201**	**R 121**	**R 201**	**R 121**	**R 201**	**R 121**	**R 201**	**R 121**	**R 201**
C1	II	II	III	III	III	III	IV	IV	V	V
C2	II	II	II	III	III	IV	IV	V	V	V
A	II	II	II	II	III	III	IV	IV	V	V
SM	I	I	II	II	II	II	III	III	III	III
M	I	I	I	I	I	I	I	I	I	I

C1- Copper brown – very immature, C2-late copper brown stage with apple green appearance, A - Apple green, SM - Semi-mature, M – Mature, *I - No symptom, II - pin-point size lesions, III- pin head size lesions, IV - discoloration extended with slight growth of mycelium, V- extended lesions with profuse mycelial growth.

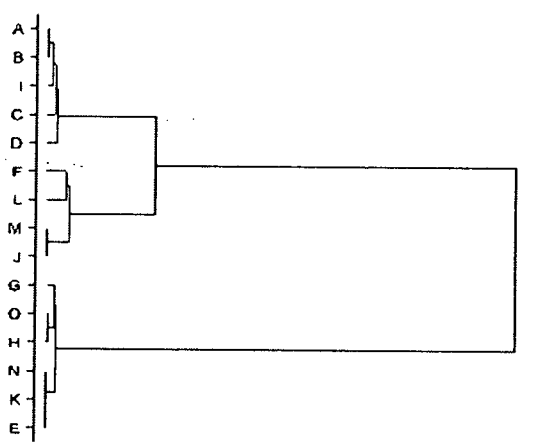


Fig. 1. Dendrogram showing the grouping of fifteen *Corynespora cassiicola* (A-O) isolates based on pathogenicity testings under laboratory conditions

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

Maintenance of nurseries established for screening purpose

The above nurseries were visited for pollarding and manuring. All the recommended clones in these nurseries were screened against *Corynespora* leaf fall disease and found to be disease-free (W P K Silva, C K Jayasinghe, T H P S Fernando, C Wijeratne and N Nishantha).

Island-wide survey on *Corynespora* leaf fall disease incidence in Sri Lanka

The above survey was conducted throughout the island. The average disease severity indices of the susceptible clones were less than those of the previous year (Table 2).

Table 2. *Disease intensity score of the clones in the RRISL recommendation list*

Clone	ADSI
RRIC 100	0
RRIC 121	0
RRIC 102	0
RRIC 130	0
PB 260	0
PB 235	0
RRISL 203	0
RRISL 204	0
RRISL 205	0
RRISL 206	0
RRISL 211	0
RRISL 215	0
RRISL 216	0
RRISL 217	0.25
RRISL 218	0
RRISL 219	0
RRISL 220	0
RRISL 221	0
RRISL 222	0
RRISL 223	0.60
RRISL 201	1.13
RRISL 202	1.11
RRISL 208	1.0
RRISL 2000	0
RRISL 2001	0
RRIC 133	1.0
PB 255	0
GPS 1	0
RRISL 200	2.0

* ADSI-Average Disease Severity Index. 0, highly resistant;
0.01-1.00,slight infections; 1.01-2.00 moderate infections; 2.01 – 3.00 severe infections

Laboratory screening of clones against CLFD using partially purified toxin

Fifteen *C. cassiicola* isolates were screened for the variation in toxin production. Several isolates produced more toxins and there were some poor producers. The toxin has to be partially purified and used in clonal screening (T H P S Fernando, C K Jayasinghe, W P K Silva and D Siriwardene).

Molecular biology of pests (MBP/97/B)

Development of molecular markers to identify Corynespora leaf fall disease resistant clones

Primers were developed based on the RGA (Resistant Gene Analog) marker band obtained for resistant clones. Experiment is in progress to identify the CLF resistant clones using the above developed primers (W P K Silva, N Nishantha, A Jayakody and E H Karunanayaka. This is a collaborative project with the University of Colombo).

Biological control of *Hevea* diseases (BC/89/1)

Biological control of bark and stem diseases

Experiments were carried out to develop basal formula for the application of an antagonistic organism on the bark or wounds. A formulation was tested in the field with little success due to drying off in dry periods (K E Jayasuriya and C Wijeratne).

Eradication of white root disease in patches of immature young and old rubber lands to increase the land use efficiency and productivity

The project has been progressing well during the year. Final results were assessed and the research terminal report was completed. Using the data obtained from the project, the existing recommendation for white root disease incidence in immature plants has revised and a treatment was recommended for mature infected trees by using a new circular (K E Jayasuriya and E B Fernando).

Studies on beneficial soil microflora (PP/SM/89)

Decorative handicrafts from partially decomposed rubber leaves

Experiments were continued with testing various brands of paints for their color lasting ability, especially to replace the green color. A variety of pigments have been identified which could be used to avoid fading of colors as a result of these experiments. Several new designs of floral arrangements, book marks and key tags have been introduced and photographs were taken for permanent records (C K Jayasinghe and N Jayawardene).

Surveillance of potential pests and disease outbreaks (PP/SP/89)

***Island-wide survey on* Cylindrocladium quinqueseptatum**

The above survey was conducted throughout the island and rubber plantations in Sri Lanka were reported to be free of the leaf disease caused by *C. quinqueseptatum* (W P K Silva, C K Jayasinghe and N Nishantha).

Treatment for bark cracking incidence

Approximately 140 affected trees in a smallholding were treated with 500 ml of 1% hexaconazole per each affected tree. Affected areas were initially cleaned by removing latex pads. The fungicide was then applied on the collar with much care to pour on affected sites and wounds were allowed to be dried. Thereafter wounds were sealed using Candarson and covered with soil. Girth measurements were taken for a period of fifteen month. There were twenty control trees which were not affected for girth comparison. Five trees were left untreated for the comparison of treatment effect. Results indicated that deeply and severely wounded (treated) trees had poor girth increment of 2-5 cm/year while moderately or slightly wounded (treated) trees performed well in girthing similarly as control trees. Non treated trees were continued to fall down due to decomposition of lateral roots. Therefore the treatment of 500 ml of 1% hexaconazole per tree can be recommended as a remedy for collar cracking incidence (K E Jayasuriya, E B Fernando and B I Tennakoon).

Formulation of a repellant against rodents and mammalian pests in rubber lands

Results (Table 3) from trials carried out in two separate fields allowed us to come out with two new recommendations for the management of wild boar and porcupine attacks in rubber fields. Field latex (containing ammonia at 0.01-0.05% weight of latex) diluted at 1:4 was found as an effective basal formulation for the application of active ingredients against animals. A mixture of Chillie: tobacco (1:1) in the latex base at 8% was found to be effective for repelling animals when applied on tree trunks. Similarly 0.5% TMTD in the latex base was also found as equally effective. Hence, these two formulations were preliminarily recommended as a repellant formulation against damaging animals in rubber fields. Trials were in progress to revise this recommendation and to develop more effective formulations (K E Jayasuriya, B I Tennakoon and E B Fernando).

Pathogenicity of papaya isolates of* C. cassiicola *on rubber

Corynespora cassiicola isolates were collected from *Carica papaya* grown in and around rubber plantations throughout the island. Cross inoculations were done on several rubber clones *viz.* RRIC100, PB260, RRISL217, RRISL201 and RRISL215. All the isolates tested were pathogenic on rubber (W P K Silva and N Nishantha).

Studies on unusual yellowing and buckling of rubber leaves

Sixty affected plants from Gallewatta and Dartonfield were selected. Observations were made to determine the predisposing factors. The intensity of

buckling was recorded monthly throughout the year. It was found that this disorder is prominent when plant is under stress and also correlates with the wintering pattern.

An island-wide survey revealed the distribution of the melody and it is more prominent in wet rubber growing districts (W P K Silva, C K Jayasinghe and N Nishantha).

***Occurrence of* Septobasidium *sp. on* Hevea**

The genus *Septobasidium* which is commonly called the felt fungus was observed in several rubber plantations. This abnormal condition was brought to the notice of the RRISL in several occasions referring as an unknown condition spreading in these clearings. The condition was identified as a mycoparasitism/symbiotic association between insects and the felt fungus. Identification of the problem and possible management strategies were reported (T H P S Fernando, C K Jayasinghe and N Nishantha).

Bark cracking disorder of rootstocks

A *Pythium* sp. was found to be associated with the bark cracks. Koch's postulates were proved to confirm the causative organism. Similar symptoms i.e. formation of a latex pad beneath the bark was seen in artificially inoculated trees. Later the fungus was re-isolated and found to have morphological characters similar to the original isolate. Investigations are underway to find an effective fungicide to control the above disorder. Observations made after three months of applying fungicides revealed that all three fungicides used were equally effective in controlling the disease. However an experiment is in progress to find out the effective concentration (W P K Silva and N Nishantha).

Defense mechanisms of rubber (DM/89/1)

Variability in defense responses of* Hevea *genotypes against* Corynespora cassiicola *infections

Synergistic effect of post-infectionally accumulated quantities of total phenols along with changes in total protein, PAL (Phenylalanine ammonialyase) and peroxidase level was analyzed.

Three leaf stages (copper brown, apple green and mature) of two clones; RRISL202 – CLFD susceptible and RRIC121-CLFD resistant were tested for the total phenol content. Mature leaves of both clones had significantly higher amounts of total phenolic compounds than those of in immature leaves of same clones (T H P S Fernando, C K Jayasinghe, R L C Wijesundera and D Siriwardena).

Studies on the hypersensitive response of* H. brasiliensis *towards CLFD infection

Hypersensitive response and cell death as measures of resistant and susceptible defense mechanisms upon inoculation with *Corynespora cassiicola* was

studied. A method was developed to assess the % cell death at the microscopy level. Experiments were carried out to microscopically measure % germination, elongation of germ tube and formation of appressoria (T H P S Fernando, C K Jayasinghe, R L C Wijesundera and D Siriwardene).

Induction of disease resistance to* Corynespora *leaf fall disease

A preliminary trial was carried out to test the efficacy of salicylic acid and 2,4 dinitrophenol in inducing disease resistance in nursery plants. They were sprayed at the time of bud sprouting and kept under conditions conducive for the development of the disease. The experiment is in progress to evaluate the effectiveness of chemicals (T H P S Fernando, C K Jayasinghe, and D Siriwardene) Project funded by CFC, The Netherlands.

Electrophoresis pattern of mycelial protein – a tool for differentiation of two* Colletotrichum *spp. of rubber

A method was tested to extract mycelial proteins of two *Colletotrichum* species causing *Colletotrichum* leaf disease of rubber. Potato dextrose broth and glucose yeast peptone (GYP) medium were tested and in the later medium mycelial protein was detected by the Bradford Method. Possibility to differentiate the two species was tested using polyacrylamide gel electrophoresis (PAGE) and the experiment is to be repeated to develop a proper staining technique (C K Jayasinghe, T H P S Fernando collaborative with Biochemistry and Physiology Department).

Agronomic approach to minimize the inoculum potential of* Corynespora cassiicola *by multiclonal planting system

Two multi-clonal clearings were established with disease resistant and susceptible clones at Kuruwita substation, Ratnapura.

Site 1 - RRISL 203/RRISL 2001/RRISL 202
Site 2 - RRISL 203/RRIC 121/RRISL 202

Growth parameters and CLFD condition of the canopy is being monitored (C K Jayasinghe, T H P S Fernando and D Siriwardena, Project funded by CFC, The Netherlands).

Agronomic approach to minimize the inoculum potential of* Corynespora cassiicola *by application of modified doses of fertilizer

Three fertilizer levels were tested for CLFD susceptible clones, RRISL202, 201 and 217, at RRISL substation, Kuruwita. Girth measurements, disease intensity of the canopy and other parameters were monitored (C K Jayasinghe, T H P S Fernando collaborative with Soils and Plant Nutrition Department).

Table 3. *Pre- and post-treatment (repellant) damage of rubber tree bark by Porcupines and Wild boars*

Formulae	No. of plants	Pre-treatment damage	Damage after			
			30 days	60 days	90 days	120 days
Site 1 (5 year old trees)						
1 c:t @50g + TMTD 2g/l of basal suspension	95	60%	0	0	28%	
2 TMTD @ 3g/l of basal suspension	113	60%	0	0	22%	
Site 2 (3 year old trees)						
1 TMTD @ 5g/l of basal suspension	70	15%	0	0	0	1%
2 TMTD @ 3g/l of basal suspension	152	15%	0	0	0	1%
3 c:t @100g of basal suspension	70	15%	0	0	0	2%

C = chilie powder, t = tobacco powder, site 1 had only porcupine damages while site 2 had both porcupine and wild boar damages

SOILS AND PLANT NUTRITION

Lalani Samarappuli

SUMMARY

It was observed that shade condition has a great impact on the growth of *Mucuna bracteata* under mature rubber and this is more prominent in *Ratnapura* series soils. Establishment of *Mucuna* two years prior to uprooting provides 75% of ground cover at the time of planting rubber. Since the soil erosion and the weeding cost are highest during the land preparation period, adoption of this strategy will significantly reduce the rate of soil degradation as well as cost of weeding at replanting. The soils under *Mucuna* in comparatively dry area showed a significantly higher moisture content of 19.6% and 18.1% for the depths of 0-15 cm and 15-30cm respectively, in comparison to the soils under *Pueraria*. Among the two species, *Mucuna* records higher moisture profile storage capacity of 25.8 cm for a depth of 90 cm. There was an increase of 41% in the moisture storage capacity as compared to *Pueraria*. Data obtained also show that *Mucuna* had more deep rooted system compared to both rubber and *Pueraria*

More effective weedicides to control weeds and *Mucuna* around young rubber plants were identified. Application of cocktails of Glyphosate + Diuron and Paraquat + 24D Amine were found effective in controlling weeds and *Mucuna* around young plants, respectively. It was found that mulching with Diuron treated paddy straw and mulching with rubberized coir mats are also very effective in controlling weeds around young rubber plants.

Scion die-back particularly during the hot and dry weather conditions could not be related to soil moisture stress level in young budding nurseries. However, it was observed that some roots die after cut-back and regenerate with time. The density of the survival roots was higher in vigorously grown seedlings.

The site-specific fertilizer recommendation programme for mature rubber provided fertilizer recommendations for 6000 hectares in the estate sector. Under the routine land selection programme 100ha. of land in the traditional rubber growing areas and 75ha. in the non traditional areas were surveyed for the suitability of rubber cultivation. The department also analyzed approximately 400 different samples (1500 parameters) for outside organizations during the year.

DETAILED REVIEW

Staff

The Head of the Department, Dr (Mrs) Lalani Samarappuli resumed duties on 01st August, 2007 and Dr R S Dharmakeerthi, Soils Chemist was served as the Acting

Head until 31st July. Mrs R Hettiarachchi, Assistant Soils Chemist, continued her postgraduate studies while on duty throughout the year.

Experimental Officers, Messrs H D S P Perera, C Maheepala, S N Silva, P Karunadasa, U Mitrasena, A N Yakandawela, T B Dissanayake, V Edirimanne and A Thevarapperuma and Technical Officers, Messrs P R Puhambugoda, J A S Chandrasiri and T Gunatilleke and the English Stenographer Mrs L Rupasinghe were on duty throughout the year.

Research students

- Miss Gothami Weerakoon from the University of Colombo started her M.Sc. research work on "Some aspects of dynamics of flora in the Waluwatta Waturana swamp forest with relation to edaphic and environmental factors" under the supervision of Dr Lalani Samarappuli.

- Mrs H A N Upekshani from the University of Colombo continued her MSc research work on "Assessing soil physical quality in rubber and oil palm plantations in the Galle region" under the supervision of Dr R S Dharmakeerthi.

- Miss E A D Siriwardana from the University of Peradeniya continued her final year project on "Effect of soil compaction and organic matter on *Hevea* plants raised by young budding technique" under the supervision of Dr R S Dharmakeerthi.

- Miss P N Iddagoda, a diploma holder from the Sri Lanka School of Agriculture, Kundasale, completed her training at the Soils & Plant Nutrition Department.

Seminars/Conferences/Meetings/Work-shops addressed

Officer	Subject	Organization
L Samarappuli	National fertilizer day work shop on Nutrient recycling in rubber: An agroforestry system	Soil Science Society of Sri Lanka
R S Dharmakeerthi	Soil degradation and its effects on crop productivity in rubber plantations	CIC TEA Advisory Services (Pvt) Ltd
R S Dharmakeerthi	Fertilizer application: Plantation crops	National Science Foundation
R S Dharmakeerthi	Fertilizer Quality Assurance	RRISL

Seminars/Conferences/Meetings/Work-shops attended

Officer	Subject	Organization
L Samarappuli and R S Dharmakeerthi	Scientific Committee Meetings	RRISL
R S Dharmakeerthi	National Fertilizer Advisory Committee Meetings	National Fertilizer Secretariat
R S Dharmakeerthi	Annual Meetings, Soil Science Society of Sri Lanka 2007	Soil Science Society of Sri Lanka
R S Dharmakeerthi	Annual Meetings, Geo-Informatics 2007	Geo-Infomatics Society of Sri Lanka

Training programmes

Client	No. of programmes
Research Assistants	1
Estate Managers	6
Field Officers	2
Rubber Development/Extension Officers	2
University Students	3
Diploma Students	3
School Teachers	1

Advisory visits

Client	No. of visits
Plantations	12
Smallholdings	10

LABORATORY AND FIELD INVESTIGATIONS

Soil fertility management

Ground cover management

Cover crop species

The experiment started to study the performance of *Mucuna bracteata* in different shade conditions under mature rubber is in progress at Payagala estate, Dartonfield estate, Salawa estate, Weniwella estate, and RRI sub station, Kuruwita. The biomass production of *Mucuna* at different shade conditions such as high, medium and low is presented in Table 1 (Lalani Samarappuli and P Karunadasa).

Table 1. *Effect of different shade conditions on biomass content of* Mucuna

Shade condition	Biomass production (kg/ha)		
	Homagama series	*Ratnapura* series	*Agalawatta* series
High	60-1150	30-700	400-1250
Medium	1000-1250	200-900	1200-1500
Low	1500-2000	1350-1900	1650-2500

Another experiment is in progress to study the establishment and growth of *Mucuna* under mature rubber (3 years before uprooting). Data on growth of *Mucuna* under mature rubber is presented in (Table 2) (Lalani Samarappuli, U Mitrasena and T Gunathillake).

Table 2. *Growth of* Mucuna *under mature rubber*

Age of *Mucuna*	Growth as coverage (%)
6 months after planting	20
1 year after planting	45
2 years after planting	75

Planting practices for tree legumes

Four field experiments are in progress, three in intermediate zone; at Nottinghill estate, Kahapathwela, Dammeria estate, Passara, Nalanda estate, Naula and the other experiment in wet zone; at Dorset division, Clyde estate, Tebuwana to study the performance of *Gliricidia sepium* as a successful tree legume species that can be grown between the rows of rubber plants which could provide wood material as energy for dendro power and leaf material as green manure. Growth measurements in three experiments are presented in Table 3 (Lalani Samarappuli, P Karunadasa, U Mitrasena and T Gunathilake).

Table 3. *Effect of different treatments on growth of rubber plants*

Treatments	Nottinghill 2 1/2 years Girth (cm)	Dammeria 2 years Girth (cm)	Nalanda 2 years Girth (cm)
Control	18.2^{b}	13.8^{a}	7.1^{a}
Mucuna	20.1^{a}	14.5^{a}	7.8^{a}
Gliricidia 450 sticks/ha (single row)	19.0^{ab}	14.0^{a}	7.3^{a}
Gliricidia 900 sticks /ha (Double row)	19.2^{ab}	14.0^{a}	7.3^{a}

(Means with same letter in a column are not significantly different)

Weeds and weed control

Circle weeding

Experiments to study the effect of different weedicides on efficient circle weeding during the immature period of rubber and on management of *Mucuna bracteata* around the young rubber trees were continued. Performance of different weedicides on circle weeding and control of *Mucuna* are presented in Tables 4and 5, respectively (Lalani Samarappuli, A Thevarapperuma and T Gunathilake).

Table 4. *Effect of different weedicides on circle weeding*

Treatments	Regeneration of weeds after application of treatments (%)		
	1st month	2nd month	3rd month
Manual weeding	52	90	100
Manual weeding + Diuron	00	10	34
Glyphosate only	04	27	50
Paraquat only	02	21	49
Glyphosate +Diuron	02	06	30
Paraquat + Diuron	02	12	33

Table 5. *Effect of different weedicides on management of* Mucuna *in the weed free circle*

Treatments	Regeneration of *Mucuna* at 10th week after application of treatments (%)
Manual weeding	74
Paraquat only	43
Glyphosate only	41
Paraquat + 2.4.D Amine	20
2.4.D Amine (level 1)	36
2.4.D Amine (level 2)	36
Rapid only	46
MCPA only	36

Growth of weeds was measured in the experiment started to study the effectiveness of rubberized coir and plastic mulching as a weed control method around the rubber tree (Table 6) (Lalani Samarappuli, R S Dharmakeerthi, T Gunatilleke, A Thevarapperuma and U Mitrasena).

Table 6. *Effect of different mulching materials on weed control*

Treatments	Regeneration at 5th month after application of treatments (%)
No weeding	100
Manual weeding	100
Mat A	03
Mat B	04
Mat C	02
Mat D	05
Mat E	02
Black polythene	03

Another experiment was started to study the effectiveness of mulching of paddy straw treated with commercially available weedicides as a weed control method around the rubber plants. Data on control and regeneration of weeds are presented in Table 7 (Lalani Samarappuli, T Gunatilleke, A Thevarapperuma and U Mitrasena).

Table 7. *Effect of different mulching materials on weed control*

Treatments	Regeneration at 4th month after application of treatments (%)
No weeding	100
Manual weeding	97
Clean weeding + paddy straw	85
Clean weeding + Diuron + paddy straw	07
Clean weeding + Diuron sprayed paddy straw	10
Roundup	76
Roundup sprayed paddy straw	90
Clean weeding + Roundup sprayed paddy straw	88

Management of different weed species

Growth measurements of "Yakadamarang" (*Quisqualis indica*) and *Ipomoea nil,* after the application of different commercially available weedicides were done. Data are being analysed (Lalani Samarappuli, T Gunatilleke, U Mitrasena and A Thevarapperuma).

Soil moisture stress management (Feasibility of growing rubber in drier areas)

Mulching

Girth measurements in the two field experiments at Bibile estate, Bibile and Nottinghill estate, Kahapathwela to study the effect of mulching on growth of *Hevea* plants are given in Table 8 (Lalani Samarappuli, P Karunadasa, U Mitrasena and T Dissanayake).

Table 8. *Effect of mulching on girth of rubber plants*

Treatment	Bibile Girth (cm)	Kahapathwela Girth (cm)
No mulch	58.8[b]	59.6[b]
With mulch	62.0[a]	64.1[a]

(Means with same letter in a column are not significantly different)

The effectiveness of different mulching materials on growth of *Hevea* plants grown in comparatively drier areas are being studied in a field experiment (SMC-Ag/M/99/1) at Nottinghill estate, Kahapathwela. Effect of paddy straw, coir dust, paddy husk, and green manure on growth of rubber plants are given in Table 9. Test tapping was continued (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Table 9. *Effect of different mulching materials on growth of rubber plants*

Treatment	Girth (cm)
No mulch	57.9[b]
Paddy husk	63.1[a]
Coir Dust	62.4[a]
Green manure	64.4[a]
Paddy straw	63.1[a]

(Means with same letter are not significantly different)

Ground cover management

The performance of *Mucuna bracteata* in comparison with *Pueraria phaseoloides* under dry agro-climatic conditions was studied in an experiment started in a 1998 replanting at Kumarawatta estate, Monaragala. Root distribution of both crops and the effect of *Pueraria* and *Mucuna* on soil moisture content and soil moisture storage capacity (SMSC) for 90cm soil profile are given in Tables 10 and 11, respectively (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Table 10. *Root distribution of* Pueraria *and* Mucuna

Species	Depth of feeder roots (cm)
Pueraria phaseoloides	20
Mucuna bracteata	70
Rubber	30

Table 11. *Effect of* Pueraria *and* Mucuna *on soil moisture content and soil moisture storage capacity (SMSC) for 90cm soil profile*

Species	Soil moisture content (%)		SMSC (cm)
	0-15cm	15-30cm	
Pueraria phaseoloides	16.1[a]	15.0[a]	18.3[a]
Mucuna bracteata	19.6[b]	18.1[b]	25.8[b]

(Means with the same letter are not significantly different)

Fertilizer practices for overcoming moisture stress

Effectiveness of potassium and mulching to overcome moisture stress and to improve growth of *Hevea* under comparatively dry climatic conditions was studied in a field experiment at Bibile estate, Bibile. Two K levels (recommended and double the recommended level) with and without a surface mulch were applied in this experiment. Girth data are presented in Table 12 (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Table 12. *Girth of rubber trees (cm)*

	K_1 (recommended level)	K_2 (double the recommended level)
Without mulch	54.8	58.9
With mulch	62.1	61.9

Rubber as a system to mitigate climate change: Biomass accumulation (carbon sequestration) in rubber plantations

The objective of this study is to highlight the potential of rubber plantations to carbon trading through carbon sequestration under Sri Lankan conditions. Rubber trees of different ages and different clones were uprooted to estimate Biomass accumulation. Data are being analyzed. Further analyses are in progress and opportunities are being explored to submit proposals for carbon trading (Lalani Samarappuli, Wasana Wijesuriya, T Dissanayake, U Mithrasena and T Gunathilake).

Fertilizer use and plant nutrition

Fertilizers to nursery plants

Effectiveness of dolomite as a basal dressing

One practical problem of the currently recommended young budding fertilizer mixtures is the precipitation of Mg as phosphates at the bottom of the fertilizer container after dissolution. This experiment was initiated at the Dartonfield estate to evaluate the agronomic effectiveness of dolomite as a basal dressing in young budding nurseries with the objective of removing DAP and Epsom salt from the young budding

mixture. Growth of the seedling plants (Table 13) indicates that dolomite cannot be applied as a basal dressing at the rates tested in this experiment. Visual symptoms of Mn deficiency were observed in the leaves of dolomite applied seedlings plants (R S Dharmakeerthi, V Edirimanne and S C Chandrasiri).

Table 13. *Effect of dolomite on growth of seedlings at 12 weeks after planting*

Treatment			Diameter (mm)	Height (cm)
HERP as basal	**Dolomite as basal**	**NPKMg as liquid**		
0g	0g	+ NPKMg	7.1^{ab}	63^{b}
50g	0g	+ NPKMg	7.2^{a}	69^{a}
50g	10g	+ N and K	6.9^{b}	54^{b}
50g	20g	+ N and K	6.7^{c}	61^{c}

(Means with same letter in a column are not significantly different)

Micro nutrient requirement of young budding plants

An experiment was initiated at the Sapumalkanda Estate, Deraniyagala to determine the micro nutrient requirement of young budding plants. Effect of the application of B, Zn, Cu and Mn (two levels at 2 or 6 ppm per bag) on the performance of young budding plants were compared against the zero micronutrient applied plants. Severe toxicity symptoms were observed in B applied 4-month old seedlings whereas other micronutrient applied plants showed yellowing symptoms on the top whorl of leaves and stunted growth (R S Dharmakeerthi, S C Chandrasiri and V Edirimanne).

An investigation on factors affecting scion die-back in YB nurseries

In collaboration with the Plant Science Department, several experiments were conducted under green house and field conditions to identify the causes for scion die-back in young budding nurseries, particularly during the hot and dry weather periods.

In one experiment, effects of factors such as moisture stress levels and graft-healing time were evaluated. It was observed that the scion die-back was not related to both of these factors (Table 14).

Table 14. *Scion growth parameters after 10 weeks after cut-back as affected by moisture stress level and time taken for cut back after grafting*

Moisture stress	Scion diameter (mm)			Scion death (%)		
	---------- Cut-back time after grafting (weeks) ---------					
	2	4	6	2	4	6
Watering at 4-day intervals	6.0	6.0	5.5	4	11	8
Watering at 8-day intervals	5.8	5.4	5.2	20	0	8
Watering at 16-day intervals	6.1	5.9	5.4	0	13	6

However, we observed that the live root density is very low in plants that were about to die, in this study. Therefore another experiment was conducted to study the root dynamics after cut-back using plants with small or large diameter at grafting. Some of the feeder roots dies-off with time after cut-back, but regenerate after about 6 weeks. Density of feeder roots that survive and the rate of root regeneration was higher in plants with a larger stock, also resulting a significantly higher girthing in the scion (Fig1). It is hypothesized that chances for plants having very small root system to survive during hot and dry weather periods is very low compared to that of plants with larger root system.

Investigations are continuing to find out ways to enhance the root growth of young budding plants by changing the physical properties of the potting media. (R S Dharmakeerthi, A M W K Seneviratne, V Edirimanne, S C Chandrasiri and W Karunathilaka).

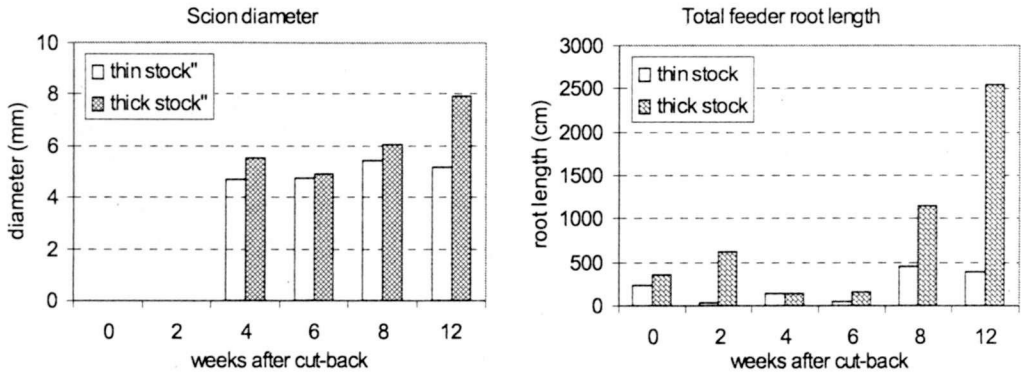


Fig. 1. *Effect of the growth of stock plant on scion diameter and root growth in young budding plants after cut-back*

Fertilizers to immature rubber

Dolomite as a source of Mg during the first year of planting

Four field experiments were in progress to study the feasibility of using Dolomite as a substitute to kieserite during the first year of planting. These experiments were at Sapumalkanda estate (*Homagama* series), RRISL Sub station at Kuruwita (*Ratnapura* series), Pitiyakanda estate, Mawathagama and Bibile estate, Bibile. Residual effects of treatments on girth of rubber plants are presented in Table 15. From 2nd year onwards the Mg source and rate are same for all treatments as per the RRISL recommendations. It appears that kieserite could be substituted with dolomite during the first year without any negative effects on the growth of the clones tested in these trials. Costs of different treatments are given in Table 16 (Lalani Samarappuli, P Karunadasa, T Gunathilake and U Mitrasena).

Table 15. *Residual effect of different Mg treatments on girth of rubber plants*

Mg application during the 1st year	Pitiyakanda Girth (cm)	Sapumalkande Girth (cm)	Kuruwita Girth (cm)
75g kieserite in 2 applications (Control)	44.6^{ab}	25.2^{a}	11.4^{bc}
25g kieserite + 75g dolomite	44.4^{ab}	22.1^{ab}	12.8^{abc}
50g dolomite + 75g dolomite	43.4^{ab}	$22.^{ab}$	13.8^{a}
75g dolomite only (planting hole)	45.9^{a}	23.9^{ab}	13.3^{ab}
75g dolomite (planting hole) + 25g kieserite	44.8^{ab}	24.5^{ab}	12.4^{abc}
100g dolomite (planting hole) + 25g kieserite	45.1^{ab}	21.6^{b}	12.6^{abc}
50g dolomite (planting hole) + 75g dolomite	43.7^{ab}	22.9^{ab}	13.0^{abc}
75g dolomite (planting hole) + 25g kieserite	42.9^{ab}	22.2^{ab}	11.6^{bc}
100g dolomite only (planting hole)	45.7^{a}	23.3^{ab}	12.8^{abc}
150g dolomite only (planting hole)	45.0^{ab}	22.9^{ab}	12.7^{abc}

(Means with same letter in a column are not significantly different)

Table 16. *Costs of different treatments*

Treatment	Cost (Rs/ha)
75g kieserite in 2 applications (Control)	1,575.0
25g kieserite + 75g dolomite	697.5
50g dolomite + 75g dolomite	287.5
75g dolomite only (planting hole)	172.5
75g dolomite (planting hole) + 25g kieserite	697.5
100g dolomite (planting hole) + 25g kieserite	755.0
50g dolomite (planting hole) + 75g dolomite	287.5
75g dolomite (planting hole) + 25g kieserite	640.0
100g dolomite only (planting hole)	230.0
150g dolomite only (planting hole)	345.0

Method of fertilizer application

Two field experiments started at Nottinghill estate and Dorset division, Clyde estate, to study the effect of cutting fertilizer pits on growth of *Hevea* under comparatively wet and dry agro-climatic conditions were in progress. Treatments consisted of two distances from the tree (1 ft. and 1½ ft), two application frequencies (4 and 2 per year) and a control. Growth measurements at 18 months after planting are presented in Table 17 (Lalani Samarappuli, P Karunadasa, U Mitrasena and T Gunathilake).

Table 17. *Girth of rubber plants (cm)*

Treatments	Nottinghil	Dorset
Control	11.9[a]	8.3[a]
4 applications/yr & 1 ft. away	12.4[a]	9.2[a]
4 applications/yr & 1½ ft. away	13.3[a]	10.2[a]
2 applications/yr & 1 ft. away	11.6[a]	9.9[a]
2 applications/yr & 1½ ft. away	12.5[a]	10.0[a]

(Means with same letter in a column are not significantly different)

Fertilizer requirement of rubber under different densities

Experiment at Mucalana division, Sirikandura estate (SMC-Ag/D/96/1) to study the fertilizer requirement of rubber under different densities was in progress. Treatments consisted of four different densities (500, 600, 700 and 800 trees/ha) and three fertilizer treatments (recommended level (F1), reduced level (F2) and 1st three

years recommended level and thereafter reduced level (F3)). Residual effect of different fertilizer treatments on yield is presented in Table 18 (Lalani Samarappuli, P Karunadasa and T Dissanayake in collaboration with the Plant Science Department).

Table 18. *Yield of rubber (g/t/t)*

Treatments	FI	F2	F3
500 trees/ha	40.3	36.5	39.8
600 trees/ha	36.8	32.3	36.8
700 trees/ha	33.1	35.0	32.8
800 trees/ha	31.8	25.3	28.5

Slow-release fertilizers for immature rubber

An experiment was started at the Sapumalkanda Estate, Deraniyagala to determine the effectiveness of a commercially available slow-release fertilizer, Agroblen, on the growth of *Hevea* during the immature period. There was no statistically significant effect on the growth of rubber (Table 19) during the first year after planting (R S Dharmakeerthi, S C Chandrasiri and V Edirimanne).

Table 19. *Effect of Agroblen on growth of* Hevea *during the first year*

Treatments	Diameter (mm) after 6 months	Girth (cm) after 15 months
Agroblen 64g in 2 applications	21.4^{b}	11.1^{a}
Agroblen 128g in 2 applications	21.9^{b}	10.8^{a}
Current recommendation in 4 applications	23.4^{a}	11.2^{a}

(values with the same superscript in a column are not significantly different)

Fertilizer use in mature rubber

Fertilizer application during mature stage on yield

An experiment started at Hillcroft division, Mirishena estate to study the effect of fertilizer application during mature stage on yield was continued (Lalani Samarappuli and P Karunadasa).

Nutrient requirement of new* Hevea *clones

Several experiments have been established using different clones and different fertilizer treatments to determine the fertilizer requirement of new vigorously growing, high yielding clones.

Trials conducted in group III soils

Three fertilizer levels (0, 100% and 200% of current recommendation) have been applied since 2003 to two new clones (RRISL 201, 202 and 217) that have been established in 1997 at RRISL sub station, Kuruwita. Girth at the end of 10th year and girth increment from the commencement of fertilizer treatments to 2007 are given in Table 20. No significant interaction effect was observed (R S Dharmakeerthi, S N Silva and C K Maheepala).

Table 20. *Effect of fertilizer level and clone on girth and girth increment of some* Hevea *clones*

Fertilizer Level	Girth (cm)	Girth increment (cm)	Clone	Girth (cm)	Girth increment (cm)
No fertilizer	60[a]	7.2[a]	RRISL 201	59[b]	7.3[a]
100% current recommendation	61[a]	7.2[a]	RRISL 202	67[a]	7.4[a]
200% current recommendation	61[a]	7.4[a]	RRISL 217	53[c]	7.0[b]

(values with the same superscript in a column are not significantly different)

Trials conducted in Monaragala

The experiment to evaluate the fertilizer requirement of two *Hevea* clones grown in Monaragala region was continued for the third year at the Kumarawatta Estate. Growth measurements made at the end of 3rd year indicated significant differences among clones and fertilizer levels (Table 21) (R S Dharmakeerthi, S N Silva and C K Maheepala).

Table 21. *Effect of clone, fertilizer mixture, and level on the growth of* Hevea *after 3 years of planting in Monaragala*

Fertilizer Mixture	Girth (cm)	Fertilizer level	Girth (cm)	Clone	Girth (cm)
R/U/12:14:14	10.0[a]	No fertilizer	9.3[c]	RRISL 203	9.8[b]
R/U/12:14:14+Mg	11.0[a]	100% current recommendation	10.5[b]	RRIC 121	11.0[a]
R/U/15:15:7	10.7[a]	200% current recommendation	11.4[a]		
R/U/15:15:7+Mg	9.8[a]				

(values with the same superscript in a column are not significantly different)

Organic fertilizers

Planting stage

Field experiment in Pitiyakanda estate, Mawathagama to study the effect of application of different organic materials (paddy straw, poultry litter, cow dung, green manure, EM treated compost and burned paddy husk) into the planting hole was continued and the girth at 4½ years after planting is presented in Table 22 (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Table 22. *Effect of different treatments on growth of rubber plants after*

Treatment	Girth (cm)
Nil (control)	41.0^{bc}
Paddy straw	42.2^{c}
Poultry litter	42.3^{bc}
Cow dung	42.4^{abc}
Green manure	40.9^{ab}
EM treated compost type 1	42.2^{ab}
EM treated compost type 2	43.8^{a}
Burned paddy husk	41.2^{ab}

(Means with same letter are not significantly different)

For the experiment in 2003 replanting in Lowmont division, Payagala estate, Dodangoda the planting hole treatments consisted of paddy straw, poultry litter, cow dung, green manure, compost, coir dust paddy husk, tea dust and saw dust. Girth at 4½ years after planting is presented in Table 23 (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Immature stage

A field experiment (FPN-Org/An/01/1), is in progress at Pembroke division, Payagala estate to study the effect of poultry litter as an organic manure for rubber. Treatments consisted of (T1) No organic manure (control), (T2) Organic manure to planting hole + 1st to 6th year, (T3) Organic manure to planting hole + 2nd year + 4th year + 6th year (Level 1), (T4) Organic manure to planting hole + 2nd year + 4th year + 6th year (Level 2), (T5) Organic manure to planting hole + 3rd year + 6th year (T6) Organic manure to 3rd year + 5th year. Effect of treatments on girth at the end of 6½years is given in Table 24 (Lalani Samarappuli, P Karunadasa, U Mitrasena and T Dissanayake).

Table 23. *Effect of different treatments on growth of rubber plants*

Treatment	Girth (cm)
Nil (control)	37.7[a]
Paddy straw	39.9[a]
Poultry litter	40.5[a]
Cow dung	37.0[a]
Green manure	41.9[a]
Compost	41.8[a]
Coir dust	40.5[a]
Paddy husk	40.2[a]
Tea dust	35.8[a]
Saw dust	38.0[a]

(Means with same letter are not significantly different)

Table 24. *Effect of different treatments on growth of rubber plants*

Treatment	Girth (cm)
T1	51.4[b]
T2	55.2[a]
T3	54.8[a]
T4	54.2[a]
T5	55.4[a]
T6	54.0[a]

(Means with same letter are not significantly different)

Two more experiments are in progress at Pitiyakanda estate, Mawathagama in a 2003 replanting and at Bibile estate, Bible in a 2004 replanting, respectively. Organic manures evaluated in these experiments are paddy straw, EM treated paddy straw, burned paddy husk, coconut husk, and green manure. Growth measurements, soil bulk density and Leaf Water Potential (LWP) at four years and six months after planting in experiment at Pitiyakanda estate and girth at three years after planting in experiment at Bibile estate are presented in Tables 25 and 26, respectively (Lalani Samarappuli, P Karunadasa and U Mitrasena).

Table 25. *Effect of different treatments on growth of rubber plants*

Treatment	Girth (cm)	Soil bulk density (g/cm^3)	LWP (-bars)
Nil (control)	43.4^a	1.47^a	14.2
EM treated paddy straw	46.5^a	1.33^{ab}	13.0
Burned paddy husk	45.4^a	1.24^{bc}	12.2
Coconut husk	45.9^a	1.21^c	11.5

(Means with same letter in a column are not significantly different)

Table 26. *Effect of different treatments on growth of rubber plants*

Treatment	Girth (cm)
Nil (control)	13.2^a
Burned paddy husk	13.9^a
Paddy straw	14.7^a
Green manure	15.5^a

(Means with same letter are not significantly different)

Organic rubber

An experiment is in progress to develop a sustainable and commercially viable system for plantations as well as for smallholders to produce an environmentally friendly new grade of rubber (organic rubber) to meet the increasing demand for "bio-market" yield data of this experiment is given in Table 27 (Lalani Samarappuli, P Karunadasa and T Dissanayake).

Table 27. *Effect of different treatments on yield of rubber*

Treatment	2006 (g/t/t)	2007 (g/t/t)
Chemical fertilizer only	18.8	31.1
Organic fertilizer only	17.8	20.1

Site-specific fertilizer recommendation by soil and foliar survey program

Under this programme about 6000 hectares of mature rubber fields were surveyed and fertilizer recommendations were given for the next three years (L Samarappuli, R S Dharmakeerthi and all the staff of the department).

Land selection and suitability for rubber cultivation

Under the routine land selection programme 100ha. of land in the traditional rubber growing areas and 75ha. in the non traditional areas were surveyed for the suitability of rubber cultivation (L Samarappuli, R S Dharmakeerthi and all the staff of the department).

An approach towards sustainable development and economics of the smallholder rubber sector

This is a collaborative study with the Biometry section and Advisory Services Department together with Ruhuna and Wyamba Universities. The soils and Plant Nutrition Department is responsible for assessing the land suitability in rubber growing areas of Moneragala and adjacent parts of Badulla and Ampara districts. Two sites in Badalkumbura AGA division were sampled and the results are presented in Table 29.

Table 29. *Indicators of land suitability in two sites of the Moneragala district*

Site	Horizon	N%	P (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	Sand %	Silt %	Clay %
Lunugala	O	0.11	3.5	152	77	482	69.3	16.0	13.5
Kolaniya	A	0.10	3.9	24	94	537	62.0	16.2	14.2
	B	0.07	1.5	33	89	765	53.0	20.2	21.0
	C	0.07	-	-	104	964	49.3	27.5	17.2
	(Composite)	0.19	3.7	106	86	701	66.0	17.0	10.1
Karawila	O	5.9	1.0	3.2	72.1	95.6	61.0	17.5	16.8
	A	6.1	1.15	2.8	70.9	96.0	51.2	23.5	22.0
	B	5.8	0.53	1.2	39.5	89.0	44.7	29.5	24.0
	C	5.6	0.13	3.7	36.0	57.2	73.4	12.0	9.5
	(Composite)	6.0	1.5	8.4	137.5	99.9	56.7	14.5	23.0

The team working on soil aspects of this project is as follows (L Samarappuli, P Karunadasa, U Mithrasena, Anoma Thewarapperuma and T Gunathilake).

Analytical services

The Department analyzed approximately 400 samples (1500 parameters) for outside organizations (L Samarappuli, R S Dharmakeerthi and all the staff of the department).

BIOCHEMISTRY AND PHYSIOLOGY

V H L Rodrigo

SUMMARY

High yields given initially with the RRIMFLOW tapping technique declined rapidly to the levels given by normal Ethephon stimulated tapping systems. However, the reduction of the gassing frequency to once a month appeared to be suitable to sustain the latex yield for a long period. Extended LFT systems, particularly the d/4 tapping were able to provide comparable yields to those given by traditional tapping systems. Sensors required to construct the proposed digital Metrolac were found and construction was in progress at the NERD centre. A new experiment was started to investigate the possibility of minimising the bark consumption with short cuts and sustain the yields with Ethephon for the extended economic life of the rubber tree. The award given by the NASTEC for excellence in scientific research – 2006 was won by Dr V H L Rodrigo.

DETAILED REVIEW

Staff

Dr V H L Rodrigo, Head and Mrs K V V S Kudaligama, Assistant Biochemist, were on duty through out the year. Mrs G V L Nilmini, Assistant Biochemist was on study leave overseas to pursue her PhD programme in the University of Maine, USA. Experimental Officers, Mr P D J Rodrigo and Mr D Ramawickrama, were on duty through out the year.

Seminars/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
V H L Rodrigo	The workshop conducted for the enhancement of technology adoption and identification of future research and development at Hector Kobbekaduwa Agrarian Research and Development Institute	RRISL
	Progress reviews of NSF funded project held at the National Science Foundation	National Science Foundation
	Workshop on rubber agronomy	Ceylon Planters' Association
	Scientific Committee meetings	RRISL

Officer	Subject	Organization
V H L Rodrigo	Climate change workshop	Ceylon Planters' Association
	Meeting on tapping knife improvement	Thurusaviya, Colombo
	Rubber Sector Advisory Committee Meetings	Export Development Board
	Awareness seminar on technology foresight	NSF
	Tapper training program	Arapolakanda estate
	Workshop on cocoa cultivation	Export Agriculture Dept. Matale
	Guest speaker on rubber exploitation	Kalutara District Planters' Association
	Annual General Meeting of YSF	NASTEC
K V V S Kudaligama	The workshop conducted for the enhancement of technology adoption and identification of future research and development at Hector Kobbekaduwa Agrarian Research and Development Institute	RRISL
	Annual General Meeting of YSF	NASTEC

Training programmes

Subject	Client	Category/Group
Use of stimulants	Rajarata University	Undergraduates
Rainguard & sealant preparation	Kelany Valley Plantation Ltd.	Executives and Field staff
Rainguard & sealant preparation	Ganepalle estate	Executives and Field staff
Use of stimulants	Sanquhar estate	Executives and Field staff
Use of stimulants	Rubber Development Department	Executive staff
Use of stimulants	Passara Group, Hapugastenna Plantation Ltd.	Executives and Field staff
Use of stimulants	Kegalle Plantation Ltd.	Latex Extraction Assistants/Officers
Centrifuge processing	Plastic and Rubber Institute	Graduate students

Advisory visits

31 advisory visits were made during the year.

Special events

Dr Rodrigo was offered the award for excellence in scientific research – 2006 by the National Science and Technology Commission.

LABORATORY AND FIELD INVESTIGATIONS

Effect of low temperature on Metrolac reading

BCP/LT&M/2003/2

This research project aims to address the problems associated with latex weighing by Metrolac under varying temperature conditions. A ready reckoner developed initially in this regard was shown in the Annual Review 2006 and used for further testing. Deviations of Metrolac reading with temperature and the associated %DRC values in the existing ready reckoner and the newly developed ready reckoner are shown in Table 1.

Table 1. *Metrolac readings under different temperatures and associated %DRC values in existing ready reckoner and the newly developed ready reckoner*

Temperature °C	Metrolac reading	Existing Ready reckoner		Newly developed Ready reckoner	
		%DRC	Difference from the value at 29 °C	%DRC	Difference from the value at 29 °C
21	60	22	-8	30	0
23	70	24	-6	30	0
25	80	26	-4	30	0
27	90	28	-4	30	0
29	**100**	**30**	-	**30**	-
31	110	32	+2	30	0
33	120	34	+4	30	0
35	130	36	+6	30	0

(K V V S Kudaligama, V H L Rodrigo, G V L Nilmini, P D J Rodrigo and D Ramawickrama).

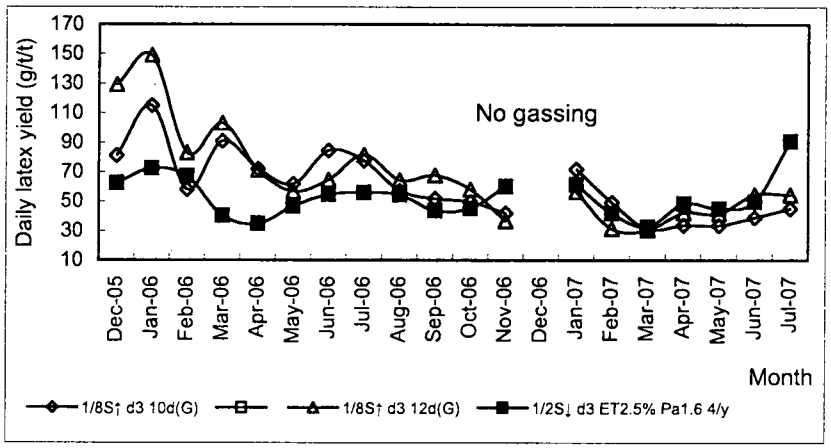
Rainguard sealant with industrial wastes

BCP/RGS/2005/1

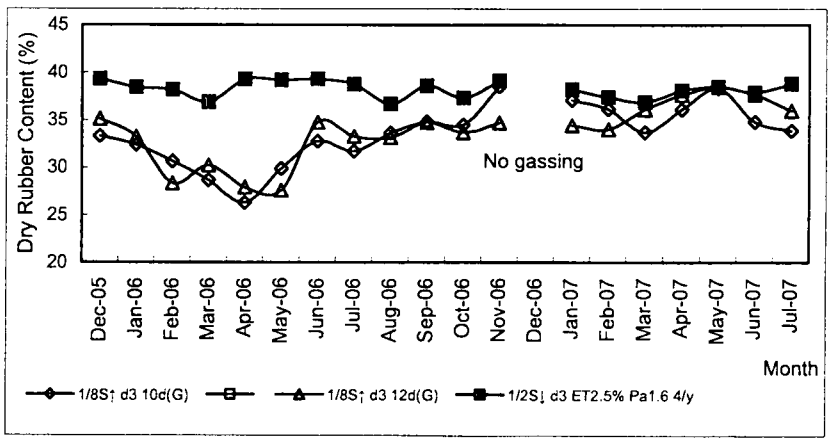
This project aims to develop new rainguard sealants with desired characteristics such as easy application and reduced cost, particularly with industrial wastes. A recipe for semisolid rainguard sealant was developed with used engine oil and the patent was obtained. Large scale field application of this sealant showed a need for further improvement of this sealant to minimise the potential leaks in rainguards. There was a little progress in this regard during the year due to lack of technical staff in the department (K V V S Kudaligama, V H L Rodrigo, G V L Nilmini, P D J Rodrigo and D Ramawickrama).

Low frequency tapping with gaseous stimulation
RRIMFLOW method
BCP/LFTG/2005/2

Details of this experiment were given in Annual Review 2006. Assessment on RRIMFLOW exploitation trials was limited to two tapping blocks of RRIC 100 in Gallewatta with one control block as required accessories were not received from the local agent on time. %DRC, latex volume and scrap weight were monitored daily in each block. RRIMFLOW experimental blocks started in 2006 in eight other estates were limited to two estates. In addition, Udapola estate joined the experiment. High yields given initially with the RRIMFLOW declined rapidly to the levels given by normal Ethephon stimulated tapping systems. With that, DRC% values also improved (Fig. 1 & 2).



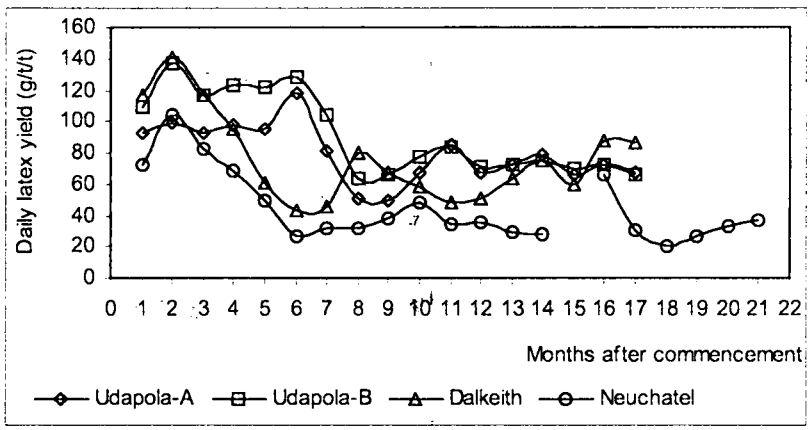
a)



b)

Fig. 1. Monthly average values of **a)**. daily latex yield (g/t/t), **b).** % dry rubber content in RRIC 100 tapping blocks in Gallewatta, RRISL

a)



b)

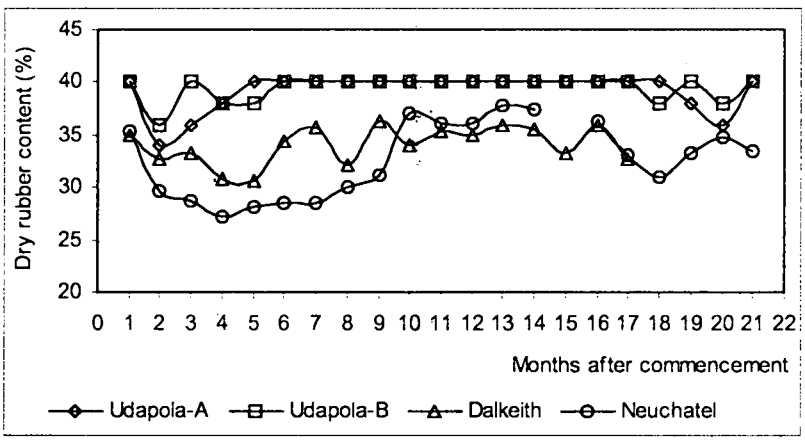


Fig. 2. Monthly average values of **a.)** daily latex yield (g/t/t), **b.)** % dry rubber content in RRIMFLOW tapping blocks in Udapola, Dalkeith and Neuchatel estates

In shifting the gas jacket after a year, exact recommendations given by the Malaysian principals could not be followed as the bark underneath the jacket has overgrown with callus formation. Also, reuse of gas jackets in subsequent years resulted in leaking ethylene gas; hence the experiment at Gallewatta had to be stopped. Therefore at the end, the study was confined to the trails in other estates.

Instead of the recommendation of Malaysian principals on gassing frequency (*i.e.* 10 day interval), once a month gassing appeared to be suitable to sustain the yield levels for a long period in Udapola estate (Fig. 2). Therefore, tentative recommendation was issued to practise the RRIMFLOW in RPCs limiting the total extent to 1500 trees per estate with monthly gassing (V H L Rodrigo, K V V S Kudaligama, P D J Rodrigo and D Ramawickrama in collaboration with the Plant Science Department).

Portable digital system to measure the dry rubber content in latex
BCP/LT & M/2006/3

The research project was aimed to develop an electronic appliance to measure the dry rubber content of latex digitally. The same principle in measuring latex with the Metrolac is used in developing the new appliance. In addition, it is expected to address the temperature associated problems in latex weighing with the standard Metrolac.

Latex samples were tested to identify the relationships between temperature, density and dry rubber content of latex and that information was given to the Electrical & Electronic Dept of the NERD centre, Ekela for the development electronic appliance. Basic sensors and accessories were found and the construction of the prototype began. More latex samples were tested to build up the relationship between the density of latex and DRC% at different temperatures (Fig. 3).

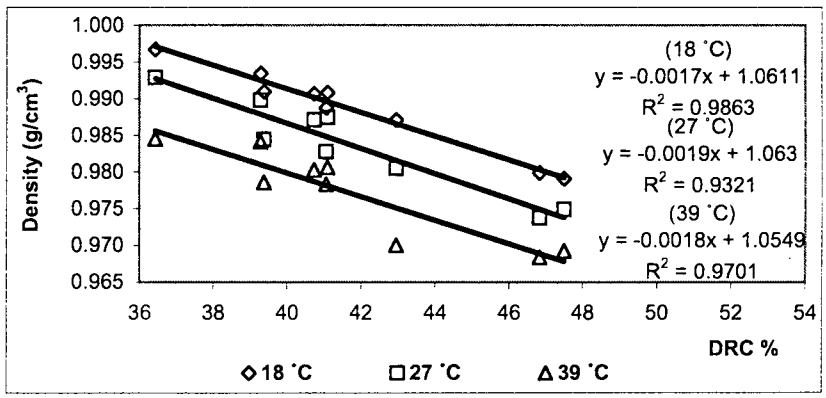


Fig. 3. Relationship of density (g/cm^3) and the dry rubber content (%) of latex at different temperatures

(V H L Rodrigo, K V V S Kudaligama, P D J Rodrigo, D Ramawickrama collaboration with NERD Centre, Ekala)

Low frequency tapping with liquid stimulation
BCP/LFT (L)/2006/1

This project aims to sustain the productivity of rubber lands using Low Frequency Tapping systems with Ethephon based liquid stimulants whilst addressing the problems of tapper shortage and high tapping cost. Low frequency tapping systems with d/4 and d/6 frequencies are tested in this project. Details of the experimental sites are given in Annual Review 2006.

At Dartonfield estate, four tapping blocks were selected from four major clones *i.e.* RRIC 100, RRIC 102, RRIC 121 and RRIC 130. Daily yields and %DRC

were monitored continuously whilst girth, bark thickness, bark consumption and length of tapping cut were assessed at six month interval. Also, raw rubber properties of latex crepe were assessed on monthly basis. Tapping blocks with RRIC 102 and RRIC 100 were selected to test LFT systems further from Udapola and Kuruwita sub station, respectively. Daily latex yields and other yield parameters were assessed (Table 2). It was too early to comment on the suitability of LFT systems, however it appeared to be possible to develop d/4 and d/6 LFT systems to provide required yield levels by changing the stimulation.

Table 2. *Yearly average values of %DRC and g/t/t of different clones tapped under different frequencies*

	d/2		d/3		d/4		d/6	
	%DRC	g/t/t	%DRC	g/t/t	%DRC	g/t/t	%DRC	g/t/t
Dartonfield (RRIC 100)	30	48	32	63	33	85	35	77
Dartonfield (RRIC 102)	32	39	34	64	36	79	37	75
Dartonfield (RRIC 121)	33	36	35	51	36	74	38	72
Dartonfield (RRIC 130)	38	46	38	75	39	116	39	119
Kuruwita (RRIC 100)	33	37	33	62	36	72	37	88
Udapola (RRIC 102)	36	32	36	38	36	56	36	57

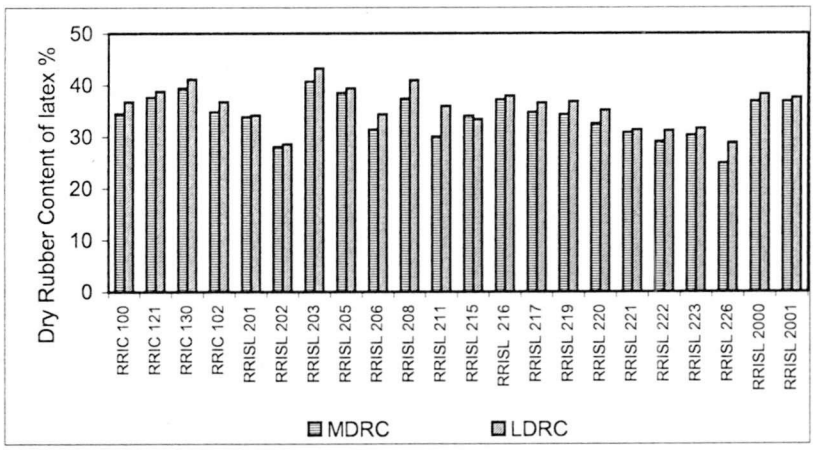
In Notinghill estate Mawathagama, 16 tapping blocks were selected from RRIC 121 for large scale testing of LFT systems (V H L Rodrigo, K V V S Kudaligama, P D J Rodrigo, R P S Randunu and D Ramawickrama)

Variation of non rubber constituents of latex in different *Hevea* genotypes and their impact on latex weighing with Metrolac and raw rubber properties *BCP/LD/2007/1*

This study is aimed to investigate the effect of organic and inorganic non rubber constituents of latex on raw rubber properties in different clones and their impact on latex weighing using Metrolac. In total, 22 clones in 4 estates were selected for this study and assessments were made on monthly basis. In all clones % DRC estimated using the Metrolac (MDRC) was lower than the Laboratory % DRC (LDRC) values. In general, % DRC of RRISL 202 and 226 clones were lower than the other clones (below 30%) (Fig. 4a).

Acetone extractable non rubber constituents (%) were high in the clones of RRISL 206, 211, 219, 221, 223 and 2000 (above 3%). However, RRISL 203 and RRIC 130 gave the lowest % non rubber constituents (Fig. 4b). Only the clones RRISL 217, 219 and 223 were within the standards of Lankaprene with respect to Initial Plasticity (Po), Plasticity Retention Index (PRI), Mooney viscosity, colour and ash% (Fig. 5 a,b,c & d).

a)



b)

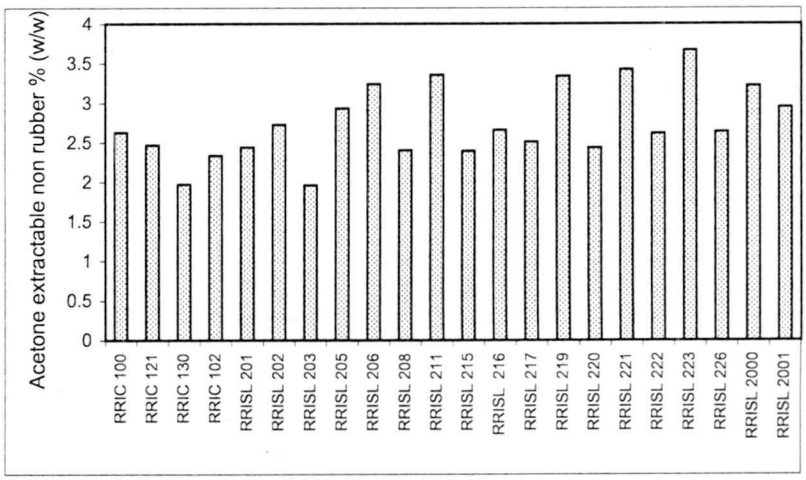


Fig. 4. Yearly means of **a).** %dry rubber content and **b).** %acetone extractable non rubber content of latex of different clones

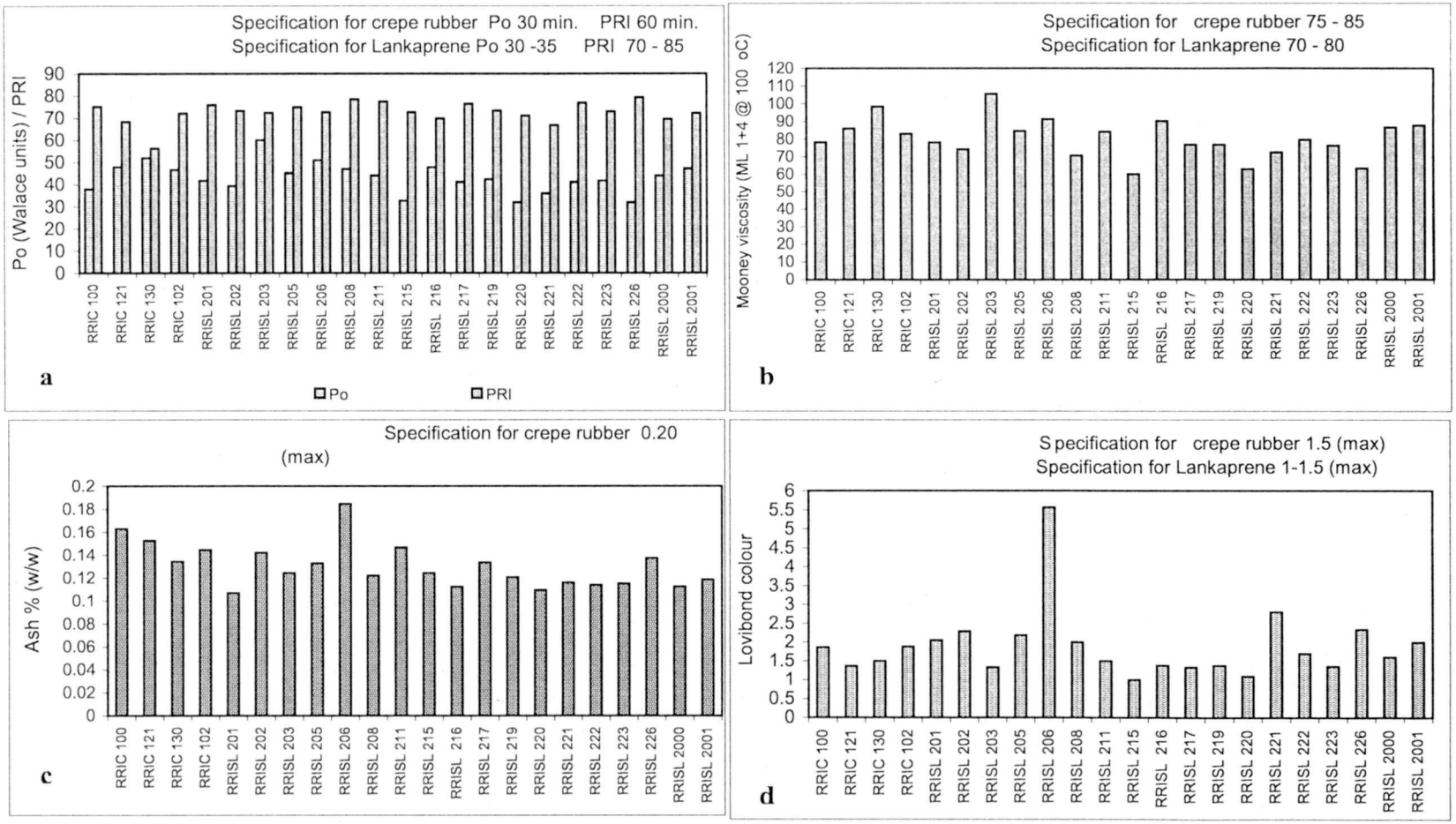


Fig. 5. Yearly means of raw rubber properties **a**. Po/PRI, **b**. Mooney viscosity, **c.** ash and **d.** colour of latex crepe of different clones (K V V S Kudaligama, V H L Rodrigo, D Ramawickrama and P D J Rodrigo)

Low intensity tapping system
BCP/LIT/2007/3

This experiment was started to investigate the possibility of minimising the bark consumption with short cuts in order to increase the economical life span of the rubber tree. Mono clonal mature rubber field (RRIC 121) due to be open for tapping, was selected from Kuruwita for the study. Practically possible combinations of tapping frequencies, *i.e.* d/2, d/3, d/4 and d/6 (once in two, three, four and six days), stimulant concentrations (2.5% and 5% of Ethephon) and tapping cut lengths (½, ¼ and ⅛ of the spiral) will be tested as shown in the Table 3. No stimulation will be done in the traditional ½2S d/2 system.

Table 3. *Different tapping systems to be tested*

Tapping system	Length of tapping cut	Tapping Frequency	% Ethephon	Stimulation frequency
½S d/2	½ of the spiral	Once in two days	-	-
½S d/3	½ of the spiral	Once in three days	2.5	Bimonthly (except wintering season)
¼S d/3	¼ of the spiral	Once in three days	2.5	Monthly
⅛S d/3	⅛ of the spiral	Once in three days	2.5	In every two months
⅛S d/3	⅛ of the spiral	Once in three days	5.0	Monthly
½S d/4	½ of the spiral	Once in four days	2.5	Monthly (except wintering season)
¼S d/4	¼ of the spiral	Once in four days	5.0	Monthly
⅛S d/4	¼ of the spiral	Once in four days	5.0	In every two weeks
½S d/6	½ of the spiral	Once in six days	5.0	Monthly
¼S d/6	¼ of the spiral	Once in six days	5.0	In every two weeks

(V H L Rodrigo, K V V S Kudaligama, P D J Rodrigo, R P S Randunu in collaboration with Plant Science Department)

ADVISORY SERVICES

A Dissanayake and A H Kularathna

SUMMARY

Highest priority was given to technology transfer programmes with the aim of increasing the adoption rates of RRI recommendations. Farmer training programmes, field workshops and awareness raising programmes were continued to address the smallholder requirements in relation to agronomic and processing practices. Accordingly, 15 tapper training programmes were conducted successfully and 461 new rubber tappers were introduced to the rubber smallholder sector. Twenty eight tapper skill development programmes and 40 training programmes on quality improvement of RSS and smoke house maintenance were conducted successfully. Eighteen awareness raising programmes were conducted to address technological and extension needs of 1388 rubber growers. Control of spreading of white root disease was identified as a 'thrust' activity of ASD. Rubber Extension Officers identified 587 rubber holdings which had 4,597 White root disease infected trees. Six regional level workshops were conducted to educate 1,388 participants on white root disease prevention and control measures.

Model rubber holdings were established in REOO ranges to demonstrate the benefits of adopting technologies to increase the land use efficiency and productivity of the rubber smallholder sector.

ASD continued to serve as a key stake holder of the FSC group certification project and 821 medium scale rubber growers were selected as beneficiaries of the pilot project.

DETAILED REVIEW

Staff

The Head of the Department, Dr Anura Dissanayake was on duty until 17th October, 2007. He was released on no pay leave, to assume duties as the Deputy Director of the Gamidiriya Fund. Three Regional Advisory Officers, Assistant Training Officer, 22 Rubber Extension Officers and 08 Divisional Rubber Extension Officers were on duty throughout the year. Mr D Rajapaksha, Regional Advisory Officer/Kegalle, resigned from services with effect from 15.03.2007. Mr A H Kularathna was appointed to cover up the duties of Head of the department with effect from 11th November, 2007.

Seminars/Conferences/Workshops/Meetings attended

Officer	Subject	Organizations
A Dissanayake	Meetings of the national steering committee of the FSC Project	FSC secretariat of the IUCN, Sri Lanka
A Dissanayake A H Kularathna D D Dasanayake	Scientific committee meetings	Rubber Research Institute
A Dissanayake A H Kularathna D D Dasanayake P K K S Gunaratna L P L Gunaratna	District training programmes of the FSC group certification project	FSC secretariat of the IUCN , Sri Lanka
A H Kularathna P K K S Gunarathna L P L Gunaratathan D D Dasanayake	Monthly progress review meetings of regional offices	Advisory Services Department, Rubber Research Institute, Sri Lanka

Advisory visits

The department staff conducted 566 advisory visits on requests of rubber growers to solve problems related to technology adoption, field management practices and other related aspects of rubber cultivation and processing, during the year.

SERVICES

Establishment of model rubber holdings and model rubber processing centers

ASD started a special extension project to establish model rubber holdings to demonstrate the benefits of adopting RRI recommendations. Accordingly, 300 rubber holdings and 150 processing centers were selected to be up graded as model rubber holdings and model rubber processing centers (Table 1).

Monitoring of progress of the project was carried out by the Director and the Deputy Director (Biology) of the RRISL in October and November 2007. Some of the holdings selected were found to be not up to the required standards. Hence, the programme was re-designed and necessary arrangements were made to complete the project successfully before 28th February, 2008.

Rehabilitation of substandard rubber smallholdings

Six hundred and thirty nine hectares of substandard rubber smallholdings were identified from rubber extension ranges. These holdings were substandard due to poor plant growth levels caused by poor quality of planting materials, and poor field management practices.

Rubber Extension Officers carried out special extension programmes to rehabilitate 176.28 hectares of rubber smallholdings during the year 2007 (Table 2). Low rate of achievements was mainly due to non availability of authenticated planting materials.

Table 1. *Rubber holdings and rubber processing centers selected from each region to be up graded as model rubber holdings and processing centers*

Type	Colombo region	Kalutara region	Galle region	Kegalle region	Rathnapura region	Total
Model rubber holdings (mature)	15	40	15	45	35	150
Model rubber holdings (immature)	15	40	15	45	35	150
Model rubber processing centers	16	40	15	45	35	151

Table 2. *Rehabilitation of substandard rubber holdings*

Region	No. of substandard rubber holdings identified		No. of rubber holdings successfully rehabilitated	
	Holdings	Extent (ha)	Holdings	Extent (ha)
Colombo	65	160.37	25	80.03
Rathnapura	46	82.95	15	15.3
Kalutara	60	174.29	41.26	41.82
Galle/Matara	33	107.73	8.1	17.73
Kegalle	222	113.86	10.4	21.4
Total	**226**	**639.20**	**99.96**	**176.28**

Farmer training programmes

Farmer training was continued as the 'thrust' area of activities of the ASD. Six types of centralized and decentralized, target oriented farmer training programmes were conducted successfully to improve the knowledge and skills of rubber smallholders.

Tapper training schools

Fifteen tapper training programmes were conducted and 461 new rubber tappers were introduced to the rubber smallholder sector (Table 3).

Table 3. *Tapper training programmes and number of new rubber tappers introduced*

Region	No. of tapper training programmes conducted	No. of new rubber tappers introduced
Colombo/Gampaha	01	31
Kalutara	04	108
Ratnapura	04	100
Kegalle	06	222
Total	**15**	**461**

Skill development of rubber tappers

Twenty eight skill development programmes were successfully completed to up grade the tapping skills of 761 semi-skilled rubber tappers selected from rubber extension ranges (Table 4).

Table 4. *Skill development programmes conducted by the ASD*

Region	No. of skill development programmes conducted	No. of tappers benefited
Colombo/Gampaha	02	60
Kalutara	11	326
Kegalle	3	84
Rathnapura	9	236
Galle/Matara	3	55
Total	**28**	**761**

Quality improvement of RSS and maintenances of processing centers

Forty training programmes were successfully conducted with the objective of transferring relevant technologies, to improve the product quality of the rubber smallholders. Seven hundred and ninety four RSS producers were benefited from these training programmes (Table 5).

Table 5. *Training programmes on quality Improvement of RSS*

Region	No. of training programmes conducted	No. of rubber producers benefited
Colombo	04	95
Kalutara	14	282
Kegalle	07	125
Ratnapura	12	241
Galle/Matara	03	51
Total	**40**	**794**

Eradication of White root disease to increase the land use efficiency and productivity of rubber smallholders

A survey was carried out to identify the number of White root disease infected rubber trees in the smallholding sector. Accordingly, Extension Officers identified 4,597 White root disease infected trees in 587 rubber holdings (Table 6).

Table 6. *Number of White root disease infected rubber holdings identified by REOO*

Region	No. of holdings	No. of trees infected with White root disease
Colombo	34	225
Kalutara	137	624
Kegalle	176	2059
Rathnapura	223	1597
Galle/Matara	17	92
Total	**587**	**4597**

Rubber Extension Officers carried out field visits to advise owners of these rubber lands on disease control and disease prevention measures. Six workshops were conducted in collaboration with the department of Plant Pathology and Microbiology, to educate farmers on identification, prevention and control measures of White root disease (Table 7).

Table 7. *Workshops conducted on White root disease control*

Region	No. of workshops conducted	No. of participants benefited
Colombo	01	47
Kalutara	02	127
Kegalle	02	154
Rathnapura	01	60
Total	**06**	**388**

Awareness raising on recommended agronomic practices for productivity improvement

To improve the farmer knowledge on RRI recommendations and to identify and solve technological and institutional problems in adopting recommended agronomic and processing practices, 18 awareness raising programmes were conducted in selected rubber growing villages with the participation of 1388 rubber growers (Table 8).

Table 8. *Awareness raising programmes conducted*

Region	No. of programmes conducted	No. of participants benefited
Colombo	01	47
Kalutara	05	321
Kegalle	04	282
Rathnapura	06	352
Galle/Matara	03	386
Total	**18**	**1388**

Centralized farmer training programmes

A bud grafting training programme was successfully conducted in the training centre in collaboration with the department of Plant science, for 40 participants, selected from rubber extension ranges.

Introduction and establishment of *Mucuna* cover crop

Hundred and forty three rubber holdings were selected for the project and extension officers successfully introduced *Mucuna* in 89 holdings (Table 9).

Table 9. *Introduction and establishment of* Mucuna *cover crop*

Region	No. of holdings selected	No. of holdings successfully introduced with *Mucuna* cover crop
Colombo	15	14
Kalutara	49	20
Kegalle	14	8
Rathnapura	40	22
Galle/Matara	25	25
Total	**143**	**89**

Short term strategies for increasing productivity of rubber small holdings

As a short-term strategy to increase the productivity of mature rubber holdings, Rubber Extension Officers were able to motivate 89 rubber smallholders to fix rain

guards in 197.64 hectares of rubber smallholdings and apply fertilizer in 801.80 hectares of mature rubber holdings (Tables 10 & 11).

Table 10. *Promotion of rain guard fixing*

Region	No. of rubber holdings fixed with rain guards	Extent (ha)
Colombo	12	34.01
Kalutara	18	53.25
Kegalle	27	48.88
Rathnapura	27	50.75
Galle/Matara	5	10.75
Total	**89**	**197.64**

Table 11. *Promotion of fertilizer usage in mature rubber holdings*

Region	Amount of fertilizer distributed for mature holdings (MT)	Extent of mature rubber holdings applied with fertilizer (ha)
Colombo	35.41	151.2
Kalutara	26.28	116.8
Kegalle	16.96	75.40
Rathnapura	17.5	78
Galle/Matara	94.65	380.40
Total	**190.80**	**801.80**

Technology transfer for construction and repair of rubber processing centers

Advisory visits were carried out to provide extension and technical support services to help rubber producers to construct new processing centers and to upgrade their substandard processing centers. Accordingly, Extension Officers could successfully provide technical advices to complete construction of 70 new processing centers and to up grade of 57 substandard processing centers (Table 12).

Table 12. *Technology transfer for construction and upgrading Rubber Processing Centers*

Region	No. of new processing centers constructed	No. of processing centers successfully up graded
Colombo	10	15
Kalutara	13	14
Kegalle	12	3
Rathnapura	20	13
Galle/Matara	15	12
Total	**70**	**57**

Provision of advisory and extension services to rubber growers in the Monaragala district

A selected team of extension officers assisted in the implementation of the NSF funded thematic research programme, "An *approach towards sustainable development and economics of the smallholder rubber sector*" conducted by the Biometry section of the Rubber Research Institute. The overall objective of the project is to improve the smallholder rubber sector in the Monaragala and adjacent parts of Badulla and Ampara districts through sustainable management of environmental, socio-economic, technological and institutional aspects. Participatory rural appraisal workshops were conducted by ASD officers in 13 selected villages in the Monaragala and Badulla districts. The project is in progress.

Forest Stewardship Council Certification (FSC) project

ASD continued to participate as a key stakeholder in the Forest Stewardship Council (FSC) certification project, which was launched by the FSC secretariat of IUCN Sri Lanka. Following activities were completed during the year 2007.

1. Regional and range level farmer training programmes were conducted to educate the rubber growers on the benefits of FSC group certification.
2. Eight hundred and twenty one medium scale farmers were registered under the FSC group certification pilot project.
3. Pre-Scoping visits were completed in 821 rubber holdings.
4. Two residential training programmes were conducted for range managers and Rubber Extension Officers, by the IUCN Sri Lanka.

Survey on medium scale rubber growers

A sample survey to collect data on production economics of medium scale rubber growers was successfully completed. Eight hundred and twenty one rubber growers participated in the survey.

Other area specific extension and advisory projects

Rubber extension officers identified different area specific extension needs of rubber smallholders in relation to their field management practices and other related aspects of rubber cultivation and processing. Accordingly, advisory works and extension activities were conducted to address following issues and problems.

1. Correction of latex exploitation practices of rubber smallholders
2. Introduction of mulching and soil conservation practices to improve soil fertility management
3. Promotion of intercropping and mix cropping systems
4. Training and demonstration programmes on tapping panel marking.

RUBBER TECHNOLOGY AND DEVELOPMENT

Dilhara Edirisinghe

SUMMARY

Preliminary trials indicated that the hardness of natural rubber (NR) latex foam mattresses could be reduced by incorporation of a plasticizer. A NR latex based carpet backing compound was developed at the request of an industry. An efficient curing system for production of room temperature pre-vulcanized latex was developed and the results were presented at the International Rubber Conference held in USA. A project on evaluation of the latex properties of different rubber clones was initiated. Several developments based on rubberized-coir were carried out. A latex coating suitable as a coating for food containers and another latex compound suitable as a binder to produce bags out of banana fibre were developed. The effect of different types of antioxidants/antioxidant combinations on ageing properties of NR latex compounds was studied. Attempts made to produce centrifuged latex free or with a low level of proteins were successful. A special technique was tried out to improve the storage stability of pre-vulcanized natural rubber latex concentrates.

The two projects on NR/SBR/BR and NR/EPDM blends were completed. Development of rubber compound formulations for tyre curing bags, dolly wheels, tyre inner tubes using rubber blend compounds were carried out. Weed control mats produced using rubber product waste showed promising results. A study revealed that soybean oil is a suitable alternative for aromatic process oils used currently in rubber compounding.

Rubber compound and product testing services were provided to the industry and several small and medium scale entrepreneurs were given advice and assistance on setting up rubber based cottage industries.

Further, the staff was actively involved in training students and organizing stalls at exhibitions. The stall of the Ministry of Plantation Industries, one of the stalls under the "Agricultural Cluster", which consisted of several exhibits of the RRISL won first place at the "Deyata Kirula" National Development Exhibition. Fabrication of machinery in connection with setting up a "Technology Incubator" in Weeraketiya in collaboration with the Vidatha Programme, Ministry of Science and Technology was completed.

DETAILED REVIEW

Staff

Mrs D G Edirisinghe, Acting Head of the Department was on duty and she commenced her PhD studies at the Department of Chemical and Process Engineering, University of Moratuwa, Sri Lanka. The project work will be funded by the National

Research Council, Sri Lanka. Dr (Mrs) M M Jayasuriya who was promoted to Senior Research Officer (Selection Grade) with effect from 10th November, 2006 was on duty throughout the year. Mrs G D D Seneviratne, Assistant Rubber Chemist was on duty until the end of September, 2007. She was granted study leave for a period of two years commencing from 25th September to carry out her postgraduate studies at the University of Sains, Penang, Malaysia.

Mrs M K Mahanama, Mrs S I Yapa, Mrs P C Wettasinghe, Mr S L G Ranjith and Mr P L Perera, Experimental Officers, Mrs Priyanthi Perera, Research and Development Assistant and Mr T A A I Siriwardena, Technical Officer were on duty throughout the year.

Research students

- Mr A D J Dharmadasa and Mr Ramesh Karunakaran, MSc (Polymer Science and Technology) students from the University of Sri Jayawardenapura completed their research projects.

- Mr Thushara Samaraweera, a MSc (Polymer Science and Technology) student from the University of Sri Jayawardenapura completed writing-up of his thesis.

- Miss Geethamala Jayawardena, a BSc (Chemistry Special) undergraduate student from the University of Sri Jayawardenapura, Sri Lanka completed her final year research project.

- Mr H Chintaka, a BSc (Polymer) undergraduate student from the University of Sri Jayawardenapura, Sri Lanka completed his vacation training.

- Miss S A N Maduwanthi, a BSc (Chemistry Special) undergraduate student from the University of Kelaniya completed her vacation training.

- Miss G Chandrasekera, a BSc (Chemistry Special) undergraduate student from the University of Sri Jayewardenepura commenced her final year research project.

- Mrs D G Edirisinghe served as the external examiner to evaluate the theses of one MSc (Polymer Science and Technology) student of the University of Sri Jayewardenepura and two MSc (Polymer Technology) students of the University of Moratuwa.

- Dr (Mrs) M M Jayasuriya served as the external examiner to evaluate the thesis of a MSc (Polymer Science and Technology) student of the University of Sri Jayewardenepura.

Seminars/Lectures/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
D G Edirisinghe	Young Scientists Forum – Six Steering Committee Meetings	National Science and Technology Commission
	Third Working Group Meeting on "Bicycle Tyres & Tubes"	Sri Lanka Standards Institution
	"Deyata Kirula" National Development Exhibition	Ministry of Plantation Industries
	172nd Fall Technical Meeting & International Rubber Conference 2007, Cleveland, Ohio, USA	American Chemical Society
	Rubber Sector Meeting	Export Development Board
	Workshop on "SME Oriented Technology Transfer Mechanisms"	National Engineering Research and Development Centre
D G Edirisinghe and G D D Seneviratne	Seminar on "Testing Facilities for the Rubber/Footwear Industry"	Industrial Technology Institute
D G Edirisinghe and M M Jayasuriya	Scientific Committee Meetings	Rubber Research Institute of Sri Lanka
	Young Scientists Forum – Annual General Meeting 2007	National Science and Technology Commission
G D D Seneviratne	Workshop on "Scientific Writing"	Sri Lanka Council for Agricultural Research Policy
M K Mahanama	Presidential Awards Ceremony	Presidential Secretariat

Lectures/Seminars/Conferences/Meetings/Workshops addressed

Officer	Subject	Organization
D G Edirisinghe	General properties of NR latex and latex technology	PRI - DPRI course
	Polymer degradation	PRI - Graduateship in Rubber Technology
	Degradation and Stabilization of Polymers	MSc (Polymer Science and Technology) - University of Sri Jayewardenepura
Priyanthi Perera	Structure and property relationship of polymers	PRI - Basic Course in Rubber Technology
M K Mahanama	Manufacture of RSS, Crepe and TSR	PRI - DPRI course
	Compounding ingredients (dry rubber and latex)	PRI - Basic Course in Rubber Technology
	Processing techniques (latex)	
	Composition of natural rubber latex	NIPM- Planter trainees - Induction Course

Officer	Subject	Organization
M K Mahanama	What is an invention?	Students of - Royal College, Colombo 7 - D.S. Senanayake College, Colombo 8 Students and teachers of the educational region, Minuwangoda

Training programmes

Client	Subject	No. of programmes
MSc (Polymer Science and Technology) students of the University of Sri Jayewardenepura	Practical training on "Rubber Technology"	1
Officers of the Vidatha Centre, Horana and small/medium scale entrepreneurs	Latex and dry rubber based articles	1
Officers of the Vidatha Centre, Divisional Secretariat, Kamburupitiya and small/ medium scale entrepreneurs	Manufacture of latex based products	1

Industrial visits

The following industries were visited during the year in order to look into the problems encountered during manufacture of products, identify new research areas relevant to the industries and for research project collaboration work.

Officer	Industry
D G Edirisinghe, G D D Seneviratne and S I Yapa	Nippon Nature Foams International (Pvt.) Ltd., Bandaragama
M M Jayasuriya, S L G Ranjith and S I Yapa	Small Scale Industry in Elpitiya
M M Jayasuriya, S L G Ranjith, S I Yapa and Leela Wanigatunga	Laugfs Corporation Coir Ltd., Horana
D G Edirisinghe and G D D Seneviratne	Prime Polymers, Avissawella
D G Edirisinghe, G D D Seneviratne and M K Mahanama	Ceyesta Factory, Madampe
D G Edirisinghe and G D D Seneviratne	Loadstar (Pvt.) Ltd., Colombo 5
M M Jayasuriya	AMW (Pvt.) Ltd., Kalutara
D G Edirisinghe and M K Mahanama	Carnival World, Katana

LABORATORY INVESTIGATIONS

Latex technology

NR latex foam

Reduction of hardness of NR latex foam mattresses

Trials were initiated to reduce the hardness of NR latex foam by incorporating a polymeric plasticizer supplied by Nippon Nature Foams International (Pvt.) Ltd. In the initial trial, the plasticizer in the form of a gel, which is insoluble in the aqueous medium was mixed into latex according to a special mixing technique. The indentation hardness index of the foam produced using the plasticizer was lower than that of the foam produced in the factory without any plasticizer. By adding about 0.8 phr plasticizer, it was possible to reduce the indentation hardness index value to half.

In the second trial, a series of foam compounds containing different amounts of the plasticizer was prepared in order to study its effect on the hardness. Hardness of the samples was measured using the Indentation Hardness Index Tester at IDB, Peliyagoda. The hardness results of the above mentioned two trials were inconsistent, probably due to thickness variations of the foam samples. A cushion mould was supplied by Nippon Nature Foams (Pvt.) Ltd. in order to minimize thickness variations of NR latex foam samples. However, a trial could not be carried out using this mould as it was too large to be kept inside the laboratory oven for vulcanization (D G Edirisinghe, G D D Seneviratne and S I Yapa).

Development of flame retardant NR latex foam

At present there is a great demand for flame retardant foam products. As such a trial was conducted with the aim of producing flame retardant NR latex foam by adding a fire resistance material called "fillite" into the NR latex foam compound. The material was supplied by Nippon Nature Foams International (Pvt.) Ltd. The flame resistance of the foam compound was tested and was not upto the level of the foam produced with graphite which has shown to be a good fire resistance material for NR latex foam. The disadvantage of using graphite is, it imparts a grayish colour to the product. Further work is in progress to combine fillite with another fire resistance material to get the synergistic effect (D G Edirisinghe, G D D Seneviratne and S I Yapa).

Development of a carpet backing out of latex foam

Attempts were made to develop a latex foam compound suitable as a carpet backing, at the request of Onril (Pvt.) Ltd., Katana. Few trials were carried out with NR latex as well as 50/50 NR/SBR latex blends. Quality of the latter foam was in accordance with the requirements (D G Edirisinghe, G D D Seneviratne and S I Yapa).

Development of a NR latex based carpet backing compound

At the request of Onril (Pvt.) Ltd., Katana, trials were carried out to develop a NR latex based compound suitable as a backing for the carpets produced by the Company.

One of the trials was successful as the binding of it to the fabric and resistance to wearing of the compound were superior to those of the compound presently produced by the company. China clay was added to obtain the required hardness and the carpet with the NR latex backing did not show any slippery effect. The developed formulation was forwarded to the Company to carry out factory trials (D G Edirisinghe, S L G Ranjith and Priyanthi Perera).

Development of an efficient curing system for production of room temperature pre-vulcanized latex

A short term project was initiated on the preparation of pre-vulcanized latex, economically. Initial trials were conducted by preparing three room temperature pre-vulcanized latex compounds containing the three accelerators namely, ZDC, MBT and DPG as per the composition ratios 1.0:1.0:0.5, 1.0:0.5:1.0 and 1.0:0.5:0.5. These ratios were selected as the cast films of the compounds prepared in the past using the same and vulcanized at room temperature have exhibited excellent strength properties. Cast films of the pre-vulcanized latex compounds were prepared and thereafter strength and ageing properties were evaluated.

Out of the three natural rubber (NR) latex compounds pre-vulcanized at room temperature, the compounds B and C containing three accelerators ZDC, MBT and DPG according to the ratios 1.0:0.5:1.0 and 0.5:1.0:1.0, respectively exhibited good tensile properties (Figures 1,2,3 and 4) and tear strength (Figure 5). Lower moduli and strength properties of the compound A prepared according to the accelerator ratio ZDC:MBT:DPG 1.0:1.0:0.5 compared to the other two compounds indicate poor vulcanization and hence lower cross-link density at the conditions used for pre-vulcanization.

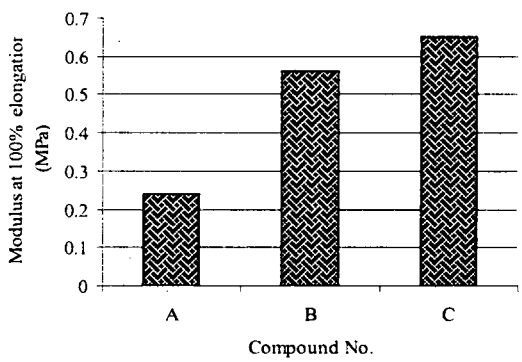


Fig. 1. Variation of modulus at 100% elongation of the cast films

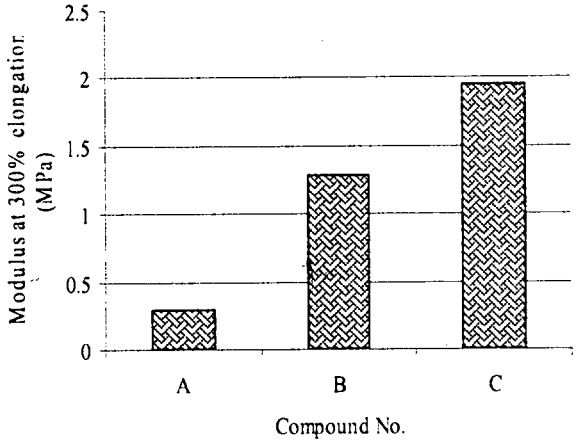


Fig. 2. Variation of modulus at 300% elongation of the cast films

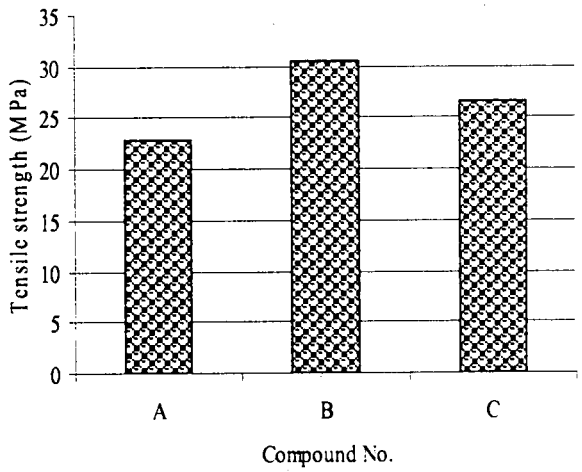


Fig. 3. Variation of tensile strength of the cast films

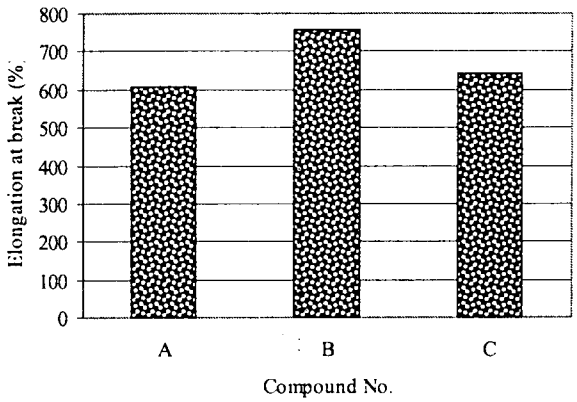


Fig. 4. Variation of elongation at break values of the cast films

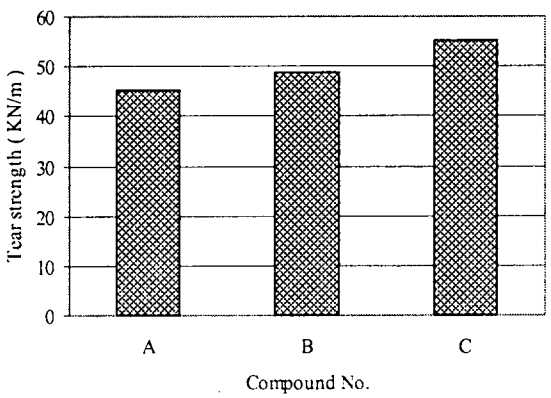


Fig. 5. Variation of tear strength of the cast films

It is apparent from the results of this study that the pre-vulcanization of **NR** latex at room temperature can be carried out by using the combination of the three accelerators ZDC, MBT and DPG. It is advantageous to use the accelerator combinations in systems B and C consisting of the accelerator ratios ZDC:MBT:DPG ≡ 1.0:0.5:1.0 and 0.5:1.0:1.0 respectively, as it produces cast films of excellent tensile properties and tear strength.

The accelerator combinations of compounds B and C, which pre-vulcanize the NR latex within about a period of one hour, would be beneficial especially for small and medium scale entrepreneurs as the cost involved for the process of vulcanization at elevated temperatures can be eliminated.

Therefore, the sulphur pre-vulcanizing systems B and C are highly effective room temperature pre-vulcanizing systems in terms of rate of vulcanization, strength properties and cost, for NR latex based compounds used in the manufacture of cast and dipped products, rubberized–coir products, latex foam, *etc.*

A research paper on this work was presented at the 172nd Fall Technical Meeting and International Rubber Conference 2007, Cleveland, Ohio, USA during 16-18th October (D G Edirisinghe, Priyanthi Perera and H Chintaka, a BSc (Polymer) undergraduate student from the University of Sri Jayewardenepura).

Evaluation of properties of different rubber clones

Evaluation of properties of latex in the RRISL 200 Series rubber clones and its effect on Brown bast

The project initiated at the end of last year in collaboration with the Genetics and Plant Breeding Dept. was continued throughout the year. Latex obtained from five new clones RRISL 205, 206, 225, 2000 and 2001 were supplied by the Genetics and Plant Breeding Dept. and the latex characteristics such as DRC, TSC, alkalinity and VFA of four of the above mentioned clones were evaluated. Determination of magnesium and copper levels of the selected clones were also carried out during the year (P Seneviratne, D G Edirisinghe and P C Wettasinghe).

Evaluation of latex properties of various rubber clones under different climatic conditions

This project was initiated with the aim of investigating the properties of new clones introduced by RRISL. Preliminary experiments were carried out using latex obtained from some of the new clones. Variation of physical properties of the field latex and the centrifuged latex prepared from these clones with the storage time was observed.

In addition, attempts were also made to prepare smoked rubber sheets and air dried sheets out of the latex of the new clones. Physical and technological properties of these raw rubbers were tested.

Most of the RRISL 200 clones available at the Galewatta Estate were used for determination of latex and dry rubber properties. The dry rubber content of the latex obtained from these clones was found to vary from 33 to 41 %. The air dried sheets prepared from these clones exhibited some discolouration. However, the effect of discolouration is difficult to observe in the RSS sheets.

Some experiments on evaluation of latex properties of RRISL 200 series clones were repeated. Latex and raw rubber properties of the new clones are satisfactory (M M Jayasuriya, L Wanigathunga, S L G Ranjith, S I Yapa and L P Witharana).

Development of rubberized-coir products

Development of a weed control mat

A low cost weed control mat was developed using rubberized-coir mattress waste, centrifuged/field latex and old newspapers at the request of the Director, RRISL. Several other techniques were also tried out on this development. Six mats which were produced using rubberized–coir waste as a replacement for weedicides were handed over to the Soils & Plant Nutrition Dept. in order to carry out field trials. Production of more of these low cost weed control mats as a substitute for the use of weedicides is in progress (W M G Seneviratne, M K Mahanama and D G Edirisinghe).

Development of natural rubber composites with coir for different applications

Trials were carried out to develop natural rubber/particulate filler/coir composites with improved properties for applications such as mats, shoe soles, etc. in collaboration with the Coconut Research Institute of Sri Lanka. Four compounds were prepared by varying the amounts of particulate filler (carbon black/china clay) and coir (mixed fiber) in the formulation. Evaluation of physical/mechanical properties is in progress (D G Edirisinghe, P C Wettasinghe and P L Perera).

Development of a cost effective method to produce coir based products

This project was initiated by the request of Laugfs Corporation Coir (Pvt.) Ltd., with the aim of improving binding properties of coir fibers for manufacturing of coir mattresses. Few factory scale trials were conducted using different types of latex compounds and some of the trials were successful. Hence a cost effective method to produce coir based products using NR latex as a binder was developed. Mattresses produced using this developed formulation exhibited similar hardness and binding properties to those produced by conventional formulations (M M Jayasuriya and S L G Ranjith).

Development of rubber coatings for food containers

A new latex compound was prepared to meet the requirements of food contact applications. Special emphasis was made to minimize the proteins in latex to reduce the allergenic effects caused by them. A number of factory scale trials had been conducted for the production of coated cups based on natural rubber and recycled papers. These trials were promising and a special latex compound using natural ingredients to achieve a low protein level (45 – 100 μg), inherent taste of yoghurt and to reduce the smell of rubber was developed. Steps will be taken to perform a clinical trial at the Medical Research Institute (MRI), before releasing this product to the market (M M Jayasuriya, S L G Ranjith and S I Yapa).

Development of low viscosity rubber

A project was initiated to produce RSS with lower viscosity to facilitate easy processing during the process of compounding. This would result in lower energy requirement. It was possible to reduce the Mooney viscosity of RSS from 80 to 50 by incorporation of a plasticizer, without any adverse effect on Plasticity Retention Index (M M Jayasuriya, S I Yapa, S L G Ranjith and Leela Wanigatunge).

Comparison of ageing properties of NR latex compounds prepared with different types of antioxidants / antioxidant combinations at different dose levels

NR latex compounds were prepared according to a surgical glove formulation with five different types of antioxidants namely, Ralox, TMQ, Lowinox 22M46, CPL and Vulcacit DS/F by varying the amount of antioxidant. Cast films were prepared and physical and ageing properties were evaluated. Experiments were repeated for confirmation of the results (D G Edirisinghe and P C Wettasinghe).

Preparation of RSS sheets using GRT incorporated NR latex

GRT produced from worn out tyres is generally regarded as a non-reinforcing filler and it is cheaper in comparison to the conventional fillers available in the market. Several industries use GRT (ground tyre rubber) as a compounding ingredient in their productions mainly to reduce the cost of production. Mixing of GRT into rubber is generally carried out using a Banbury or a two roll mill which causes environmental pollution as in the case of mixing other fillers.

The aim of this work was to develop a technique suitable for incorporation of low cost GRT into NR latex in order to reduce environmental pollution. Several RSS sheets were prepared by coagulating NR latex incorporated with GRT according to a special technique. The texture of the sheets appears to be very good. Work is in progress to prepare a tyre tread compound using these RSS sheets and to determine the mechanical properties of the same (D G Edirisinghe and S L G Ranjith).

Protein free latex for industrial applications

This project was initiated with the aim of investigating the methods to reduce the protein level in natural rubber latex to a greater extent in order to reduce the risk of latex allergy problems in sensitive individuals. In recent past, various research work had been conducted by the use of enzymes or by using anionic exchange resins to remove proteins. These methods are costly and sometimes leads to destabilization of latex.

In this project, three methods including naturally available materials containing proteolytic enzymes and low cost, non hazardous chemicals were used to reduce the protein level in natural rubber latex during the manufacture of centrifuged latex. The rubber films produced from centrifuged latex were prepared according to these novel methods and the protein level was determined by the ASTM method. Results clearly indicated that the residual soluble protein content of these unleached rubber films vary from 90 μg/g of rubber to undetectable level.

It indicates that the protein levels of centrifuged latex produced using these chemicals and enzymes were significantly lower than the normal centrifuged latex in which protein levels varies from 200-800 ppm depending on the processing conditions. Hence, these chemicals can be considered as viable materials to reduce the protein level in natural rubber latex. Plans are being made to patent these processes (M M Jayasuriya, S L G Ranjith and S I Yapa).

Development of a latex compound suitable as a binder to produce carrier bags, hand bags *etc.* out of banana fibre

Trials were carried out to develop a latex compound suitable as a binder to produce the above products on a request made by a small scale manufacturer. The multi-coloured bags produced with the developed NR latex compound were free from the inherent odour of rubber and are of very high quality. Further, the appearance of the bags indicated the suitability of same for the export market (D G Edirisinghe and M K Mahanama).

Improvement of the storage stability of pre-vulcanized natural rubber latex concentrates

The overall aim of this research was to develop an advanced technology to prevent over vulcanization and thereby improve storage stability of pre-vulcanized natural rubber latex.

When latex is pre-vulcanized, it retains its original fluidity and general appearance. The cure takes place in the individual latex particles without altering their state of dispersion.

Excess compounding ingredients remaining after pre-vulcanization cause to form primary linkages between the particles (over vulcanization of the latex). To prevent further cure which takes place during storage, three techniques were tried out in this research. Latex quality parameters such as alkalinity, TSC, DRC, VFA and storage stability of pre-vulcanized latex (by testing MST and viscosity) were tested, weekly. Further, state of cure was also determined twice a week to maintain the initial level of pre-vulcanization.

The results revealed that the technique which consists of re-centrifuging the pre-vulcanized latex by replacing 40% of it with field latex (technique 1) gives the best stability properties compared to the other two techniques namely, technique 2 and 3 (Fig. 6).

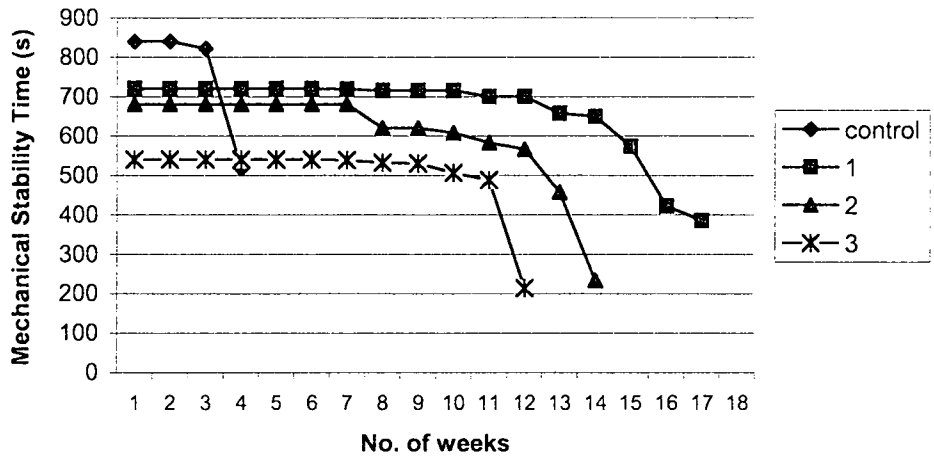


Fig. 6. Variation of mechanical stability time (MST) of the samples prepared according to different techniques

Also, the cast films produced using the pre-vulcanized latex prepared according to this technique exhibited excellent tensile strength (W M G Seneviratne, Priyanthi Perera, D G Edirisinghe and G D D Seneviratne).

Dry rubber technology

Dry rubber blends

NR/SBR/BR blends for tyre treads

Further work on this project was carried out in collaboration with Loadstar (Pvt.) Ltd. Initial trials were conducted last year by preparing nine NR/SBR/BR tri-blend compounds and mechanical properties of these compounds were evaluated and compared with those of the 100% NR compound. As the second stage, preparation and mechanical property testing of NR:SBR:BR 50:40:10, 50:30:20 and 30:60:10 compounds (which exhibited good overall mechanical properties compared to the others) together with the control NR sample were repeated for confirmation of results. At the same time, four compounds were submitted to Loadstar Ltd. for them to carry out mechanical and dynamic property tests.

Out of the nine NR/SBR/BR tri-blend compounds, the compound with the best overall physical/mechanical properties was found to have the composition ratio NR:SBR:BR 50:40:10. This was further examined by varying the carbon black grade and by adding a greater amount of oil to produce oil-extended rubber, which is generally used in winter tyres (D G Edirisinghe, G D D Seneviratne and A D J Dharmadasa, MSc (Polymer Science and Technology) student, University of Sri Jayewardenepura).

Improvements in ozone resistance of NR/EPDM blends

Mechanical and ageing property evaluation of the series of NR/EPDM blend compounds prepared according to different compositions of the two rubber components and different combinations of the antioxidants/antiozonants was continued. Testing of ozone resistance of the NR/EPDM blend compounds was carried out at DSI, Mahara, Kadawatha. Subsequently the ozone cracked surfaces of the blend compounds as well as the two control samples NR and EPDM were analyzed using the Scanning Electron Microscope at the MRI. Some interesting observations on morphology as well as crack formation were noted. Almost all the NR/EPDM blends exhibited a co-continuous morphology. The compounds were also characterized using the Differential Scanning Calorimeter (DSC).

Out of the formulations studied, the 60/40 NR/EPDM formulation consisting of a semi-efficient vulcanizing system and silica as the filler exhibited both good physical properties and ozone resistance. It was also found that replacing part of the NR with EPDM is more effective towards protection against ozone than protecting NR with common anti-ozonants such as waxes and IPPD.

Further, a trial was carried out by introducing homogenizer 501 into the blend system, but no significant improvement in properties was observed (D G Edirisinghe, H N K K Chandralal, Ramesh Karunakaran - MSc (Polymer Science and Technology) student, University of Sri Jayewardenepura and S L G Ranjith).

Development of a rubber compound for tyre curing bags

This project was initiated by the request of Associated Motorways (Pvt.) Ltd. A series of natural rubber (NR) and ethylene-propylene-diene monomer (EPDM) blends were prepared and their technological properties were evaluated. It was found that the ageing resistance of the product could be improved to a significant level by the incorporation of EPDM and by using a suitable curing system. Nevertheless, blooming of zinc-stearate was noted, and therefore, attempts were made to overcome the problem of the NR/EPDM blends by varying the curing system.

Further, improvement in ageing resistance of the NR/EPDM blends was made by using a suitable combination of accelerators and antioxidants. The physical properties of these blends were also determined. Among the series of blends studied, the formulation of the blend with 96% ageing resistance (aged at 100°C for 3 days) was forwarded to AMW Ltd. in order to produce tyre curing bags. A research paper on this work was accepted for presentation at the International Rubber Conference 2007 held in Cambodia, organized by the IRRDB (M M Jayasuriya, G D D Krishantha, S I Yapa and S L G Ranjith).

Development of a rubber compound suitable for dolly wheels

At the request of Sampan Film Service, trials were conducted to develop a rubber compound suitable to produce dolly wheels locally. The imported dolly wheels contain silicone rubber as the base rubber material. The properties required are oil resistance, heat resistance, good resilience and sound proof properties. As such a 50/50 NR/NBR compound was prepared and the properties were evaluated. As most of the properties were in accordance with the requirements, a large quantity of the compound was produced and handed over to the company in order to produce the rubber coating of the dolly wheel by transfer moulding (D G Edirisinghe, Priyanthi Perera and P L Perera).

Development of a tyre inner tube formulation using NR/IIR blends

The objective of this short term project was to develop a NR/butyl rubber (IIR) blend compound having low resilience and high hardness, tear strength and tensile properties. Work on this project was carried out by preparing a series of rubber compounds out of which five were NR/IIR blends. The other two compounds were the 100% NR compound and the 100% IIR compound. Tensile properties, tear strength, hardness and resilience of the compounds were evaluated. However, dynamic properties could not be analyzed as the Flexometer at Loadstar (Pvt.) Ltd. was out of order.

The effect of blending of N 330 carbon black with N 660 carbon black on the above mentioned properties was also studied. Results indicated that the 40/60 NR/IIR blend compound containing a mixture of N330 and N660 carbon blacks having 35 phr:30 phr, respectively is suitable for production of inner tubes with required mechanical properties (D G Edirisinghe, G D D Seneviratne, T A A I Siriwardena and S A N Maduwanthi - BSc (Chemistry Special) undergraduate student, University of Kelaniya).

Development of a cost-effective weed control mat out of rubber product waste

Trials carried out to develop low cost mats using latex based product waste were successful. Five mats were produced and handed over to the Soils and Plant Nutrition Dept. to carry out field trials at the request of the Director, RRISL. Field trials indicated that the durability and weed control of these mats is superior to those of the mats produced using rubberized–coir waste. Field trials are being continued.

Further, preliminary trials were conducted to develop low cost mats using dry rubber based product waste, especially tyre waste (D G Edirisinghe and M K Mahanama).

A study on suitable alternatives for aromatic oils used in the dry rubber products industry

This project which is aimed at identifying suitable alternatives for aromatic rubber processing oils from plant oils and their derivatives was continued in collaboration with the Department of Chemistry, University of Sri Jayewardenepura.

Sunflower oil, soybean oil and palm oil were selected for the study and tyre tread compounds were produced. Mechanical, rheological and ageing properties of the compounds were evaluated and compared with the reference compound. Some interesting results have been obtained.

The first stage of this project was completed during the second quarter. Physical and mechanical property results revealed that out of the natural oils studied, soybean oil is the best alternative for aromatic process oils used in rubber compounding. Writing up of a research paper on this work for publication in the Journal of National Science Foundation of Sri Lanka was nearly completed (L Karunanayake, D G Edirisinghe, Priyanthi Perera and Geethamala Jayawardana – BSc (Chemistry Special) student from the University of Sri Jayewardenepura).

The second stage of this project was initiated during the year in collaboration with the Dept. of Chemistry, University of Sri Jayewardenepura (L Karunanayake, D G Edirisinghe, M K Mahanama and G Chandrasekera - BSc (Chemistry Special) student from the University of Sri Jayewardenepura)

Industrial extension

The following services were provided to various rubber companies at their request.

Service	No. of companies
Physical properties of rubber compounds	9
Tensile properties of gloves	4
Tensile properties of latex based strips	1
Tensile properties of cast films	1
Hardness of sole crepe samples	3

In addition to the services rendered to rubber industries, a large number of entrepreneurs were provided with advice and assistance on setting up of NR latex based cottage industries as well as dry rubber based industries.

Fabrication of machinery and purchasing of most of the equipment in connection of setting up a "Technology Incubator" in Weeraketiya in Collaboration with the Ministry of Science and Technology under the "Vidatha Programme" was completed. Plans have been made to initiate production of rubberized-coir mattresses, especially beneficial to small and medium scale entrepreneurs, at the chosen site in Weeraketiya, next year.

Participation/providing assistance at exhibitions and trade fairs

Mrs D G Edirisinghe, Mr P L Perera, Mrs M K Mahanama, Mr S L G Ranjith and Mr T A A I Siriwardena were actively involved in organizing the stall of the Ministry of Plantation Industries and providing advice to entrepreneurs on setting up

rubber based industries as well as educating school children on rubber technology, at the **"Deyata Kirula"** National Development Exhibition held at the BMICH, Colombo 7 from 04th to 09th February. The stall of the Ministry of Plantation Industries, one of the stalls under the "Agricultural Cluster" won first place in the competition held among the different clusters.

Mrs D G Edirisinghe and Mr T A A I Siriwardena were actively involved in organizing the RRISL stall and specially educating school children on rubber technology, at the exhibition and fair held at Ananda Shastralaya, Matugama from 23rd to 26th February.

Mrs D G Edirisinghe, Mrs M K Mahanama and Mr P L Perera were actively involved in organizing the RRISL stall and providing advice and assistance to entrepreneurs mainly on rubber machinery required for setting up rubber based industries at the "International Machinery Exhibition and Trade Fair 2007 held at the BMICH, Colombo 7 from 2nd to 4th November. This exhibition was organized by the Small and Medium Enterprise Developers and the Ministry of Rural Industries and Self Employment Promotion.

POLYMER CHEMISTRY

Champa Wellappili

SUMMARY

The physical properties of NR latex-styrene/acrylate copolymer blends were found to be satisfactory when blends were prepared by combining compounded lattices rather than mixing them together prior to compounding.

Bio degradation of the foam rubber waste, generating from foam rubber manufacturing industry has been examined to counteract its current disposal problem. Certain bacterial cultures are being investigated to enhance the bio decomposition.

NR based pillows were manufactured from foam rubber waste using latex blends as binder for crumbs.

New preservative system for NR latex was developed based on nitrosoamine free phenolic type bactericide as a replacement for currently used low ammonia TMTD/ZnO (LATZ) preservative system.

The effect of metallic substances in reducing the Natural Rubber latex proteins is being investigated.

Prevulcanized lattices with improved storage stability were developed for commercial applications.

Preparation of thermo plastic composites based on wood fiber and polypropylene, polystyrene, poly (Vinyl Chloride) was carried out enabling conversion of low value waste wood resources into high-value products such as garden benches.

Preliminary work was started to fabricate an equipment to estimate the DRC of NR latex having a digital display in collaboration with the Department of Physics, University of Colombo.

DETAILED REVIEW

Staff

Dr (Mrs) Champa Wellappili, Senior Research Officer was on duty throughout the year. Ms Nilmini Liyanage, Assistant Rubber Chemist, continued her postgraduate studies at the University of Cardiff, UK.

Experimental Officers Mr H N K Chandralal, Mr S S Warnapura, Mrs Chitra Kuruppu, Mrs Indra Denawaka, Mr Ananda Samarakoon and Mrs Renuka Wijeratne, Clerk/Typist, were on duty through out the year.

Research students

- Mr N S Disanayake, a BSc undergraduate student of the University of Kelaniya, and Mr K K D Priyashantha, a BSc (Chemistry Special) undergraduate student of the University of Sri Jayawardanapura conducted their research projects at the department

- The staff of the department was involved in conducting practical classes for the students following the NDT course in Chemical Engineering at the University of Moratuwa and postgraduate course in Polymer Science and Technology at the University of Sri Jayewardenepura.

Seminars/Conference/Meetings/Workshops/Lectures attended

Officer	Subject	Organization
Champa Wellappili	Export industry Awareness seminar	Institute of Technological Industries
Champa Wellappili, H N K K Chandralal and Ananda Samarakoon	Waste plastic recycling	National Engineering Research and Development (NERD)
H N K K Chandralal	Valuation of machinery	SRMC- Rubber Products manufacturing factories

Training programmes

Client	Subject	No. of programmes
MSc (Polymer Technology) students of the University of Moratuwa	Polymer adhesives	1
Graduate ship students of the Plastics and Rubber Institute	Adhesive technology	1
BSc (Polymer)students of the University of Sri Jayawardanapura	Surface coating	1
MSc (Polymer Science and Technology) students of the University of Sri Jayawardanapura.	Surface coating	1
DPRI students from Plastic and Rubber Institute	Manufacture of monomers Natural and synthetic rubbers	1
Small and medium scale industries	Workshop on "rubber wood treatment"	3

Exhibitions

Officers in the department participated/assisted at the following exhibitions

- Dayata Kirula Exhibition at BMICH 04th February 2007
- Ruhuna Mela at Hambantota 2007

LABORATORY INVESTIGATIONS

Latex film compound with improved elastomer properties (PC/L/PS/2006/02)

The physical properties of natural rubber- styrene/acrylic copolymer emulsion blends were investigated as a function of blend composition and mixing methods. In the first method (method 1), NR latex compounded/ matured and styrene/acrylic emulsion were blended separately. In the second method (method 2), two latex samples were blended, compounded and matured. Mechanical properties of the resulting blends were studied by blending with varying the blend composition and the blending technique. Crosslink density was determined by swelling method. Blends prepared as per different mixing schedules are given in Table 1. Physical properties are shown in Fig.1 to Fig. 5.

Table 1. *Blends prepared as per different mixing schedules*

Sample No	Mixing method	
	Method /type	Maturation time
A	1	Just mixed
B	1	48hours after mixing
C	1	Just mix-ageing
D	1	48hours after mixing-ageing
E	2	Just mixed
F	2	48hours after mixing
G	2	Just mix-ageing
H	2	48hours after mixing-ageing

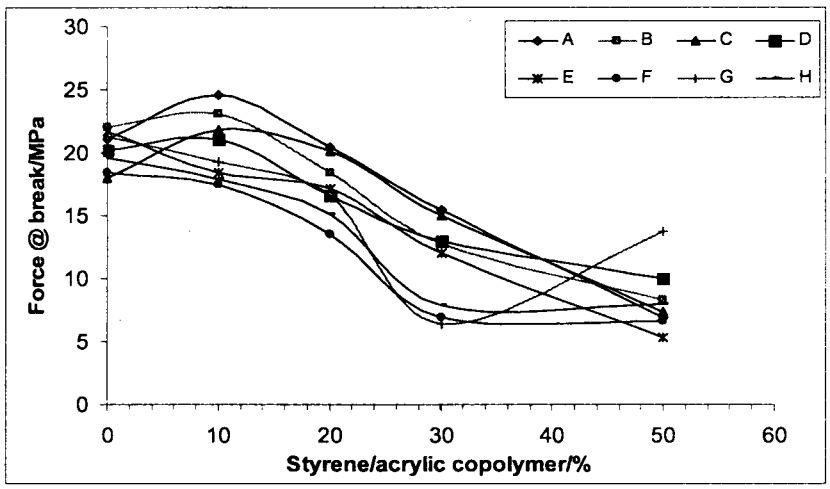


Fig. 1. Variation of tensile strength as a function of polymer ratio and mixing method

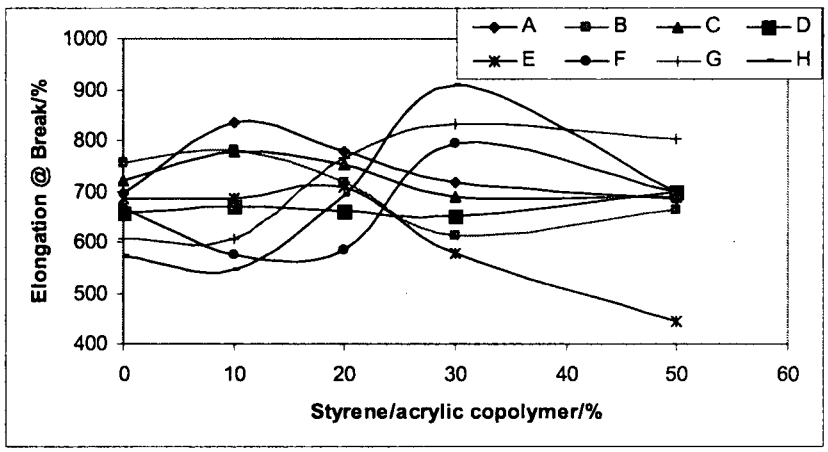


Fig. 2. Variation of Elongation at break as a function of polymer ratio and mixing method

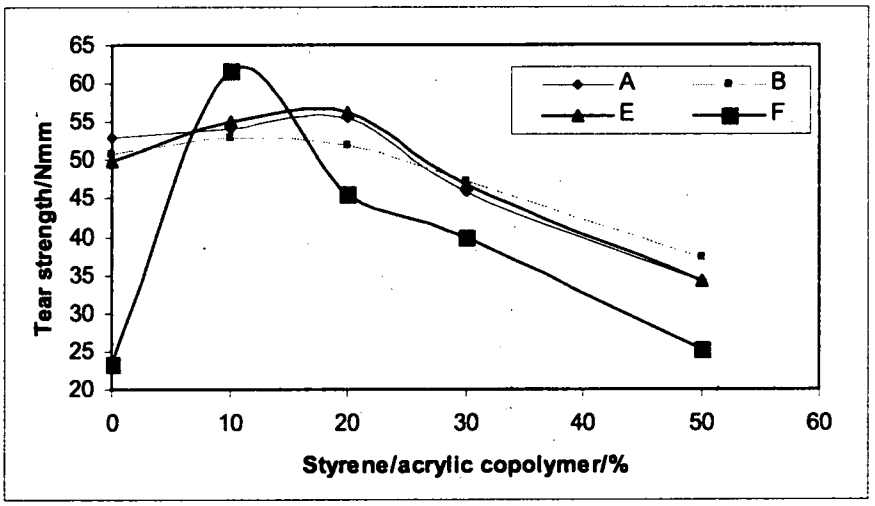


Fig. 3. Variation of tear strength as a function of polymer ratio and mixing method

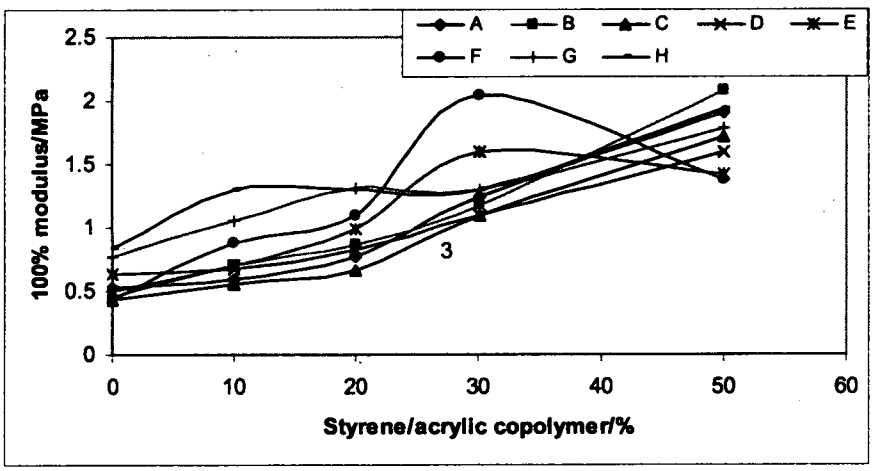


Fig. 4. Variation of 100% modulus as a function of polymer ratio and mixing method

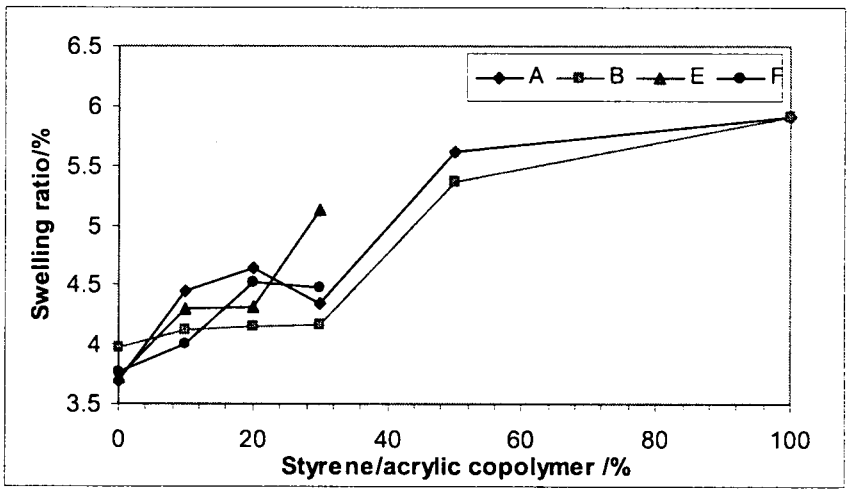


Fig. 5. Variation of swelling ratio as a function of polymer ratio and mixing method

Tensile strength, Tear Strength and elongation were found to be increasing upto 10% incorporation of the copolymer in the blend and beyond which it could be seen a decreasing trend with increasing content of copolymer in the blend. Increase in the modulus was observed due to the increase of the styrene plastic phase in the blend.

In addition to acrylic/styrene copolymers, acrylic/methylmethacrylate copolymers too were blended with natural rubber latex and the physical properties are yet to be examined. One of the applications of this project to prepare granular rubber from these blends for adhesive applications (Champa Wellappili, Chitra Kuruppu and S S Warnapura).

Utilization of waste foam rubber (PC/D/WFR/2007/10-a)

Enhancing of Biodegradability of foam rubber

The project was initiated with a view to improve the biodegradability of foam rubber as a solution to the current problem of disposing rejects generating from the foam rubber manufacturing industry. One of the appropriate disposal technique is the bio decomposition of the rejects.

Incorporation of an appropriate bacterial media which enhances the microbial activity was investigated with the aim of accelerating the biodegradation in the NR matrix. Samples were kept under soil with varying conditions like under compost, Sugar bagasse *etc.* to enhance the biodegradability. Attempts were also taken to accelerate degradation using certain other chemicals. This project is in progress (Champa Wellappili and Indra Denawaka).

Utilization for NR based products

Recycling is one of the popular methods of transforming the waste/rejected rubber products into reusable forms. However, they cannot be reused as it is since they are vulcanized products. As such, either they have to be reclaimed or transfer into ground/crumb form to be used in rubber products.

The aim of this study was to find a more economical method of recycling for waste generating from foam rubber manufacturing industry. Waste rubber samples were treated with a dispersing agent like long chain fatty acid in a two roll mill. Physical properties are being evaluated. When compared to the control sample, foam/NR blends rubber compounds showed reversion as exemplified by the rheograph. This may be due to the degradation of foam rubber matrix during vulcanization (Champa Wellappili and Indra Denawaka).

Manufacture of Pillows

The objective of this project is to find out the possibility of manufacturing pillows from waste foam rubber as a commercial application.

NR foam waste was made into crumb form using a crusher and Compounded latex of NR/SBR blend was sprayed onto crumbs to improve the adhesion which finally results in a crumb agglomerate. These agglomerates were finally moulded into pillows. Resultant densities of the moulded pillows prepared with different compositions of Crumbs *vs* Compounded latex and Water are given in the following table.

Texture composition (Crumb vs Compounded latex)	**Resultant density/kgm^{-3}**
Crumbs 32g/ 32g 60% compounded latex/water 10g	124.49
Crumbs 32g/32g 60% compounded latex/water 20g	113.23
Crumbs 32g/32g 60% compounded latex/water 30g	125.22
Crumbs 26.67g/32g 60% compounded latex/water 10g	115.96
Crumbs 26.67g/32g 60% compounded latex/water 20g	115.17

Further experiments are being conducted to achieve the required densities as the above are higher than the expected results (Champa Wellappili, H N K Chandralal, N S Disanayake - Sri Jayawardanapura University).

Development of environmental friendly preservative system for NR latex as a replacement for TMTD/ZnO system (PC/L/NPS/2007/1)

New preservative system for latex was developed based on nitrosoamine free phenolic type bactericide commonly known as Preventol used in the leather industry

as a replacement for currently used low ammonia TMTD/ZnO (LATZ) preservative system.

Fig. 6 depicts the Variation of VFA content of NR latex with time in the presence of different concentration of preventol. It could be seen that the effect of preservation is not satisfactory with concentrations of preventol in latex fall below 0.5% w/v.

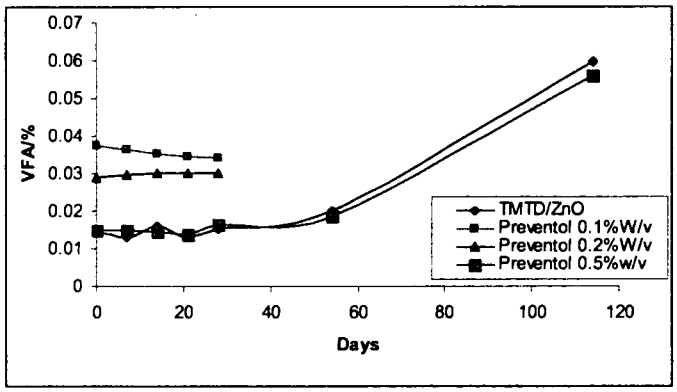


Fig. 6. Variation of VFA content of NR latex with time in the presence of different concentration of preventol

Apart from preventol, other bactericides commonly used in food preservation such as DB300, payabens and cismolan were investigated to study their effect of controlling the bacteria growth in latex. All three samples were given similar results when compared with the conventional system as can be seen in Fig. 7. Further investigations are in progress.

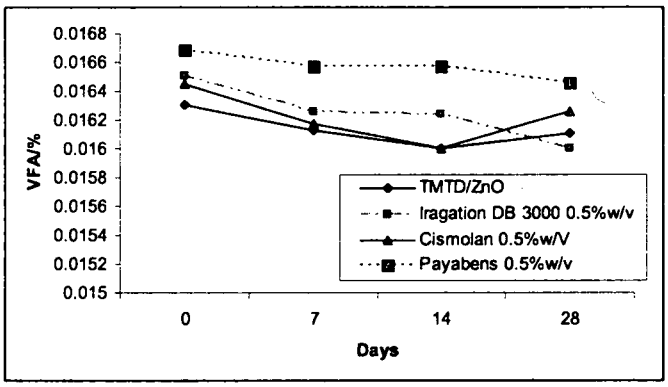


Fig. 7. Variation of VFA no as a function of no of days, with different types of bactericides (0.5%w/v) (Champa Wellappili, H N K K Chandralal and Ananda Samarakoon)

Effect of metal ions incorporation on Natural rubber latex proteins (PC/L/MPRO/2006/06)

Allergenic reactions in human skin due to wearing of NR latex gloves are a recurrent issue in latex glove manufacturing industry. This allergy is said to be caused by the leachable proteins present in NR lattice. An attempt has been made to reduce extractable proteins in latex gloves with the use of metallic substances. Aluminum is one of such metal ion which had been examined in this project.

$Al(OH)_3$ addition into latex was carried out prior to centrifuging of latex at a concentration of 0.5%w/w, and the percentage reduction of N observed to be 55%. When $Al(OH)_3$ at a similar concentration was incorporated into centrifuged latex prior to vulcanization, the reduction of N was found to be only 38%.

Further, It was also observed that there is no effect of $Al(OH)_3$ on the physical properties of vulcanized latex compounds (Champa Wellappili, Ananda Samarakoon and K K K D Priyashantha- Sri Jayawardanapura University).

Value addition of agricultural waste and municipal waste materials by means of mechanical process (PC/D/NRW/2007/02)

This project was initiated with a view to add value to waste solid material such as saw dust, plastics collected from the municipal solid waste streams. Thermoplastic composites based on wood fiber from the waste and polypropylene, polystyrene, poly (Vinyl Chloride) is expected to be developed in order to convert this low value wood resource into value added products.

Mixing equipment such as industrial extruder commonly used in the plastic industry shown to have a potential to prepare Wood Plastic Composite (WPC) pellets. The project will be continued (Champa Wellappili, H N K Chandralal and Ananda Samarakoon).

Filler/latex master batch (PC/L/MB/2007/03)

NR latex incorporated with Metal Silicates were attempted in this project to manufacture masterbatches of filler/NR. The product was made into crumb form and the retention of silica in the masterbatch was found to be 95%. Further work is in progress (Champa Wellappili and H N K Chandralal).

Preparation of stable prevulcanised latex (PC/L/PVL/2007/04)

This project was initiated in view of preparing commercial scale batches of prevulcanised lattices mainly for export. The request was made by Ms/Lalan Group of Companies, one of the largest centrifuged latex and glove manufacturer in Sri Lanka. The important feature of the latex is to achieve storage stability. Improve stability of prevulcanised latex was achieved through compounding and subsequent recentrifuging. Samples prepared were handed over to the company for industrial

property evaluations. The project is to be continued (Champa Wellappili, H N K Chandralal and Anada Samarakoon).

Development of Dry Rubber Content measuring equipment of NR latex (PC/L/MTE/2007/05)

Preliminary work was started to fabricate an equipment to estimate the DRC of NR latex having a digital display in collaboration with the Department of Physics, university of Colombo. This project is in progress (H N K K Chandralal, Champa Wellappili and Prof. Sonnadara-Colombo University).

Manufacture of environmental friendly latex coated fabric for carrier bags (PC/L/PS/2007/06)

Work was initiated to develop a NR latex based compound suitable as a coating base material in order to produce environmentally friendly carrier bags, on a request made by an industrialist. A suitable acrylic latex binder was identified and blended with NR latex to improve quality of adhesion, brushability of latex on the textile. The out come was quite satisfactory and is currently being used commercially (Champa Wellappili and Chitra Kuruppu).

Evaluation of the composition VITEX (PC/C/VIT/2007/07)

A newly introduced latex yield stimulant known as VITEX is currently under investigation by the RRISL to ascertain it's effectiveness for stimulation of latex yield from Havea trees. A series of trials were conducted to evaluate its composition. FTIR and ^{1H}NMR studies of the analysis of components were found to be not satisfactory as VITEX appears to contain a mixture of compounds. Extraction of some components using PET Ether as a solvent confirmed that it has silicone oil. Further, FTIR studies indicate that VITEX contain certain amount of latex stimulant known as Etheral widely used in Sri Lanka having the major chemical component, 2 Chloro Ethyl Phosphonic acid. Further analysis is in progress (Champa Wellappili, H N K K Chandralal, Indra Denawaka and Ananda Samarakoon).

Industrial extension and testing samples

The following services were provided to the companies given as below;

Company	Analytical Services
Water Board	Analysis of polymer composition of 'O' rings
Malindu Timber	Testing of timber for moisture
Richard Pieris	Analysis of polymer composition of rubber mat
Samson compounds (Pvt) Ltd.	Analysis of polymer composition of rubber products
Sinwa Holdings	Analyze the solvents by distillation
Associated Motorways	Analyze the purity of chemicals by melting point
Air Force, Ratmalana	Polymer identification
Work Wear Lanka (Pvt) Ltd.	Analysis of polymer composition
Michal Angelo	Analysis of Adhesives
Moratuwa University	Polymer identification
Industrial Development Board	Polymer identification
Microcells	Polymer identification
Kanchana Tyre House	Polymer identification
Ceylon Paper sacks	Swelling ratio
Leolanka Trading	Polymer identification
Gordon International	Polymer identification

RAW RUBBER AND CHEMICAL ANALYSIS

Anusha Attanayake

SUMMARY

A total number of 531 rubber samples of both latex and dry forms of NR were tested for quality parameters. 321 samples of different grades of processed raw rubber were tested for quality assessment for both export and local consumption purposes. Seven number of raw rubber analysis certificates of TSR samples were issued for grading and shipping purposes. Thirty three numbers of rubber chemicals and 114 number of bleaching agent samples were analyzed for quality assurance and quality control purposes.

The department was also engaged in testing of rubber products such as rubber gloves for sodium pentachlorphenate content and powder content to ascertain their products comply with health and safety regulations. Certain rubber products were tested for isoprene content.

In addition to the above routine testing and analytical work department was also involved in different trouble shooting activities in the raw rubber processing industry and recommendations were made accordingly. The research work on analysis of latex and dry rubber properties of new clones and development of novel method to determine the magnesium concentration in natural rubber latex was continued during the year.

DETAILED REVIEW

Staff

Ms A P Attanayake, Assistant Rubber Chemist resumed duties on 26th July 2007 after maternity leave and functioned as the Officer in charge of the department afterward.

Experimental Officers, Ms H S Weeraman, L Wanigatunga, H V K Gamage, C Lokuge, L P Vitharana, M Wijesekera, B Gunasiri, N Karunatilaka, W Vithanage and Clerk/Typist, Mrs I Wijesinghe were on duty through out the year.

Instrument Technician Mr L G P Lelwela was on duty through out the year.

Seminars/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
Mrs A P Attanayake	Scientific Committee Meeting	Rubber Research Institute, Ratmalana

Training programmes

Following training programmes were conducted as detailed below;

Client	Subject	No. of programmes
B G N Rubber Pvt (Ltd) - L C Bopagamage	Dry rubber analysis	01
Department of Polymer Technology, University of Moratuwa - 24 Nos. NDT Students	Dry rubber analysis	01
Aroma Rubber Factory, Mawanella - Rinoza Cader	Dry rubber analysis	01
University of Kelaniya - S.A N Maduwanthi	Latex analysis	01
University of Kelaniya - N S Amarasinghe	Latex analysis	01
University of Ruhuna - M B Sugandi Wasana	Bleaching agent analysis	01
Athula Upendra Perera, Kolamadiriya, Bandaragama	Latex analysis	01
Ellawala Rubber (Pvt) Ltd. – J M M Janaka	Dry rubber analysis	01
Na-Latex Pvt (Ltd), Horana - Chamila Gunaratna & Sumudu Priyangika	Latex analysis	01
Ansell Lanka Pvt (Ltd) - J C L Jayalath	Latex analysis	01
Aroma Traders – G R Sanoja	Rubber testing	01
University of Jayawardanapura - Group of students	Latex and dry rubber analysis	01
University of Colombo - M N N Farhath	Dry rubber analysis	01
IDB, Peliyagoda - H L K Thushari	Plasticity Retention Index	01
Indika Prageeth, HNDE Project	Latex Creaming by electrodecantation	01
N W S Sudarshana, HNDE Project	Latex test	01

Services

Calibration of latex tanks

Calibration of latex tanks were carried out as in following estates/factories as requested.

a. RRI Kuruwita sub station.
b. Ellawala Rubber Factory, Eheliyagoda estate
c. Lalan Rubbers (Ambepussa, Dedigama)
d. Devalakanda estate,
e. Kiriporuwa estate, Yatiyanthota

(A Attanayake and L P Vitharana)

LABORATORY AND FIELD INVESTIGATIONS

Analysis of latex and dry rubber properties in new clones

Latex properties such as DRC, TSC, VFA Nitrogen and Mg content etc of new RRISL 200 series of clones were determined. Dry forms such as Ribbed Smoked Sheets and Air dried sheets were prepared from these lattices and raw rubber properties such as Dirt, Ash, Nitrogen, VM, Po and PRI were determined. Latex properties of new clones found to be comparable with those of existing clones in plantations in the country. Similarly Properties of RRISL 2000 clones will be examined (Madupani Jayasuriya, Leela Wanigatunga, S L G Ranjith and Sriyani Yapa).

Development of noval method to determine the magnesium concentration in natural rubber latex

Total Magnesium content, an important quality parameter of centrifuged latex and NR field latex was determined using spectrophotometric analytical method. This is a very much quicker method when compared with conventional and very slow titrimetric method used in current analysis. Results are now being investigated (Upul Ratnayaka, Champa Lokuge, A K D Warnajith Prasad and U M S Priyanka).

Analytical services

Samples tested from TSR factories and other miscellaneous samples during the year were as follows:

Service	No. of samples
TSR Factory	
Le-Ferne Block Rubber Factory, Getahetta, Nathupana	07
Miscellaneous	
Raw rubber samples	321
Latex samples	531
Chemical samples	33
Bleaching agent	114
Glove samples	18
Polythene	48
Shipping certificates	07
Testing certificates	1072

RAW RUBBER PROCESS DEVELOPMENT AND CHEMICAL ENGINEERING

S Siriwardane

SUMMARY

A Single day Smoke drying unit (SS drying unit) was developed for drying of sheet rubber within a day and was introduced to the producers. Farmer level trials are being carried out in 10-15 units of this new drying system.

The results of the experiments carried out showed that the current standards for total iron (Fe) in processing water (1 ppm) are too low. However, contamination of even minute quantities of copper ions affected the quality of crepe rubber.

An industrial collaborative research project on "natural rubber nanocomposites based on layered silicates for tyre tread compounds" was initiated with a leading solid tyre manufacturing company.

Emulsifier technique was preferred over ball milling to prepare silica slurry for the incorporation into latex for the preparation of silica/latex masterbatches.

Material safety data sheets (MSDS) were drafted for RSS and sole crepe.

DETAILED REVIEW

Staff

Dr Susantha Siriwardane, Head of the department and Mr P H Sarath Kumara, Assistant Rubber Chemist were on duty throughout the year. Dr Upul Rathnayake, who returned and resumed duties on 19th January after completing his postgraduate studies at the University of Loughborough, UK was promoted to the post of Rubber Chemist with effect from 11th December 2006. Mr P P Jayasinghe, Research Assistant retired from the service on 07th August.

Mrs Chandrika Nalini, Messrs Chandana Senanayake, T A S Siriwardane and A K D Warnajith Prasad, Experimental Officers, Mrs Ruckmanie Liyanage, Store Keeper and Mrs Anusha Paranavithana, Typist/Clerk, were on duty throughout the year. Mrs Shirani Priyanka and Mrs C Rohanadepa, Experimental Officers were on maternity leave from 20th August to 20th December and 31st July to 30th November respectively.

Research students

- Mr G D Dinesh Krishantha, a Temporary Research Assistant who was recruited to work on the research project on "Development of irradiated natural rubber (NR) and Ethylene - Propylene - diene ter polymer (EPDM) based composite materials for outdoor applications" terminated his work on 01st. November.

- Mr Nalaka Seneviratne, a Chemistry special undergraduate from University of Colombo carried out his final year research project under the supervision of Dr Susantha Siriwardena from February to August.

- Miss H M S Wasana and Miss M B S Wasana, BSc (special) Degree (Chemistry) undergraduates from University of Ruhuna were trained under the industrial training programme with the supervision of Dr Susantha Siriwardena and Dr Upul Ratnayake from 14th May to 14th June. They were assigned two research projects titled "Development of novel test method to determine metal ion content in bleaching agent and Chemical interaction between metal ion and bleaching agent".

- Miss Dimitri Dissanayake and Mr Mohamed Farharth, BSc (special) Degree (Chemistry) undergraduates from University of Colombo were trained for 2 months under the industrial training programme from October 2007, with the supervision of Dr W M G Seneviratne. They were assigned research projects on "Sedimentation trials on centrifuged latex effluents"

- Miss S Devagi, a final year NDT chemical Engineering student from university of Moratuwa underwent her six months industrial training programme under the supervision of Dr W M G Seneviratne from 27th August 2007. She worked on a project connected with designing of aerobic and anaerobic treatment plants using fundamental wastewater treatment technology kinetics. She also worked on effluent clarification methodologies of the treated effluent.

- Miss Waruni S Gamage, a final year NDT Polymer Engineering student from University of Moratuwa underwent her three months industrial training programme under the supervision of Dr W M G Seneviratne from 14th November 2007. She was assigned to write a project proposal on the manufacture of three wheeler tyres.

Lectures/Seminars/Workshops/Meetings attended

Officer/s	Subject	Organization
W M G Seneviratne	Board of Management Meetings Education Sub Committee Meetings	PRI
	Ceyesta Board Meetings	Ceyesta
	Joint staff meetings	RRISL, Agalawatte
	Scientific Staff Meetings	RRISL, Ratmalana
	"Subarathi" Radio programme/Discussion as a Resource person	Sri Lanka Broadcasting Corporation
	Business Forum	Export Development Board
	Workshops on Capacity Development and Laboratory Accreditation held at Hotel Taj Samudra and at ITI	UNIDO
	Workshop on Corporate Plan discussion held at the Sri Lanka Foundation Institute	Sri Lanka Foundation Institute
	Meeting on Development of SRMC factories	MPI
	Corporate Plan workshop held at the Tea Board	NIPM
	Rubber Advisory Committee meeting of the EDB	EDB
	Meeting on Rubber Sector Revolving Fund held at the Treasury	Ministry of Finance/Treasury
	Meeting of CESS recoveries held at MPI	MPI
	CESS Committee Meetings	MPI
	Served as a committee member of the Technical Evaluation Committee of the SRMC factory development under joint venture partnership basis	MPI
	Parliamentary sub committee meeting on the plantation sector	MPI
	Technical Assessment of the SLSI Chemical Testing Laboratory for two days as a Technical Assessor appointed by the Sri Lanka Accreditation Board (SLAB)	SLAB

Officer/s	Subject	Organization
	Meeting with Hon Minister along with Heads of RRI delegation on the Future Development Strategies of the RRI	MPI
	Meeting of the Examination panel on Professional Exam in Rubber Manufacture	NIPM
	Technical Assessors Committee meeting	SLAB
	Directors Forum of four research Institutions *i.e* TRI, CRI, RRI and SRI held at the CRI, Lunuwila	CRI
Susantha Siriwardena	Served as the chairman of the technical evaluation committee for purchase of rubber sheeting machinery	Thurusaviya Fund
	Served as a member of viva examination panel for a student from Master of Science (Polymer science and technology) degree programme	University of Sri Jayewardenepura, Nugegoda.
	Served as a judge for the Kalutara district inter-school innovation competition	National Innovation Commission
Upul Ratnayake	Workshop on Scientific writing organized by CARP at Gannoruwa, Peradeniya	In Service Training Institute, Peradeniya.
	Served as a panel member for the viva examination at the Professional Examination on Rubber Manufacture 2007.	NIPM
	Served as the convener of the consultative committee group on polymer nano-composites	NSF

Lectures/Seminars/Workshops/Meetings addressed

Officer/s	Subject	Organization
W M G Seneviratne	Served as a visiting lecturer for Bachelor of Science degree course conducted by the Department of Chemistry Subject: ISO quality Management Systems	University of Sri Jayewardenepura
	Served as a Visiting Lecturer for DPRI Course 2007 of the PRI Subject: Nature and Structure of Polymers	PRI
	Addressed the Scientific Committee meeting on the subject of "Wastewater Treatment of rubber factories and Current status"	RRISL

Officer/s	Subject	Organization
	Served as a visiting lecturer for Professional Examination on "Rubber Manufacture" on the following subjects; a. Centrifuged Latex Manufacture b. Wastewater Treatment c. Rubber Industry and its future directions	NIPM
	Served as a lecturer for graduateship course conducted by the PRI on the following subjects a. Nature and Structure of Polymers b. Molecular weight determination techniques c. Polymerization Kinetics	PRI
	Served as a visiting lecturer for Bachelor of Science Microbiology course conducted by the Department of Microbiology on Effluent Treatment Technology	University of Wayamba
Susantha Siriwardena	Addressed the RRI Scientific and Technical staff on "Vulcanisation of rubber and Theory of Vulcanisation"	RRISL
	Addressed Small and medium scale rubber growers on "Manufacture of Quality RSS manufacture" at two workshops held at Hanwella and Horana.	ASD of RRISL
	Served as a visiting lecturer for Professional Examination on the following subjects; a. RSS manufacture b. Drying of NR and operation of drying towers, smoke houses and alternative drying methods	NIPM
	Made a presentation at the meeting of the Board of Directors on "Newly developed single day smoke (SS) drying unit for sheet rubber"	Thurusaviya Trust Fund
	Served as a visiting lecturer for Bachelor of Science degree course conducted by the Department of Chemistry.	University of Sri Jayewardenepura
Upul Ratnayake	Served as a visiting lecturer for Bachelor of Science degree course conducted by the Department of Chemistry	University of Sri Jayewardenepura
	Served as a visiting lecturer for Professional Examination on Rubber Manufacture on the following subjects; a. Chemicals used in rubber industry b. Manufacture of crepe rubber	NIPM

Officer/s	Subject	Organization
Upul Ratnayake	Served as a visiting lecturer for Master of Science (Engineering) Degree conducted by the Department of Chemical Engineering.	University of Moratuwa
	Addressed the RRI Scientific and Technical staff on "Introduction to Polymer nanocomposites"	RRISL
P H Sarath Kumara	Addressed the Managers, Asst. Managers, Factory & Field staff at a workshop on "Metrolac weighing of field latex" organized at Thaldua Estate, Avissawella.	Malwatte Valley Plantations Ltd.
	Addressed the RRI Scientific and Technical staff on "Tensile properties of rubber products and compounds"	RRISL
	Addressed Small and medium scale rubber growers on "Metrolac weighing of field latex and related problems" at two workshops held at Hanwella and Horana.	ASD of RRISL
	Served as a visiting lecturer for Professional Examination on Rubber Manufacture on the following subject; a. Latex weighing	NIPM
	Addressed the executive staff of RDD on "weighing of latex" and "RSS manufacture"	RDD
	Served as a visiting lecturer for DPRI Course 2007 of the PRI Subject: Latex testing & Property Evaluation	PRI
	Addressed the Planters on "Latex weighing and Related problems" at a workshop held at Yatadola Estate.	Namunukula Plantations Ltd.
	Addressed the Planters, field staff and factory staff on "Latex weighing and Related problems" and held demonstrations at a two day workshop	Atale estate
Susantha Siriwardena and P H Sarath Kumara	Addressed the Managers, Asst. Managers, Factory and Field staff on "Rubber Manufacture"	Horana Plantations Ltd.
Susantha Siriwardena Upul Ratnayake P H Sarath Kumara	Addressed an Audit Team on "Quality and processing aspects of latex".	Richard Pieris & Company

Training programmes

Client	Subject	No. of programmes
Managers, field staff and factory staff of Hapugastenne Plantations Ltd.	Practical demonstration on weighing of field latex held at Dartonfield.	01
Managers of Namunukula Plantations Ltd.	Practical demonstration on weighing of field latex at a workshop held at Yatadola estate	01

Advisory visits

Sample collection – Waste water

Type of industry	No. of factories
Rubber Industries	11
Non Rubber Industries	12

Factory development

Service provided	No. of factories
Subsidy recommendations for infrastructure development from CESS fund	21
Advisory on process and quality improvements	23
Advisory on waste water treatment	08
Waste water treatment plant designing	04
Inspection for other purposes	03

Field visits

Experimental visits

Six visits were made to 3 estates and rubber factories in order to collect latex samples and to prepare other experimental samples.

Laboratory testing

The number of samples tested and certificates issued are shown in Table 1.

Table 1. *Sample testing and certificates issued*

Samples tested	Number of samples				
	1 Quarter	2 Quarter	3 Quarter	4 Quarter	Year total
Waste water	32	25	37	30	124
Processing water	05	Nil	02	05	12
Certificates issued					
Waste water	12	17	26	26	81
Processing water	02	Nil	01	Nil	03
"Certificate of Epidemic prevention"	19	16	21	05	61

LABORATORY AND FIELD INVESTIGATIONS

Mechanization of crepe rubber manufacturing process (Project No. RRPD/D/MCM/2006/01)

It was found that the coagulum slabs obtained through newly fabricated wooden coagulum partitioning unit was much efficient in terms of labour input and time consumption. However, operation of the coagulum partitioning unit made out of wood was difficult as it became very heavy due to absorption of water. In addition, cleaning process was not easy. Considering the above advantages as well as drawbacks, another easy handling light weight unit was designed and fabricated. This was installed at Dartonfield crepe rubber factory and studies of its performance are yet to commence.

An investigation was carried out to study the effect of thickness of coagulum and the number of mill passes on quality of resultant laces. The results are tabulated in Table 2.

Table 2. *Effect of thickness of coagulum and number of mill passes on quality of laces*

Thickness of the coagulum (inches)	Number of passes			Quality of laces
	Macerator	Intermediate mill	Smooth mill	
1.5	3	3	1	Good in quality
1.5	3	1	1	Good in quality
3.0	3	3	1	Good in quality
3.0	3	1	1	Good in quality
6.0	3	3	1	Surface was less smooth
6.0	3	1	1	Surface of the lace had perforations

These results show that the number of mill passes could be cut down by two, if the thickness of the coagulum is maintained at 3" (Susnatha Siriwardena, T A S Siriwardane and P Lionel Perera).

Investigation of discrepancies of DRC estimated by Metrolac and lab test (Project No. RRPD/L/DMR/2006/03)

Investigations were continued at Sapumalkande Group to find out the reason for the underestimation of DRC of field latex, estimated by the use of metrolac, in specific divisions of the estate. It was concluded that the reason for the underestimation was the lower temperature at these particular divisions where the problem existed. Since their real problem was lower DRC of high yielding clones, further investigations were directed to the relevant department.

Studies are being continued to develop a simple method to detect any deliberate dilution of fresh latex in collaboration with University of Sri Jayewardenepura (P H Sarath Kumara, A K D Warnajith Prasad, Shirani Priyanka, Laleen Karunanayake and W Geeganage).

Effect of metal ions on quality of latex crepe (Project No. RRPD/D/EMC/2001/05)

Investigation of the effect of metal ions on quality of latex crepe rubber in order to review the present critical limits of metal ions in processing water was continued throughout the year. The experimental trials for total iron were completed. The results showed that the current standards for total iron in processing water (1 ppm) are too low. It was observed that the quality of latex crepe was not significantly affected up to a concentration of 10 ppm of total iron in processing water. However, it was revealed that the retention of total iron in latex crepe was more significant than the iron content in processing water since it was the retained iron in latex crepe that affected its quality.

Fig. 1 shows the retention of total Fe ions in both fractionated bleached (FB) and fractionated unbleached latex crepe rubber processed with water containing different concentrations of Fe. Fractionated bleached rubber shows a slightly higher retention of total Fe ions compared with fractionated unbleached rubber.

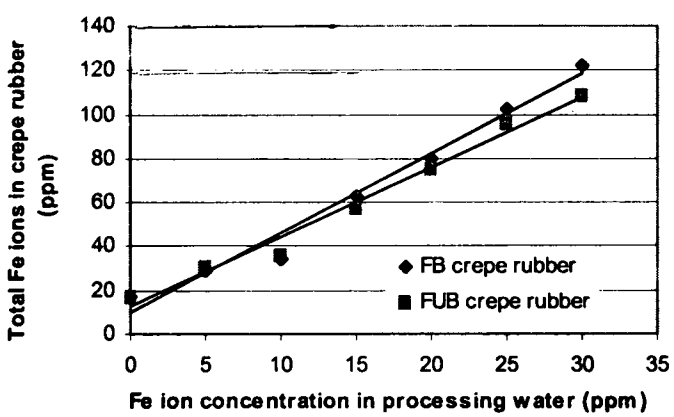


Fig. 1. Total retained Fe in FB and UFB crepe rubber

Fig. 2 shows the effect of total iron retained in latex crepe on raw rubber properties. It is clear that Wallace Plasticity Retention Index (PRI) of bleached rubber is adversely affected with the increase in retention of total Fe ion in crepe while Wallace Plasticity Number (Po) is only very slightly affected under the investigated range of total Fe.

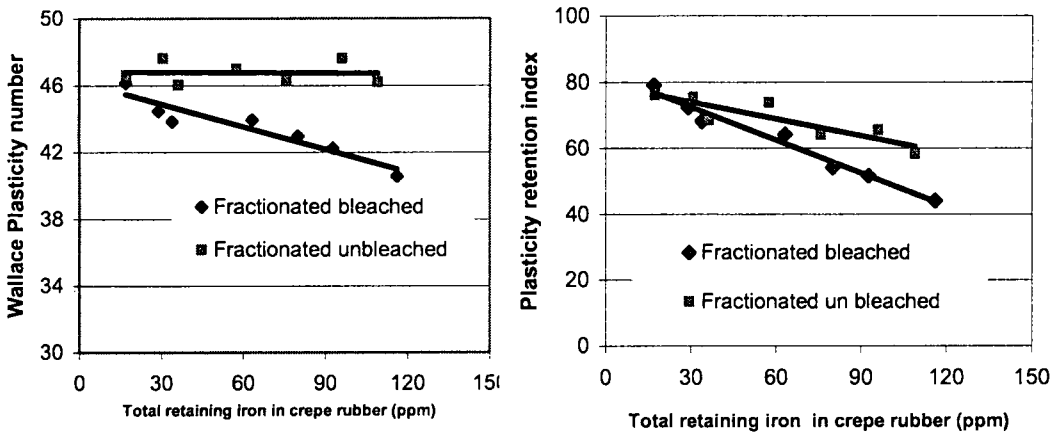


Fig. 2. Wallace Plasticity Number and Wallace Plasticity Retention Index for FB and FUB pale crepe rubber against the total iron retained in rubber

Based on the above results, new standards for total iron in processing water and also critical limits for crepe rubber can be established. Similar studies carried out to investigate the effect of copper ions on quality of crepe rubber, revealed that oxidative degradation of crepe rubber was severely affected even with minute quantities of copper ions retained in crepe rubber. Proposed standards for total iron content in processing water and in rubber are shown in Table 3.

Table 3. *Proposed standards for total iron and copper*

Metal ion	Current standards (ppm)		Proposed standards (ppm)	
	Processing water	Rubber	Processing water	Rubber
Total iron	1	-	5 (max.)	40 (max.)
Copper	0.5	-	0.25 (max.)	-

Based on the results of the investigations being carried out, following will also be introduced/reviewed.

- Maximum allowable copper content in latex crepe rubber
- New maximum limits of total iron and copper for chemicals used in crepe rubber manufacture (Upul Ratnayake, P H Sarath Kumara, T A S Siriwardane, Warnajith Prasad and V C Rohanadeepa)

Study of quality of blends of Low VFA and High VFA centrifuged latex (Project No. RRPD/L/QLT/2006/14)

This project was continued from the previous year. Analysis was carried out to characterize a second batch of blends of high VFA latex and low VFA latex. Variations of VFA No., KOH No. and MST of latex blends with time were analyzed. The results of the second batch trial also confirmed the previous results. However, physical properties of latex films are yet to be carried out. Characterization of a third batch of latex blends will be carried out and the physical properties will also be tested next. Variation of VFA No. of blended latex with time is shown in Fig. 3.

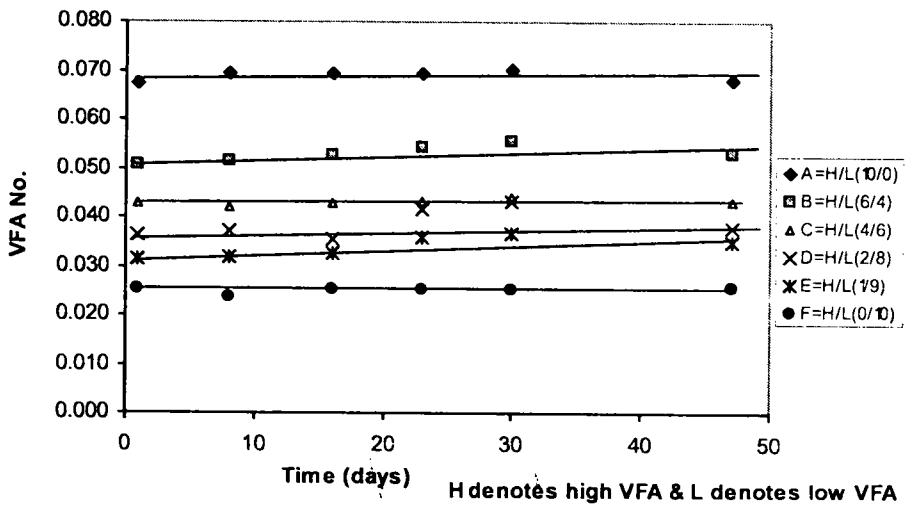


Fig. 3. Variation of VFA No. of blended latex with time

(P H Sarath Kumara, A K D Warnajith Prasad and V C Rohanadeepa)

Portable small scale solar assisted dryer for drying of sheets (Project No. **RRPD/D/PSD/2006/11)**

A movable sheet hanging unit tested for hanging rubber sheets for drying of sheets both in the sun and in a conventional smoking chamber was proved to be successful. The effectiveness of uninterrupted smoking in the chamber was tested and it was found that drying could be completed within two days.

Experience gathered from the experiments carried out using a movable sheet hanging dryer unit led to develop a mini RSS smoking unit, called Single day Smoke drying unit (SS drying unit). Results of initial trials showed that drying can be completed within one day, provided that the weight of sheets does not exceed 500 g and thickness is maintained at 1/8" which is the standard thickness. Figs. 4 and 5 show the temperature profile of an SS drying unit with a capacity of 30 kg and the drying curve for sheets dried in it.

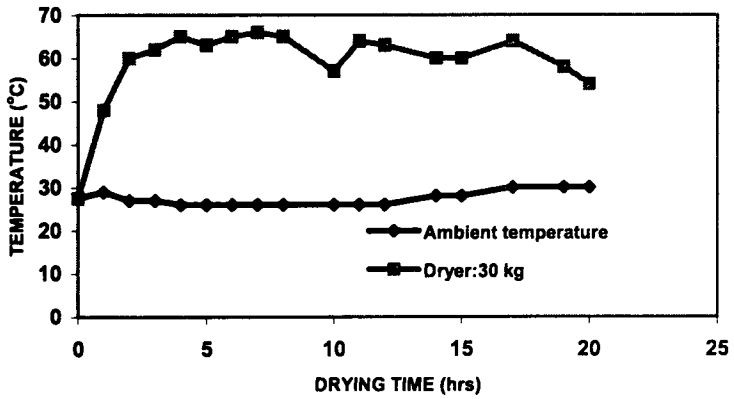


Fig. 4. Variation of temperature with time inside the SS drying unit (Dryer capacity = 30 kg)

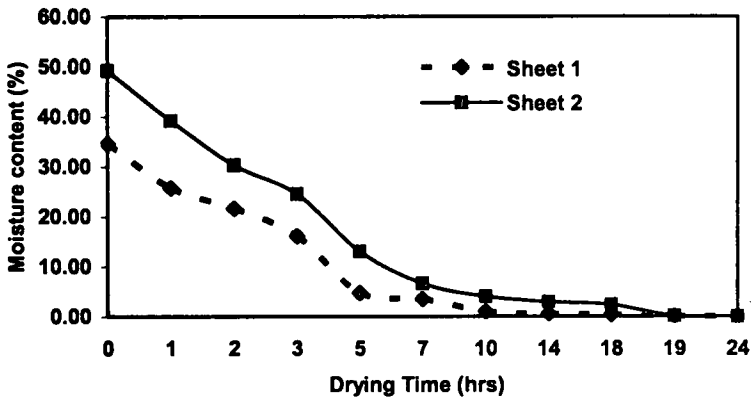


Fig. 5. Variation of moisture content of rubber during drying (Dryer capacity = 30 kg)

Subsequent tests done with modifications to the unit confirmed that smoking and drying can be accomplished within a single day in these SS drying units. Maximum capacity of SS drying units under investigation was 125 kg of rubber.

An awareness and introductory program was conducted in collaboration with the Advisory Services Department to the small and medium scale RSS manufacturers.

A group of participants who volunteered to conduct field level trials was selected and 10-15 units are now in operation. System is being evaluated for its effectiveness and drawbacks.

Designs were given and consultation services were provided to Loadstar Ltd. on the request of the company to fabricate a number of SS drying units (Susantha Siriwardena, T A S Siriwardena and A K D Warnajith Prasad).

Preparation of silica masterbatches incorporating silica at latex stage (Project No. RRPD/L/PSM/2006/15)

Preparation of silica/Natural Rubber masterbatches with silica loadings of 20pphr was done by incorporating 17 % (w/w) silica slurry at latex stage. Silica slurry was prepared using two mixing techniques with a coupling agent incorporated into the slurry. In the first technique, silica was dispersed in a ball mill in an aqueous chemical mixture containing a silane coupling agent, while in the second technique, an emulsifier equipment was used instead of the ball mill. For the purpose of comparison, NR/Silane treated silica composites were prepared by dry mixing on a two roll mill. Methods of preparation of samples are shown in Table 4. The performance of these techniques was evaluated by examining the uniformity of filler dispersion and percentage retention of silica in the masterbatches. The results are shown in Table 5.

Table 4. *Sample identification code*

Sample Identification	Description
Si17B	Silica slurry was prepared in a Ball mill. Silica–NR field latex masterbatch was then coagulated and dried before the preparation of the compound
Si17CB	Silica and other ingredients were directly added to dry rubber in the preparation of the compound. Silica loading was adjusted to the level of percentage retention of silica in Si17B sample
Si17E	Silica slurry was prepared using emulsifier equipment. Silica–NR field latex masterbatch was then coagulated and dried before the preparation of the compound
Si17CE	Silica and other ingredients were directly added to dry rubber in the preparation of the compound. Silica loading was adjusted to the level of percentage retention of silica in Si17E sample

Table 5. *Silica distribution in five different randomly selected locations in rubber sheets*

Sample	Ash (%)						Retention (%)
	Loc. 1	Loc. 2	Loc. 3	Loc. 4	Loc.5	Average	
Si17B	12.25	11.43	7.21	8.46	9.81	9.83	49.15
Si17E	18.25	18.91	19.01	18.32	18.65	18.63	93.15

Silica incorporated field NR latex masterbatches were then coagulated and Ribbed Smoked Sheets (RSS) were manufactured according to the standard manufacturing procedure. The compounds were prepared according to the formulation in Table 6.

Table 6. *Compound formulation*

Ingredient	Quantity (g)
Silica incorporated RSS	100.0
Peptone	2.0
Whiting	10.0
Naphthenic oil	4.0
Stearic acid	2.0
ZnO	5.0
TMQ	1.0
DEG	1.0
MBTS	1.5
Sulphur	3.0

The cure characteristics and mechanical properties of the vulcanisates of compounds prepared on a two mill are shown in Table 7 and 8 respectively.

Table 7. *Cure characteristics of NR/silica compounds*

Sample label	Minimum torque (dNm)	Maximum torque (dNm)	Scorch time (t_{s1}) (S)	Cure time (t_{90}) (S)
Si17B	21.11	166.13	108.60	298.21
Si17CB	39.30	232.94	72.90	726.36
Si17E	62.00	269.80	64.59	558.84
Si17CE	30.44	215.50	81.24	787.59

Table 8. *Mechanical properties of silica-natural rubber latex masterbatches*

Sample label	Tensile strength (MP)	Elongation at break (%)	Modulus @ 100 (MPa)	Tear Strength (kN/m)	Hardness (Shore A)	Abrasion weight loss (%)
Si17B	6.58	300	1.6	65	55	11.0
Si17CB	11.28	755	0.7	78	40	8.5
Si17E	22.44	610	1.2	138	45	8.5
Si17CE	12.01	800	0.8	70	40	8.0

Results of mechanical properties above show that the compounds based on masterbatches prepared by mixing silica slurry made using emulsifier equipment produced better compounds. Therefore, the emulsifier technique was considered the best mixing technique for preparation of silica slurry among the two candidate systems studied (Susantha Sirwardena and Nalaka Seneviratne).

Development of an uninterrupted drying system for crepe rubber (Project No. RRPD/D/UDS/2007/17

This project was commenced as a collaborative project with the NERD center. Bio mass hot air generating unit has already been installed at Dartonfield rubber factory. However, project was not made a significant progress during the year (Susantha Siriwardena, T A S Siriwardane and A K D Warnajith Prasad).

Rubber toughened thermoplastic nano composites based on layered silicates (Project No. RRPD/D/RTN/2007/05)

A research project proposal titled "Rubber toughened polypropylene-clay nanocomposites" was submitted to National Research Council (NRC) for funding. This proposal is being evaluated by NRC and a final decision is yet to be announced (Upul Ratnayake).

Development of natural rubber nanocomposites based on layered silicates (Project No. RRPD/D/UDS/2007/19)

Layered silicates (nano-clay) can be used at very low loading levels to improve mechanical properties of rubber nanocomposites, in comparison with highly filled conventional compounds.

An industrial collaborative research project on "natural rubber nanocomposites based on layered silicates for tyre tread compounds" was initiated with Loadstar (Pvt) Ltd. Rubber nanocomposites based on modified and unmodified layered silicates were prepared using RSS. Initial set of samples were analysed to examine the reinforcement effect of layered silicates on rubber compounds and it showed that modified silicates enhanced the mechanical properties compared to that of unmodified silicates. Different methods are being investigated to incorporate layered silicates into rubber in order to achieve maximum level of exfoliation of layered silicates in the rubber compound (Upul Ratnayake, M R N Fernando, T A S Siriwardane, A K D Warnajith Prasad and Asela Siriwardane).

Development of irradiated natural rubber (NR) and Ethylene - Propylene - diene ter polymer (EPDM) based composite materials for outdoor applications

The project continued in this year too. A chemical designated as A-400 was selected as the best performing poly functional monomer (PFM) and it was incorporated into the NR/EPDM/CB composite at different concentrations and irradiated at 80 kGy which was the optimum dose previously selected. The best performance in terms of physical properties was recorded at 1 phr of A-400. Five

different antioxidants were incorporated into NR/EPDM/CB composite containing 1phr A-400 to study the effect of those antioxidants on physical properties. The antioxidants namely TMQ, 6PPD, Ralox LC, Irganox 1520 and Vanox ZMTI, were used as binary mixes or as individual ingredients in the composites.

Out of the five different antioxidants tested for NR/EPDM/CB composites irradiated at 80 kGy, Vanox ZMTI was selected as the best antioxidant, based on the results of ageing properties. Ageing of the samples was carried out in a laboratory oven for 25 days at 70 °C. This project was completed and the final report will be submitted to NSF. The results will also be compiled in the form of a thesis and will be submitted to University of Sri Jayewardenepura for an Mphil degree (Susantha Siriwardena, Dilhara Edirisinghe, Priyanthi Perera, Laleen Karunanayake, Samantha Kulathunge and Dinesh Krishantha).

Development of novel method to determine Mg content of natural rubber latex (Project No. RRPD/L/NMM/2007/20)

A new method for analyzing the total Mg content in centrifuged latex was investigated using an atomic absorption spectrophotometer (AAS) in comparison with the present used titrimetric method. The titrimetric method uses KCN which is a toxic chemical. Main Objectives of the project were to develop a new accurate method to determine the total Mg concentration in NR latex (*i.e.* field latex and centrifuged latex) and to find out a possible correlation between titrimetric and AAS methods.

Both rubber phase and serum phase of centrifuged latex was separately analysed for total Mg ion concentration using AAS method. Initial experimental trials revealed that significant percentage of Mg ions were retained in rubber phase when centrifuged latex was coagulated using acetic acid in the titrimetric method. Few more centrifuged latex samples are to be analysed for total Mg ion concentration before establishing this new AAS method as an alternative method to titrimetric method (Upul Ratnayake, Champa Lokuge, A K D Warnajith Prasad and Shirani Priyanka).

Development of novel method to determine metal ions in bleaching agent

A new method for analyzing the total iron contamination in bleaching agent was investigated since there are certain drawbacks such as long procedure, handling difficulties *etc.* in the current method. The new method was tried out by crystallizing the para toluene thiophenate (active ingredient of bleaching agent) and analyzing the iron concentration in the solution using Atomic absorption spectrophotometer (AAS). However, experimental results showed that certain percentage of iron was trapped within the crystals of bleaching agent and as a result only part of iron was remained in the solution. Therefore, this method of analyzing the iron content in bleaching agent using AAS was found to be unsuitable for determination of iron concentration in bleaching agent (Susantha Siriwardena, Nimal Karunathilake and H M S Wasana).

Chemical interaction between bleaching agent and metal ions

A project was carried out to study the chemical interaction between para toluene thiophenate (bleaching agent) and iron (Fe) since previous trials showed that fractionated bleached crepe rubber contained more iron than in the fractionated but unbleached crepe rubber. The experimental results revealed that red coloured complex is formed due to chemical reaction between ferric (Fe^{+3}) ions and bleaching agent. However, ferrous (Fe^{+2}) ions do not complex with bleaching agent effectively. These results indicate that contamination of high levels of Fe^{+3} could lead to the formation of red coloured complexes with the bleaching agent, which in turn, may affect the colour and quality of crepe rubber (Upul Ratnayake, Nimal Karunathilake and M B S Wasana).

Disposal of waste silicon rubber

Studies were carried out, on the request of a leading textile company, in order to find out a suitable disposal technology for waste silicon rubber generated at this company. Preliminary trials were carried out to convert the waste to a user friendly form. A cost effective method was developed for this conversion. Basically two techniques were tried to blend it with NR and the possibility of using it in the adhesive industry too was attempted. Both techniques used for blending were successful. These blending systems were used in pilot scale trials to manufacture floor mats, caster wheels and small heavy-duty tyres at a leading tyre manufacturing company. The textile company was introduced to the tyre manufacturing company for further necessary communications between the two companies (Susantha Siriwardane, Madupani Jayasuriya, Champa Wellappili and Upul Rathnayake).

Development of materials safety data sheets (MSDS) for different raw rubbers

Several enquiries were made by rubber exporting companies for material safety data sheets (MSDS) for different types of raw rubbers. Two MSDS were already drafted taking into consideration all safety aspects for RSS and sole crepe and these were provided to the clients who requested them. Preparation of similar MSDS for latex crepe rubber, brown crepe rubber centrifuged latex and skim rubber is in progress (Upul Ratnayake, Susantha Sirwardane and P H Sarath Kumara).

ADAPTIVE RESEARCH

V H L Rodrigo and S M M Iqbal

SUMMARY

Emphasis was given to educate farmers in Eastern province on planting practices and nursery management with that rubber was successfully planted in 27 hectares among 61 smallholdings. Anthurium variety "Tropical Red" was found to be suitable to grow under rubber even for export market. Observations of a survey conducted in Kalutara region indicated that stencil is not used to mark the tapping panels resulting in high bark consumption rate. However, tapping depth was reasonably good in most of smallholdings in this region. Absconding of bee colonies in wooden boxes was found to be a major problem in bee keeping. Performance of new clay bee pot was also not satisfactory. Rubber plants at Polgahawela substation performed well irrespective of the cropping system. Growth of seedlings was greater than that of clonal plants. Construction activities of Monaragala substation progressed slowly and problems associated with the boundary of the site were resolved.

DETAILED REVIEW

Staff

Dr V H L Rodrigo coordinated the activities of this unit. Dr S M M Iqbal (Agronomist), Research Assistants Mr W A D D S Wettasinghe, Mrs B M D C Balasooriya, Mrs E S Munasinghe, Experimental Officer Mr E A T Senadheera (sub-station, Polgahawela) and Account Clerk Mrs C Weeramanthree, (sub-station Polgahawela) were on duty through out the year. Mr R Handapangoda (Development Assistant) was on duty only up to 31st January.

Seminars/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
S M M Iqbal and V H L Rodrigo	Presentation on latex exploitation and rubber based farming systems at the workshop conducted for the enhancement of technology adoption and identification of future research and development needs at Hector Kobbakaduwa Agrarian Research and Development Institute with the executive staff of Plantation Companies	RRISL

Officer	Subject	Organization
S M M Iqbal and V H L Rodrigo	Presentation on the progress of rubber cultivation in Eastern province at the stakeholder awareness and participatory workshop of the "Nagenahira Navodaya" programme held at BMICH	Ministry of Nation Building and State and Infrastructure Development
	Progress reviews of NSF funded project held at the National Science Foundation	National Science Foundation
	Meeting with Korean Ambassador	RRISL
S M M.Iqbal, V H L Rodrigo and E S Munasinghe	Presentation on the progress of rubber cultivation in Eastern province at the district level workshop in Ampara under the Nagenahira Navodaya programme	Ministry of Nation Building and State and Infrastructure Development
S M M Iqbal, V H L Rodrigo and B M D C Balasooriya	Discussion on problems related with rubber based farming systems with the executive staff of the Elkaduwa Plantation company	RRISL
S M M Iqbal and C K Jayasinghe	Attended to the ministerial meeting on rubber cultivation in Eastern province under the Nagenahira Navodaya programme	MPI
E S Munasinghe	Workshop on Scientific writing	Institute of Biology, Sri Lanka
	Presented a research paper titled "Estimation of economic value of rubber plantations: Prospects for global carbon markets" at the Forestry and Environmental Science Symposium held at Kalutara	University of Sri Jayawardanepura
V H L Rodrigo, E S Munasinghe and B M D C Balasooriya	Workshop and Annual General Meeting of Young Scientists' Forum	National Science and Technology Commission (NASTEC)
S M M Iqbal	A lecture on "Rubber Multicropping Systems" in a refresher course conducted for the executive staff of the Rubber Development Department	RRISL

Officer	Subject	Organization
S M M Iqbal	A lecture on mixed cropping systems under rubber to the undergraduates of the Rajarata University, Sri Lanka	RRISL
V H L Rodrigo and S M M Iqbal	Lectures on rubber based farming systems at the workshops on "Rubber Agronomy" held at Fingara Town and Country Club in Moratuwa	Ceylon Planter's Association
S M M Iqbal and K A G B Amaratunga	Field day programme on nursery techniques, planting rubber and first year maintenance to the smallholders in Padiyathalawa	RRISL
E A T Senadheera	A lecture on "Diseases in rubber plantations" at the tapper training programmes conducted for smallholders in Kegalle region	RDD/Kegalle
S M M Iqbal and E A T Senadheera	Two training programmes were conducted on "Planting Rubber" and "Nursery Management" for the smallholders in Padiyathalawa	RRISL
	A lecture on exploitation and processing of rubber latex to school children and science Teachers in Polgahawela area	Sub-station Polgahawela

Advisory visits

114 experimental and 18 advisory visits were made.

FIELD INVESTIGATIONS

Adaptive research programme

Beekeeping in Rubber Plantations (ARU/BK/2004/1)

Studies on bee keeping were confined to few bee colonies present in Dartonfield/RRISL and Kuruwita sub-station (Table 1).

Table 1. *Bee colonies available at Dartonfield and Kurwita substation*

Site	Wooden boxes	Clay pots
Dartonfield	5	2
Kuruwita	2	1

Artificial feeding with sugar was carried out during the dearth period and the honey harvesting was done during the period of April to June. Average honey yield per colony (in wooden boxes) was 1395 ml (Table 2).

Table 2. *Honey harvest from wooden boxes at Dartonfield Estate and Kuruwita Substation*

Site	Volume of honey (ml)
Dartonfield	1440
Kuruwita	1350

The major problem encountered in beekeeping was the absconding of bee colonies from the standard wooden bee box. The cause for absconding bee colonies was unclear and therefore Dr R W K Punchihewa/University of Ruhuna was consulted in this regard. Two reasons were suggested, i.e. wax moth infestation caused by *Galleria melonella* and carnivorous wasp attack, however there was no sufficient evidence to confirm those. Number of colonies absconded during the year is given in the Table 3.

Table 3. *Absconding of bee colonies*

Site	No. of colonies absconded
Dartonfield	3
Kuruwita	14

Survey on the beekeepers in rubber plantations and awareness programme

This survey was conducted to collect the information on bee keepers to prepare a programme on scientific methods of beekeeping in rubber smallholders in Kegalle and Ratnapura districts. Altogether there were 51 beekeepers found in both districts and only 11.24% of them were rubber smallholders. Low level popularity in bee keeping could be due to absconding of bee colonies and unawareness of the potential of the rubber tree in producing nectar.

Beekeepers who maintain few colonies (1-2) were higher in Ratnapura than in Kegalle district (Fig. 1). Nevertheless, apiaries over five colonies were restricted to 1 to 2 smallholders in both districts. In large apiaries, some farmers maintained in Kitul *(Caryota utens)* logs and modified Langsworth standard wooden boxes to retain bees.

Success of the 3 piece new clay bee pot introduced by Dr R W K Punchihewa, University of Ruhuna was not satisfactory with only bee colonies settled in 3 boxes out of 103 boxes installed (Table 4).

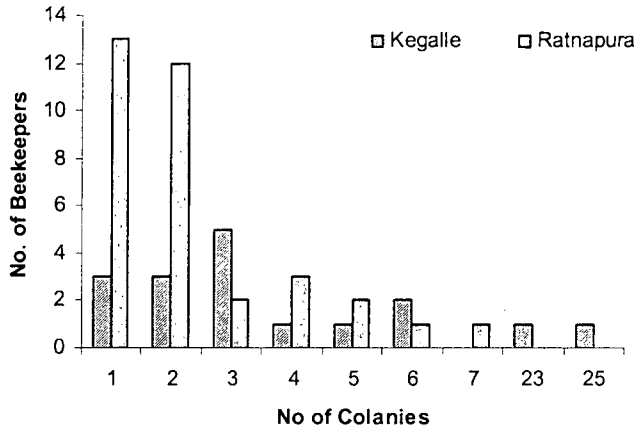


Fig. 1. Size of the apiary in Kegalle and Ratnapura districts

Table 4. *Fixing of 3 piece clay pots*

Site	No of clay boxes installed	No. of colonies settled
RRISL Agalawatta	8	-
Nivithigalakele Sub-station	5	-
Kuruwita Sub-station	15	1
Polgahawela Sub-station	4	-
Farmers in Colombo district	7	-
Farmers in Kalutara district	4	1
Farmers in Kegalle district	23	-
Farmers in Ratnapura district	37	1
Total	103	3

Nectar production in different rubber clones

Data collection on seasonal variation of the nectar flow of clones RRIC 100, RRIC 121 and RRIC 102 was repeated for the second year at Kuruwita substation. Volume of the nectar produced at the extra floral nectary glands of petioles was measured through out the honey flow period of rubber (W A D D S Wettasinghe, S M M Iqbal, V H L Rodrigo in collaboration with Ruhuna University).

***Expansion of rubber cultivation to the eastern province* (ARU/RCEP/2004/1)**

Objectives and the approach taken to establish rubber initially are shown in Annual Review 2004.

In brief, main activities of the year were,

- Assessment of photosynthetic performance of rubber leaves.
- Soil moisture measurements during dry spell.
- Leaf chlorophyll a fluorescence emission *(Fv/Fm)* of rubber leaves.
- Growth assessments of rubber.
- Workshops on planting practices and nursery management to smallholders in Padiyatalawa.
- Collecting leaf and soil samples for nutrient analysis.
- Assessment of rural livelihood

Leaf chlorophyll a fluorescence emission *(Fv/Fm)* was measured by using a Plant Efficiency Analyser (PEA, Hansatech Instruments Ltd., England. UK). Assessments were done on nine leaves in three plants each from four age groups during 10:00 hours and 14:00 hours. The F_v/F_m ratio was less in afternoon than in morning, however afternoon values tended to increase with the age of the tree (Fig. 2). Nevertheless, there was no clear indication for photoinhibition as the values recorded were always above 0.7.

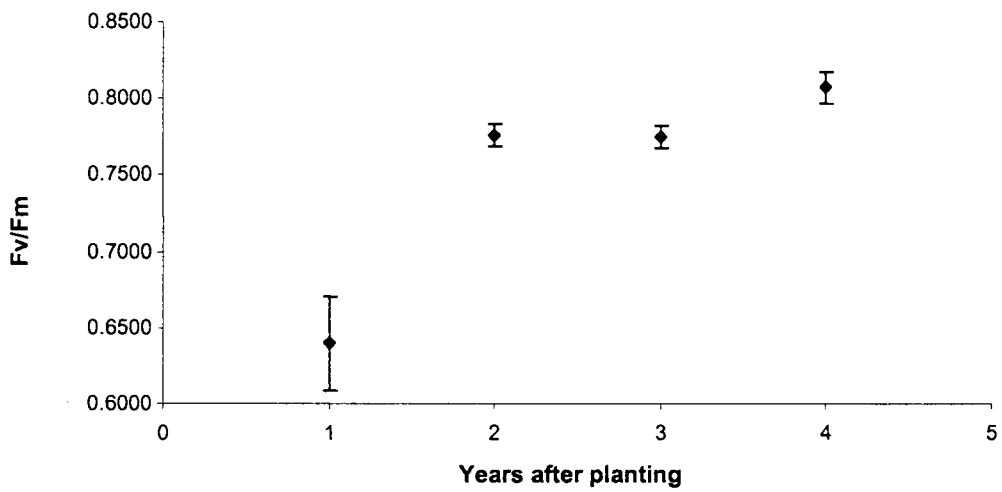


Fig. 2. Chlorophyll *a* fluorescence emission (Fm/Fv ratio) of rubber plants in four age categories. Values are means of 9 replicate measurements and error bars represent ± Standard Error of Mean.

(S M M Iqbal, V H L Rodrigo, R S Dharmakeerthi, K B A Karunasekera and A Nugawela. This project was funded by NSF under the RG/2005/AG14 grant).

***Polgahawela Sub-station* (ARU/RCWP/2005/1)**

Expansion of rubber cultivation in Wayamba region (North Western Province)

Growth of rubber

A detailed growth assessment of rubber plants was performed in December 2007. Girth values of rubber trees planted in 2005 were comparable among different densities/spatial arrangements with the mean value of 20.66 cm. Seedlings were outperformed over the clonal plants of RRISL2001 (Table 5).

Table 5. *Growth of rubber in Polgahawela substation*

Month/Year of planting	Clone	Spacing of rubber (ft) (intercrop with)	Mean girth as at December 2007 (cm)
May 2005	RRIC 121	8 × 27 (intercrop with banana)	19.66
May 2005	RRIC 121	8 × 19.5 (intercrop with banana)	22.64
May 2005	RRIC 121	8 × 23 (intercrop with banana)	20.53
May 2005	RRIC 121	8 × 40 (intercrop with cinnamon)	19.81
May 2006	Seedling RRIC 121	8 × 27	11.51
May 2006	Seedling RRIC 100	8 × 27	10.64
May 2006	RRISL 2001	8 × 40	9.03

New planting rubber

Rubber was planted in four hectares and intercropped with 200 banana plants. Clones of RRISL 203, RRISL 2001, RRISL 205, RRIC 121 and RRISL 214 were established. Initial establishment rate of RRISL 214 was very poor and could be attributed to unexpected dry spell during the planting season, some management deficiencies and clonal characters.

Upkeep of crops

General maintenance of rubber/banana, rubber/cinnamon intercrops and, cashew and pineapple plots. Being uneconomical to adopt best management conditions due to monkeys' damage, coconut was in rather neglected form except the pineapple planted area. Banana and pineapple were able to produce good harvests during the year. Harvests made on alternate crops with their income are shown in Table 6. Altogether, it was possible to obtain an income of Rs.557,864/= during the year.

Awareness programmes on rubber cultivation

A workshop on field establishment and immature upkeep to smallholders and a field day programme for school children and science teachers of Polgahawela area were conducted at the sub station.

Table 6. *Yield and Income status of Banana, Pinneapple and Coconut in Polgahawela substation*

Crop	Yield	Income (Rs)
Banana	414 (No of bunches)	113,635.00
Pineapple	2,214 (No of fruits)	112,995.00
Coconut	3,113 (No of nuts)	50,109.00
Old rubber	Contract tapping (500 No of old rubber)	281,125.00

(V H L Rodrigo, S M M Iqbal, B M D C Balasooriya and E A T Senadeera in collaboration with all biological departments of RRISL).

Water supply to the office building of the substation

In order to obtain water for mainly drinking and other general purposes, a well was constructed and a water pump was installed at a cost of Rs.100,000/=.

***Monaragala substation* (ARU/RCMR/2006/1)**

In general, construction activities of the substation progressed very slowly. Supervision of the construction of the office building complex was not properly done by the Provincial Engineer Monaragala resulting in low quality work. Therefore, overall supervision was taken to the custody of the RRISL appointing a contractual technical assistant and making frequent visits by RRISL's officials. Under this set up, it was able to correct some poor quality work done before in the construction process. Also, problems associated with the boundary of the site was resolved and fencing along the boundary was completed.

Preparation of BOQ of the proposed guest house of sub-station was in progress with the administration of RRISL. The tender procedure to uproot senile rubber for the purpose of setting up the budwood nursery and adaptive research plots were finalized (V H L Rodrigo, S M M Iqbal, E S Munainghe and A Nugawela in collaboration with all departments).

***Mixed clonal system for smallholder sectors* (ARU/MCS/2004/1)**

Field trials established in Kegalle region were maintained with the estate/smallholder collaboration. Arrangements were made to get the assistance from the Rubber Development Officer of Kegalle for growth assessments in the smallholder trials. Arrangements were also made to transfer the monitoring of estate sector trials to the Genetics and Plant Breeding Department due to the lack of supporting staff in the ARU to collect the data (S M M Iqbal, V H L Rodrigo and K B A Karunasekara).

***Anthurium culture under mature rubber* (ARU/AC/2004/1)**

Flowering of anthurium variety, "Tropical Red" was found to be successful under rubber with that 96 % of plants were capable of producing flowers (Table 7). Quality of flowers was also in acceptable level (Table 8). Water soluble fertilizer, 'Albert solution' at the rate of 5g in 4.5 liters of water was sprayed monthly to supply micro nutrients to the plants.

Table 7. *Flower production in anthurium under rubber*

Site	Total No. of plants	No. of flowering plants	Flowers harvested	Flowers damaged (physical)	Flowers damaged (by mites)
Dartonfield	2,208	2,130	5,644	523	691
Kuruwita	152	148	296	50	30

Table 8. *Mean flower dimensions during the year*

Site	Flower length (cm)	Flower width (cm)	Stalk length (cm)
Kuruwita	8.40	6.66	28.40
Dartonfield	8.49	7.02	27.08

Repotting of anthurium plants completed with the following medium.

Coir dust - 1 part
Wood shavings - 4 parts
River sand - 4 parts

A slow releasing fertilizer, 'Osmocote' was incorporated to the medium at a rate of 10g per pot.

New shoots emerged from the stem cuttings of old plants were used for propagation. In repotting, it was observed that a large quantity of rubber and Alstonia roots had entered to anthurium pots through the hole in the bottom (Table 9). To overcome this problem of competition for nutrients, the anthurium pots were rearranged at six months intervals.

Table 9. *Dry weights of the roots entered through the bottom of pots*

Type	Alstonia	Rubber
Mean value/pot (g)	1.12	2.66

(W A D D S Wettasinghe, S M.M Iqbal and V H L Rodrigo)

***Rubber with poultry system* (ARU/PS/2005/1)**

Details of the study were given in the Annual Review 2005 and 2006. Smallholder survey was commenced in Ratnapura and Kalutara districts to assess the present status of rearing poultry in rubber plantations (B M D C Balasooriya, S M M Iqbal and V H L Rodrigo).

***Assessments of different tapping systems practiced in the smallholder sector* (ARU/TSPSH/2005/2)**

This study was commenced to assess the performance of major recommended rubber clones *i.e.* RRIC 100, RRIC 121 and PB 86, under different tapping systems practised under smallholder conditions. Twenty one sites from Kalutara district were assessed for tapping quality and social information of smallholders was gathered through structured interviews. Seasonal variation of latex yields was monitored in 15 smallholdings and second set of tapping quality assessment was done in 12 sites.

Arrangements were made to extend this study to Ratnapura and Monaragala districts.

In all sites observed, the bark consumption rate was over the expected level. Farmers only in four sites had used a stencil to mark tapping guidelines; hence only in 29% sites, tapping cut lengths were properly maintained. Tapping angle was found correct in 71% sites. The depth of tapping cut was reasonably good in 81% sites. Although cup hangers were available in the majority, their placement was not properly done (Table 10).

Table 10. *Summary of the tapping quality assessment in twenty one sites in the Kalutara district. For each parameter, sites with over 80% trees in order were considered as good*

Status of the quality of tapping system	Guide line	Tapping angle	Depth of the cut	Length of cut	Bark consumption	Cup hangers	Placement of cups
Good	4	15	17	6	0	14	5
Poor	17	6	4	15	21	7	16

(E S Munasinghe, V H L Rodrigo and S M M Iqbal)

Economical assessment of environment benefits of rubber crop under different cropping systems with special emphasis on carbon sequestration (ARU/CS/2003/1)

Growth parameters, *i.e.* diameter at 150 cm height and total height, of RRIC 100 clone in sixty sites of the Intermediate zone of the country were measured. Then two models (Model 1 & 2) were developed to explain diameter and total height development with the age (Fig. 3 & 4).

Diameter at 150 cm height (cm) =8.99 Ln (YAP) – 2.41 ---------- Model 1
Total height (m) = 6.22 Ln (YAP) + 2.55 ---------- Model 2
Where, YAP refers to years after planting.

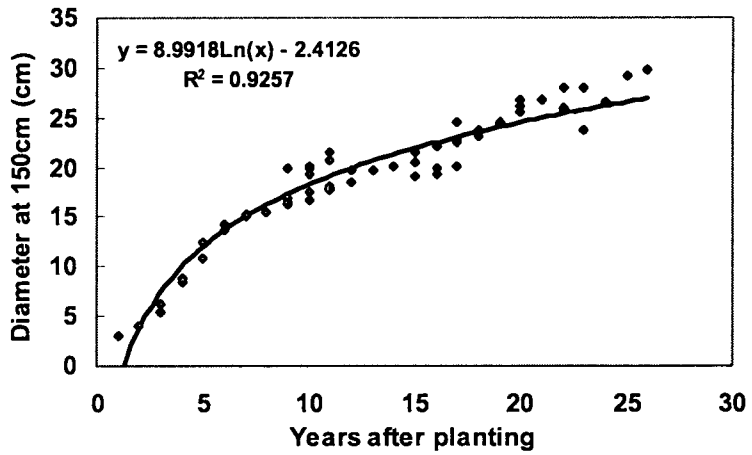


Fig. 3. Diameter (at 1.5m height) development of rubber tree (genotype RRIC 100)

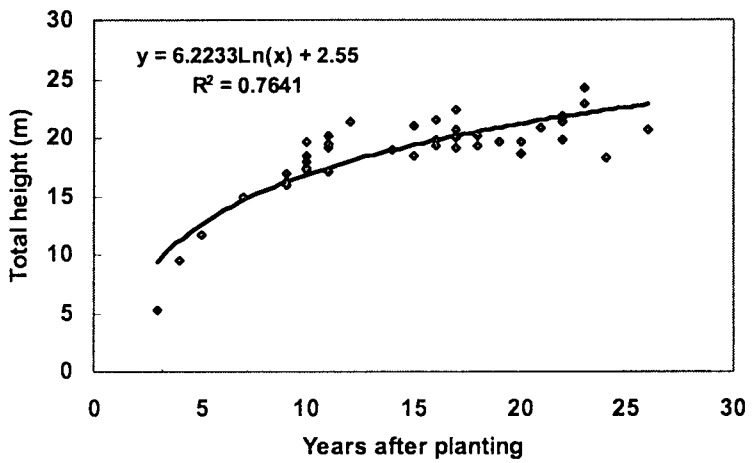


Fig. 4. Total height development of rubber tree (genotype RRIC 100)

A field survey was conducted to investigate the socio economic benefits of rubber based intercropping systems. Three widely adopted rubber based intercropping systems (*i.e.* banana, tea and pineapple) have so far been assessed in 78 smallholdings

(E S Munasinghe and V H L Rodrigo in collaboration with the University of Sri Jayewardenapura).

Interplanting of rubber lands with tea

Productivity in rubber/tea systems - Gallewatta/Dartonfield (ARU/TRIC/1990/2)

Details of the experiment were given in the Annual Review 1990.

Yield of tea was collected throughout the year. Tabulation of yield data for a detailed analysis was affected by the transfer of the Development Assistant (R Handapangoda) to the MPI. Collection of yield data of tea in mono- and inter-crops in commercial estates was commenced to develop a yield profile for tea in the rubber /tea system (S M M Iqbal and R Handapangoda).

BIOMETRY

Wasana Wijesuriya

SUMMARY

Providing research support to other research departments, maintenance of databases, conducting research in the discipline of Biometry and involving in collaborative research in the rubber sector are among the major activities of the Biometry section during the year under review. Biometry section assisted other research departments in various ways; *viz.* experimental design, analysis and interpretation of results and construction of databases. Databases were satisfactorily maintained during the year under review on meteorological data collected at the Meteorological station at Dartonfield, auction prices of rubber and information on research personnel and projects of RRISL.

Studies conducted during the year under review were mainly focused on developing appropriate statistical methods for the studies conducted in the rubber sector. The major areas of interest were climate change, statistical quality control, participatory studies and economic analyses on efficiency and profitability of rubber cultivation. The multidisciplinary study on 'Sustainability of the smallholder rubber sector in the Moneragala district' is in progress. Participatory studies, questionnaire surveys, land suitability surveys and GIS applications are among the key activities carried out under this project in collaboration with Advisory Services and Soils and Plant Nutrition departments.

DETAILED REVIEW

Staff

Dr (Ms) Wasana Wijesuriya (Biometrician) and Mr Vidura Abeywardene (Experimental officer) were on duty throughout the year. Ms Chintha Munasinghe (Experimental officer) has undergone a three months training programme at RRI, India with effect from 01st February. Mr Keminda Herath (Assistant Biometrician) is on study leave since 15th August, reading for his PhD at Virginia Poly Tec University in USA.

Research students

- Ms Krishanthi Kulasekera from Faculty of Agriculture, University of Ruhuna completed her final year project on "Factors affecting the decision of evading from rubber cultivations: A case study in Baduraliya area" under the supervision of Dr (Ms) Wasana Wijesuriya.

Seminars/Conferences/Meetings/Workshops attended

Officer	Subject	Organization
Wasana Wijesuriya	Application dimensions of GIS	Geo-informatics Society of Sri Lanka
	Climate change conference	Department of Meteorology
	Workshop to finalize the proposed policy and institutional structures on CDM	World Bank & Ministry of Environment & Natural Resources
	Scientific committee meetings	Rubber Research Institute of Sri Lanka
	Seminar on financial management of research/thematic grants	National Science Foundation (NSF)
Wasana Wijesuriya & Keminda Herath	Using ArcView 9.2 for GIS applications	EMSO Ltd., Colombo

Seminars/Conferences/Meetings/Workshops addressed

Officer	Subject	Organization
Wasana Wijesuriya	Progress of thematic research	National Science Foundation (NSF)
	Using Excel for statistical analysis	National Science and Technology Commission (NASTEC)
	Statistics: An essential tool for climate change assessment	Sri Lanka Association for Applied Statistics

Services

Statistical analysis and interpretation

Research support was provided to other Research Departments and students attached to those in designing of experiments, statistical analyses and interpretation of experimental results (W Wijesuriya and K Herath).

Database management

Meteorological

The database with daily meteorological data collected in the Dartonfield meteorological station was properly maintained. Monthly reports were prepared from this database and sent to the Central Meteorological Station, Colombo and the Natural Resources Management Centre (NRMC), Peradeniya. These data were made available to researchers and organizations on request (K Herath, W Wijesuriya, C Munasinghe and V Abeywardene).

Auction prices of rubber

The database on auction prices of different grades of rubber was updated for 2007. Some important information derived from this database is given below.

Prices of Ribbed Smoked Sheets (RSS)

The prices of RSS1 in 2007 reached the maximum of Rs.268.00 at the auction on the 31st October. The minimum was Rs.187.00 in January. Monthly averages for this grade were above Rs.200.00 in all months as shown in Fig. 1. The prices of RSS grades increased by 15-20% from 2006 to 2007 compared to 42-44% from 2005 to 2006.

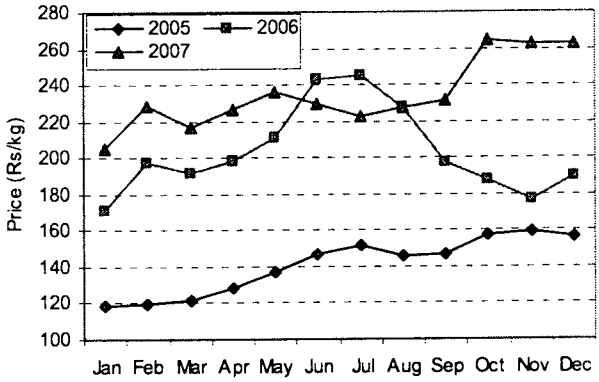


Fig. 1. Monthly variation of auction prices of RSS1 in 3 consecutive years

Prices of Latex Crepe (LC)

The prices of LC1X in 2007 ranged from Rs.210.00 to Rs.276.00 and recorded a decline of 4% compared to 2006. Monthly averages of 2007 were below than 2006 from April to August (Fig. 2). The decline ranged from 2% to 4% for grades; LC1, LC2 and LC3 while an increase of 9% was observed for LC4.

Monthly averages of auction prices for different rubber grades; *viz.* RSS, latex crepe and scrap crepe are given in Table 1.

Table 1. *Monthly averages of auction prices for different rubber grades in 2007*

Month	RSS prices (Rs.)					Latex Crepe prices (Rs.)					Scrap Crepe prices (Rs.)			
	RSS1	RSS2	RSS3	RSS4	RSS5	LC1X	LC1	LC2	LC3	LC4	1Xbr	2Xbr	3Xbr	4Xbr
Jan	205	201	201	190	191	247	244	236	228	189	172	165	162	158
Feb	228	221	216	213	212	228	223	216	215	206	192	187	184	177
Mar	216	211	210	205	205	221	217	210	206	199	192	190	189	185
Apr	227	221	218	216	-	226	222	213	211	207	204	204	203	198
May	236	234	230	226	223	244	237	232	225	217	213	213	213	211
Jun	230	228	227	226	226	232	229	220	216	211	209	202	207	203
Jul	223	216	217	215	212	227	217	214	208	201	192	192	194	183
Aug	228	221	218	215	-	231	224	215	210	202	199	197	201	196
Sep	231	225	224	220	218	233	227	221	219	217	214	213	213	211
Oct	265	258	258	249	-	254	247	243	240	231	227	222	220	218
Nov	262	258	254	252	252	246	244	237	235	232	230	222	220	217
Dec	262	259	256	251	249	243	240	237	235	232	228	226	225	222
2007 average	**234**	**229**	**227**	**223**	**221**	**236**	**231**	**224**	**221**	**212**	**206**	**203**	**202**	**198**

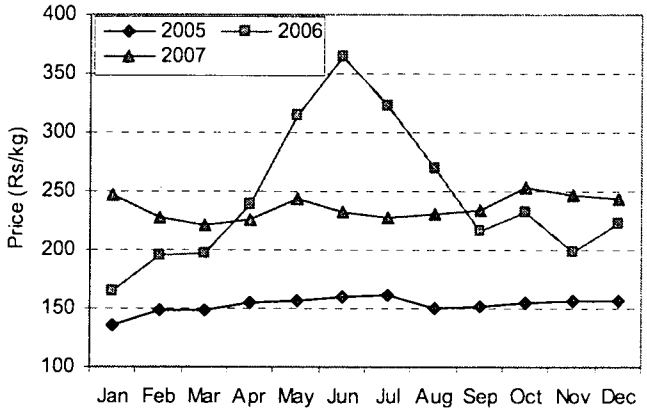


Fig. 2. Monthly variation of auction prices of LC1X in 3 consecutive years

The changes in annual average prices for RSS1 and LC1X are presented below. The difference between LC1X and RSS1 in 2007 was only Rs.1.50.

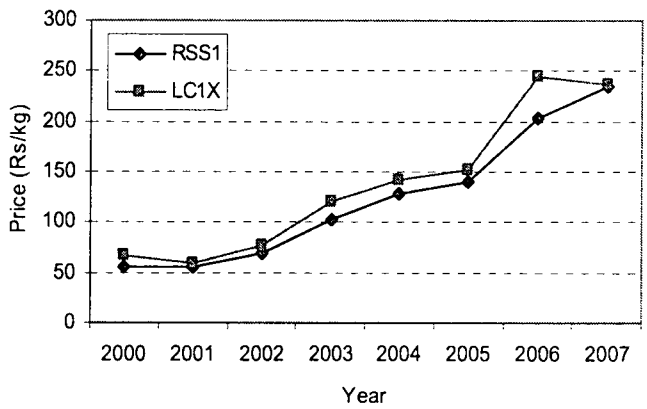


Fig. 3. Changes observed in yearly averages of auction prices for RSS1 and LC1X from 2000 to 2007

RESEARCH

Studies completed in year 2007.

An examination of profit inefficiency of smallholder rubber producers in Sri Lanka (CARP contract 12/636/479)

This study was based on a questionnaire survey in three major rubber-growing districts in the country. The objectives include estimation of profit

efficiencies and finding reasons for inefficiency in smallholder units. A stochastic frontier model was employed to examine profit efficiency in smallholder units.

The empirical results showed that farmers' human capital represented by the level of education and age (proxy for experience) contributes positively to efficiency. The farmers using high yielding clones and those who sell rubber as latex, rather than producing sheets tend to exhibit greater efficiency. Farmers who own smaller extents were found to be more efficient than those who own larger farms. Further, off-farm activities of family members reduce the efficiency. The project report was submitted to CARP and the thesis was submitted to Postgraduate Institute of Agriculture of University of Peradeniya (Wasana Wijesuriya, Jagath Edirisinghe - Wyamba University and C Bogahawatta - University of Peradeniya).

Factors affecting the decision of evading from rubber cultivations: A case study in Baduraliya area

This study emphasized that rubber lands were transferred into alternatives such as, tea, coconut and cinnamon in this area, located in the Kalutara district. Number of lands transferred into tea was 94% while it was 3% in case of coconut and cinnamon. About 3% of the rubber lands were transferred into other alternatives. This study reveled that the major reason for the transition from rubber cultivation to other alternatives is the reduction of rubber prices prevailed until 2003. After the transition, farmers have recognized that possibility to engage in another employment and leisure time have been reduced and soil degradation has been increased due to laborious work in tea compared to rubber cultivation. However, based on the actual costs collected from this area, pay back period for tea is only 3 years compared to 10 years in rubber cultivation. The Benefit/Cost ratio for rubber was 1.7, while it was 1.8 for tea. The values of Internal Rate of Return (IRR) was higher for tea (52) compared to 45 for rubber (Wasana Wijesuriya, Anura Dissanayake, Krishanthi Kulasekera - University of Ruhuna and A Abeywickrama - University of Ruhuna).

Analysis of project worth: smallholder and estate rubber cultivation

In technical terms the number of years required to recover the investment costs is the "payback period". The present day investment cost of planting rubber is about Rs.443,000.00 per ha and this amount can be recovered by 3½ years of tapping, *i.e.* in the 10^{th} year of plantation in both sectors. The average annual profit per ha. after six years of planting excluding the sale of old rubber trees in estate and smallholder sectors are Rs.218,000.00 and Rs.370,000.00, respectively. Other indicators of project worth assuming a 10% discount rate in estate and smallholder sectors are given in Table 2. These calculations were based on 2006 values for costs and returns.

Table 2. *Indicators of project worth for replanting of rubber in estate and smallholder sectors*

Indicator of project worth	Estate sector	Smallholder sector
Sum of Present Value of Income (PVB)	Rs.2,452,053.00	Rs.2,339,304.00
Sum of Present Value of costs (PVC)	Rs.1,044,777.00	Rs.873,350.00
Net Present Value (NPV) = (PVB-PVC)	Rs.1,407,275.00	Rs.1,465,953.00
Benefit/Cost Ratio	2.35	2.68
Internal Rates of Return (IRR)	45.44	45.88

The NPV of an investment is the difference between the sum of discounted cash flows, which is expected from the investment, and the amount, which is invested. In other words, NPV is an amount that expresses how much value an investment will result in. The positive NPV obtained in this case study suggest a worthwhile investment. IRR is the discount rate that results in a NPV of zero for a series of future cash flows. High Benefit/Cost ratio and the IRR value in both sectors suggest the worthiness of investing on rubber (Wasana Wijesuriya).

Studies in progress:

Tapping related activities and payment systems adopted in the smallholder sector

This study was done in all rubber-growing areas through a questionnaire survey to study tapping related activities and payment methods adopted by smallholders and how they deviate in different areas. The analyses are in progress. Some results of Kegalle district are presented below.

Examination of tapping panel and comparing with the age of the crop is depicted in Fig. 4 for PB 86 and RRIC series clones. Over exploitation is more pronounced with PB 86, which is still found in some areas. The situation is much better with RRIC series. The fields categorized as 'under exploited' may be due to poor growth conditions, which resulted delay in commencement of tapping.

Involvement of family labour in tapping was around 38% while 58% used hired labour for tapping. The rest, approximately 4% used both family and hired labour for tapping. Involvement of family labour reduced with the extent of the holding as in Fig. 5. Payments for tapping in terms of shares is more pronounced. Only 33% of the holdings adopted cash payments for tapping (Wasana Wijesuriya and Anura Dissanayake).

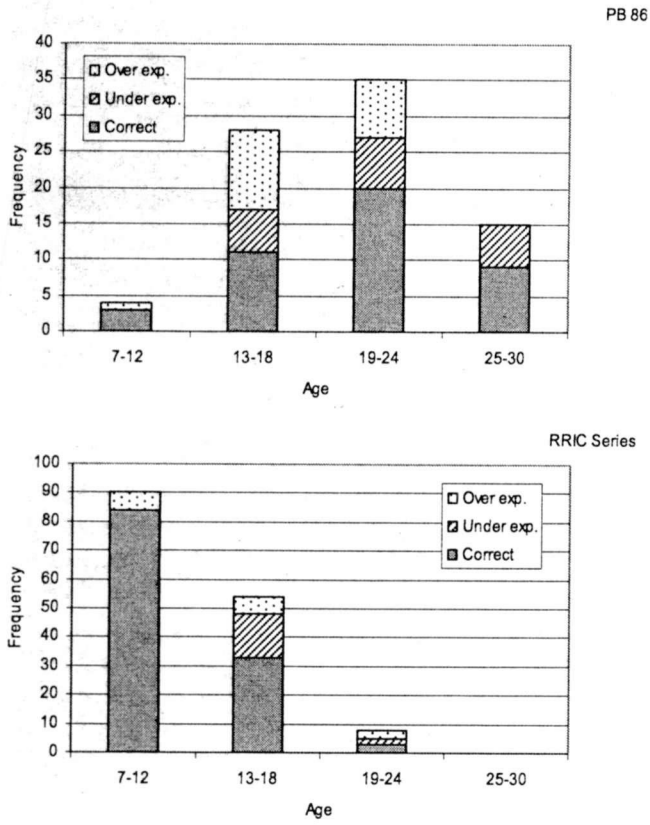


Fig.4. Status of tapping with age of the crop in smallholder units in Kegalle district

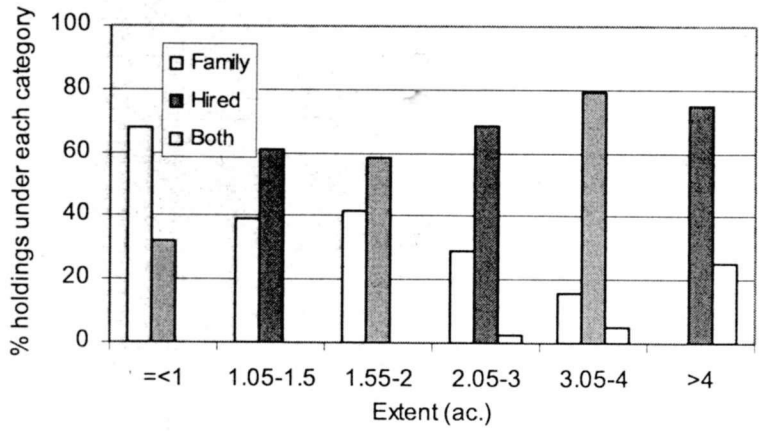


Fig. 5. Variation in labour use for tapping with the extent of the rubber holding

An approach towards sustainable development and economics of the smallholder rubber sector (NSF contract RG/2006/EPSD/01)

This project is funded by NSF under the theme "Environmental protection and sustainable management" of the Coordinated Thematic Research Programme (CTRP). The overall objective of this project is to improve the smallholder rubber sector in the Moneragala and adjacent parts of the Badulla and Ampara districts through sustainable management of environmental, socio-economic, technological and institutional aspects. It is expected to generate knowledge and integrate them through information tools such as GIS and decision support systems in a user-friendly interface for effective policy making and planning. This project falls into different disciplines. The departments, soils and plant nutrition and advisory services and the Biometry section are involved from RRISL together with Ruhuna and Wayamba Universities. The results under different disciplines are presented in respective departmental reviews.

The project commenced during the 4th quarter of 2006 and the following activities were done during this year. Participatory studies were conducted in 22 sites covering 170 villages in the study area. The questionnaire survey and land suitability monitoring is in progress.

Results of participatory studies

Major issues raised by the smallholder farmers:

The majority of farmers who participated in Participatory Rural Appraisal (PRA) were 'potential' rubber growers who have already received permits for rubber cultivation. Hence, the major issues in most of the areas were related to planting material. Due to the high demand on planting material, poor quality planting material have been released to the farmers in certain occasions. Some farmers have raised the issue of difficulty in getting permits for rubber cultivation, as they have not yet received permits from Divisional Secretariats for cultivation. Further, delay in subsidy payments, poor knowledge on rubber farming, marketing problems and lack of training facilities were also raised as major issues in some areas.

The issues raised by farmers falling into environmental, socio-economic, technological and institutional aspects are presented below.

Environmental	Socio-economic	Technological	Institutional
▪ Prolonged dry spells ▪ Rains during peak yielding period ▪ Damage from animals ▪ Termite attacks	▪ Problems with land ownership ▪ Improper price determination ▪ Lack of knowledge on the subsidy scheme ▪ Poor knowledge on rubber market ▪ High transport cost for marketing ▪ Poor infrastructure facilities ▪ Non availability of a rubber society ▪ Non availability of rubber dealers ▪ Scarcity of skilled tappers	▪ Poor quality planting material ▪ Lack of standards for processing chemicals ▪ Insufficient processing equipment & smoke houses ▪ Poor knowledge on nursery maintenance ▪ Poor knowledge on land preparation ▪ Poor knowledge on immature upkeep ▪ Poor knowledge on intercropping ▪ Poor knowledge on disease control ▪ Poor knowledge on tapping ▪ Poor knowledge on processing	▪ Scarcity of plants ▪ Non availability of plants at the required time ▪ Delayed subsidy payments ▪ Untimely issue of fertilizer through subsidy ▪ Insufficient number of extension officers ▪ Lack of efficient extension service ▪ Non availability of purchasing units for fertilizer & tapping utensils ▪ Frequent transfers of extension officers

Farmers' perception on suitable crops for the Moneragala area

Matrix ranking was used to gather information on this as a participatory tool. The farmers have listed the important crops in the area and criteria they consider in selecting a suitable crop for the area. In the next step they allocated weights for each crop considering a single criterion at once. The criteria used by farmers are listed below.

Environmental	Economic	Technological	Institutional
▪ Tolerant to droughts ▪ Tolerant to diseases & pests	▪ Profitability ▪ Income throughout the year ▪ Market facilities ▪ Long term income	▪ Easy planting ▪ Knowledge on the crop	▪ Government interventions ▪ Advisory services ▪ Supply of inputs

Rubber is preferred over the other crops according to the results of PRA carried out so far as shown in Table 3.

Table 3. *Ranks obtained by different crops in matrix ranking exercises in different sites*

Crop	DS Division																	
	Badalkumbura			Bibile			Moneragala			Medagama		Madulla	Buttala	Siyamba-landuwa	Lunu-gala	Haldummulla		Padiya-talawa
	1	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*1*	*1*	*1*	*1*	*1*	*2*	*1*
Banana	3	7	4	4	4	8	4	5	8	4	6	7	5	4	5	5	3	5
Coconut	2	2	-	2	2	2	2	-	2	2	2	2	3	-	-	-	-	3
Pepper	-	4	2	3	3	3	3	2	3	-	3	5	-	5	2	2	2	-
Lime/orange	8	-	6	5	5	7	-	4	7	5	-	4	-	-	-	-	-	4
Tuber crops	-	-	-	8	9	6	5	7	-	-	-	-	-	-	-	-	-	-
Pineapple	-	-	-	6	7	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubber	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sugarcane	8	-	-	7	-	-	-	-	-	-	-	6	4	6	-	-	-	-
Corn	7	-	-	10	6	-	-	7	-	-	8	6	9	2	6	-	-	6
Chena crops	8	-	-	11	8	-	-	-	-	-	-	-	-	-	-	-	-	-
Vegetables	-	-	7	9	-	-	-	10	9	-	9	-	-	-	-	-	5	8
Cowpea/ Mung bean	6	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	4	7
Chilies	5	-	-	-	-	-	-	6	-	-	-	8	7	-	-	-	-	-
Mango	4	-	-	-	-	-	-	3	6	-	-	3	2	-	-	-	-	-
Arecanut	-	5	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Cinnamon	-	-	3	-	-	4	-	-	4	3	-	-	-	-	4	3	-	-
Kurakkan	-	-	-	-	-	-	-	8	-	-	7	-	-	-	7	-	-	-
Manioc	-	-	-	-	-	-	-	-	-	-	-	-	-	3	7	-	-	-
Coffee	-	6	-	-	-	-	-	-	-	7	-	-	-	-	-	4	-	-
Cocoa	-	3	5	-	-	5	-	-	5	6	5	-	-	-	-	-	-	-
Papaw	-	8	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-
Ground nut	-	-	-	-	-	-	-	7	-	-	-	-	8	7	-	-	4	-
Sweet melon	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
Rambutan	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
Cashew	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Results of questionnaire survey

Questionnaire surveys were done separately for potential rubber farmers and those who own mature and immature rubber lands. During this year, 255 potential rubber farmers and 248 and 76 farmers who own immature and mature rubber lands, respectively were interviewed. The analyses are in progress.

Activities on GIS

Land suitability, soil, climatic and socio-economic information are being processed for the rubber growing areas in the Moneragala district and adjacent parts of Ampara and Badulla districts ([Wasana Wijesuriya, Keminda Herath and Vidura Abeywardene from the Biometry Section, Lalani Samarappuli, P Karunadasa, U Mithrasena, Anoma Thewarapperuma and T Gunathilaka from Soils and Plant Nutrition Department, Anura Dissanayake, Kapila Gunaratne, Shantha Perera, Susith Rathnayake, R A D Ranawaka, R L R U S Bandara, Manoj Nanayakkara, D R A M G Abeydissanayake, M Dharmadasa, U N Jayasuriya, W C Siriwardene, E G U Dhanawardene from Advisory Services Department], Mahinda Wijeratne from University of Ruhuna and Senani Karunaratne from Wyamba University).

Studies on statistical quality control (SQC)

During the latter part of the year under review daily data from the Dartonfield rubber factory were collected and compiled in a database covering the period 01st November 2006 to 31st October 2007. A study is in progress to make use of available SQC methods for better decision making and planning. It is intended to employ available specific software such as 'change point analyzer' and general-purpose statistical software for analyses (Wasana Wijesuriya and Vidura Abeywardene).

LIBRARY AND PUBLICATIONS

S U Amarasinghe

SUMMARY

Main functions of the Library and Publications section such as maintaining, processing and publishing of the Institute's regular publications and disseminating of information on natural rubber and related areas were carried out successfully throughout the year.

DETAILED REVIEW

Mr S U Amarasinghe, Librarian and Publications Officer, Mrs Ramani Amaratunga, Library Assistant and Assistant Publications Officer, Mrs Irene Perera, Acting Library Assistant (Colombo Office), Mr P M Prema Jayantha, Clerk/Typist and two Library Attendants were duty throughout the year.

Meeting/Seminars

- The AGM of the Sri Lanka Library Association SLFI on 29th June.
- The Seminar on resource sharing in the digital environment at NSF on 08th February.
- The Seminar on National Union Catalogue at HARTI.
- Three AGRINET Librarian's meeting at CARP Office on 30th July and 04th December.

Resource development activities

Seventy books were added to the existing library collection, bringing the total number of books to 5841. The library subscribed to a limited number of journals due to financial constraints. Nearly twenty five journals were received on exchange basis.

Publications

The following publications were published during 2007.

- Annual Report 2006
- Annual Review 2006
- RRISL Bulletin, Vol.48 (2007)
- RRISL Journal, Vol.87 (2005)
- රබර් සුවඳ, කවිළුම 24 (2005)
- Five (05) Advisory Circulars

Training

Mrs R M Amaratunga, Library Assistant and Assistant Publications Officer successfully completed the Course on Desk Top Publishing/Graphic Design conducted by IDM/Kalutara.

ILL Service

Twenty six articles were sent to various agriculture libraries on their request and vice versa nineteen articles were requested for RRISL users. Nearly twelve literature surveys on rubber were done using CD-ROM databases available at CARP and PGIA libraries.

Information services

Computerized bibliographic data up to the year 2007 were sent to the National Library of Sri Lanka and CARP library for compilation of the National Union Catalogue and the National Agriculture Bibliography respectively.

Office equipment

The following were received to the library during the year.

- Computer with 17" Colour Monitor (Hp).
- Computer (CPU).

DARTONFIELD GROUP

J Perera

SUMMARY

A total crop of 212,996kg, have been harvested during the year recording an increase of 1.85% on previous year's crop. When comparing with the estimated crop it records a decline of 7.65%. It is an encouraging fact to record that 17.30% of the total crop harvested during the year was from rainguarded areas.

The YPH recorded during the year was 1,136kg. This is an increase of 21kg over the previous year.

The average intake per tapper during the year was 8.50kg from a tapping task of 275 trees which records a slight decrease of .49% over the previous year. The highest intake per tapper recorded during the year was 12.90kg from a 275 tree tapping task tapped on ½S d/3 tapping system.

The total number of normal, late, double, rainguard, rain interference and no tapping days recorded during the year were 212, 22, 44, 46, 7 and 76 days respectively.

The total rain fall recorded during the year was 3,997.40 mm with 187 wet days and total rainfall and wet days are less when compared with the last year.

The COP and NSA achieved for the year are Rs.128.12 and Rs.223.28 respectively, thus giving a profit margin of Rs.95.16 per kg and a total profit Rs.20.2 million from the year. Further Rs.1 million has been generated from sundry income during the entire year.

The latex crepe No.01X grade manufactured during the year recorded as 81%.

82% of the total revenue extent had been rainguarded during the year.

DETAILED REVIEW

Mr J Perera the Estate Superintendent, Mr K K P Gunawardena, Acting Chief Clerk, Mrs S I K Pathirage and Mrs O W Namali Udayanthie, Junior Clerks, Mr D S K Ranaweera, Factory Officer, Mr W D D Senanayake, Assistant Factory Officer, Mr Somaratne Tennakoon, Field Officer, Mr Ajith Basil Nakandala, Mr B M Siriwardena, Mr Jagath Nakandala, Mr N L D Nihal and Mr K A Sarath Kumara, Junior Assistant Field Officers were on duty throughout the year.

The demise of Mr Jayantha Premalal the Field officer who was working in the office is recorded with regret.

The group cadre stood as follows at the end of the year.

Senior staff	01
Assistant staff	14
Minor staff	03
Total	16

Hectarage summary - Dartonfield group

Hectarage summary of the Dartonfield group is given in Table 1.

Table 1. *Land distribution (ha.) of Dartonfield group*

	Dartonfield division	Gallewatte division	Nivitigalakele division	Total
Mature area	39.02	138.46	15.47	192.95
Immature area	-	11.59	14.05	22.64
Estate : land take in	0.27	-	-	0.27
Nurseries	7.27	1.00	2.00	10.27
Paddy/Deniya land	-	1.22	1.22	2.44
Waste land	0.19	0.18	-	0.37
Earth slipped area	3.01	1.26		4.27
Jungles	0.80	-	3.29	4.09
Rocky areas	2.14	5.16	1.26	8.56
Uprooting areas	-	10.93	12.79	23.72
Roads	2.92	6.86	0.36	10.14
Building	16.14	5.07	7.79	29.00
Building complex	2.53	-	-	2.53
Abandoned areas	-	2.62	12.84	15.46
Streams	-	-	2.17	2.17
Grand total	**74.29**	**184.35**	**73.24**	**331.88**

Rainfall

The annual rainfall recorded for the year was 3997.4mm with 187 wet days.

Table 2. *Annual rainfall and wet days of the group for last five years*

	2003	2004	2005	2006	2007
Rainfall (mm)	4,454.1	4,349.7	4,129.0	4260.9	3997.4
Wet days	229	235	222	204	187

Crop

A total crop of 212,996 kg have been harvested against the estimated crop of 230,736 kg. This is a decrease of 17,740 kg (7.69%) against the estimated crop. A crop of 36,848kg (17.30%) have been harvested from rainguarded areas.

Table 3. *The comparison of crop and YPH (kg) Dartonfield group from 2003 to 2007*

Hect.	2003		2004		2005		2006		2007	
	189.69		184.71		196.15		187.48		195.10	
Division	**Crop**	**YPH**	**Crop**	**YPH**	**Crop**	**YPH**	**Crop**	**YPH**	**Crop**	**YPH**
Dartonfield	40951	1177	31394	850	33527	859	40278	1032	38025	974
Gallewatte	137910	1010	119433	872	144169	997	156863	1133	163228	1179
N'kele	11252	613	8618	689	8211	656	11970	1197	11743	1174
Group total	190113	1002	159445	863	1859	948	209111	1115	212996	1136
Group estimate	187550	989	178124	964	169350	1001	184900	986	1230	1231

Tappers productivity

The average IPT during the last five years are given in Table 4.

Table 4. *The average IPT (kg.) of Dartonfield group from 2003 to 2007*

	2003	2004	2005	2006	2006
Dartonfield	6.6	6.4	6.8	7.1	6.6
Gallewatte	9.8	9.6	9.4	9.9	9.4
Nivitigalakele	4.6	5.9	5.7	6.3	6.3
Group average	8.4	8.7	8.9	8.9	8.5

The tapper productivity shows a slight decrease of 0.4kg over the previous year.

Tapping days

Monthly break down of normal tapping (NT), late tapping (LT), double tapping (DT), rainguard tapping (RT) and no tapping, of Dartonfield estate is given below in Table 5.

Table 5. *Average number of tapping days of Dartonfield group during last five years*

	2003	2004	2005	2006	2007
Normal tapping	261	168	190	199	212
Late tapping	24	12	06	35	22
Double tapping	-	-	(11)	(27)	(44)
No tapping	80	186	104	77	76
Rainguard tapping	-	-	65	54	46

Total number of tapping days have increased over the previous year.

Rainguards

Total of 144.79 hectares were rainguarded during the year and a crop of 36,848 kg (17.30% of the total annual crop) have been harvested. Additional tapping days done during the year were 64 and 89 days for Dartonfield and Galewatta divisions respectively. A profit of Rs.134.75 per kg was made with the crop harvested from rainguarded areas which is equivalent to Rs.4.9 million.

Table 6. *Additional income generated by fixing rainguard (Rs./kg.)*

	Dartonfield division	Gallewatte division	Total
Hectarage (ha.)	34.89	109.90	144.79
No of Rain guards fitted	9,388	31,159	40,547
No .of kilos harvested	5,890	30,958	36,848
Tapping cost (Rs./kg)	41.38	41.38	41.38
C.O.M (Rs./kg)	22.56	22.56	22.56
Rainguard cost (Rs./kg)	24.59	24.59	24.59
Total cost (Rs./kg)	88.53	88.53	88.53
Profit (Rs./kg)	134.75	134.75	134.75
Additional profit from rainguads (Rs.)	793,677.50	4,171,590.50	4,965,268.00
Additional profit per hectare (Rs.)	22,747.99	37,958.06	34,292.89
Additional tapping days	64	89	76

Total profit and profitability per hectare

Total profit and profit per hectare were Rs.20,268,699.36 and Rs.108,111.26 respectively for the year under review. This is an increase of Rs.712,638.06 and Rs.3,801.14 respectively when compared with last year.

Table 7. *Comparative statement of total profit and profit per hectare*

	Years				
	2003	**2004**	**2005**	**2006**	**2007**
Mature area (ha.)	189.69	184.71	196.15	187.48	187.48
Total profit (Rs.)	9,868,973.18	9,000,670.79	10,777,920.74	19,556,061.30	20,268,699.36
Profit per ha. (Rs.)	52,026.85	48,728.66	54,947.34	104,310.12	108,111.26

Cost of production and productivity

Labour wages has increased by 12%, compared to last year. Details are given in Table 8.

Table 8. *Labour rates and break down of cost of production from 2002 to 2006(Rs./Kg.)*

	2003	**2004**	**2005**	**2006**	**2007**
1. Labour wages	147.35	178.75	216.25	285.50	320.00
2. Cost of production	57.16	74.50	86.84	116.24	128.12
2.1 Tapping	22.33	25.45	29.29	35.35	41.38
2.2 Manufacture	12.66	17.47	16.33	19.20	22.56
2.3 General charges	14.90	19.21	28.35	47.47	50.47
2.4 M/area upkeep	7.27	12.37	12.87	14.22	13.71
3. N.S.A.	109.07	130.95	144.34	209.76	223.28
4. Profit	51.91	56.45	57.50	93.52	95.16

The profit has increased by Rs.1.64 per kg when compared with previous year.

Manufacture

Out of the 191,234kg of latex crop harvested 150,550kg were dispatched as No.1 which is 81% of the crop used for crepe manufacture. Further, out of 6,406kg of RSS manufactured 6,078kg (95%) have been graded as No.1. Details are given in Table 9.

Table 9. *Summary of grades manufactured during the year*

Grade	Quantity (kg.)	Percentage %
Crepe No: 1	150,550	81
Crepe No:3	34,278	19
Total	184,828	100
Scrap crepe No. 1	15,763	73
Scrap crepe No.2	5,526	25
Scrap crepe No.3	473	02
Total	21,762	100
RSS No.1	6,078	95
RSS No.2	328	05
Total	6,406	100
Grand total	**212,996**	

KURUWITA SUB STATION

S A R Samarasekera

SUMMARY

A crop of 84,128 kg was harvested during the year 2007 which is an increase of 26.5% over the estimated crop for the same period. The actual yield per hectare (YPH) achieved was 1615.3kg and a yield per hectare of 1,240 kg was achieved from intercroped rubber area during the same period. The average intake per tapper was 8.6 kg. This is a decrease of 0.8 kg over the last year. The annual rainfall was 3,365.2 mm with 130 wet days as against 4,100.3 mm with 132 wet days during the last year. The average number of normal, late, rain interference, double, and no tapping days were 315, 01, 18, 3, 31 respectively.

The cost of production and the net sale average for the year were Rs.95.75 and Rs.202.41 per kg respectively. The profit per kg was Rs.106.66 and profit made for the year was Rs.8,973,092.48. The total profit made inclusive of sundry income was Rs.9,661,732.71.

DETAILED REVIEW

The Visiting Superintendent Mr Anusha S Perera over looked the activities of the Sub Station up to 31.07.2007. Mr S P Dissanayaka Deputy General Manager of Agalawatta Plantation was appointed for the Post of Visiting Superintendent of the Kuruwita Sub Station with effect from 01.08.2007.

Staff

Mr S A R Samarasekara Assistant Superintendent, Mr D S Jayasinghe Clerk, Mr J R C Jayalath Assistant Field Officer and Mr V G D N Gunaseela, Mr N V U S V Kumara Junior Assistant Field Officers were on duty throughout the year.

The estate cadre stood at 05 at the end of the year made as follows.

Intermediate staff	- 01
Assistant staff	- 01
Minor staff	- 03

Hectarage

A summary of the hectarage is given in Table 1.

Table 1. *Land distribution (ha.) in Kuruwita Sub station*

Land type	Extent (ha.)
Mature area	55.31
Immature area	25.40
Nurseries	2.25
Tea area	3.25
Fruit plantation	2.00
Paddy	1.00
Buildings, gardens and road	7.54
Water tank	.01
Proposed replanting area	2.40
Unsuitable for planting	.84
	100.00

Crop

A total crop of 84,128kg was harvested from an extent of 55.31 hectares during the year.

When compared with the actual of the previous year there is an increase of 5,853kg.

The yield per hectare (YPH) for the past 5 years is given in the Table 2.

Table 2. *Yield per hectare for the past five years*

YPH (kg)	Year				
	2003	2004	2005	2006	2007
Estimate	1,080.0	1,197.7	1,200.0	1,200.0	1,200.0
Actual	1,371.5	1,393.9	1,451.2	1,610.2	1,615.3

The yield per hectare recorded for different months of the year is given below.

Month	YPH (kg)
January	183.5
February	129.7
March	108.1
April	61.2
May	127.1
June	130.5
July	143.4
August	133.5
September	119.1
October	147.8
November	170.9
December	160.5

Tapper productivity

The average intake per tapper at the end of the year was 8.6kg. This is a decrease of 0.8kg over the last year (Table 3).

Table 3. *The average I.P.T. (kg) for the last five years*

	Year				
	2003	**2004**	**2005**	**2006**	**2007**
Intake per tapper	9.4	8.5	8.7	9.4	8.6

Vacant blocks

The number of vacant blocks recorded for the past 3 years in the estate is given in Table 4.

It has increased in year 2007 when compared with the previous year (Table 4).

Table 4. *Vacant blocks during past 3 years*

Year	No. of vacant blocks	Percentage %
2005	477	5.66
2006	195	2.27
2007	308	3.03

Tapping

There were 334 tapping days recorded during the year (Table 5). This was possible merely due to the use of raingurds.

Table 5. *The number of tapping days, average intake per tapper and YPH for the last five years*

	Year				
	2003	**2004**	**2005**	**2006**	**2007**
1. Total tapping days	280	327	336	335	334
1.1 Normal	258	306	302	306	315
1.2 Late	14	14	18	20	1
1.3 Rain interference	08	07	16	09	18
1.4 Rain guard	(32)	(92)	(88)	(122)	(109)
1.5 Double	(46)	(11)	(4)	(02)	(3)
2. No tapping	85	39	29	30	31
3. Average intake per tapper	9.4	8.5	8.7	9.4	8.6
4. Y.P.H.	1,371.5	1,393.9	1,451.2	1,610.2	1,615.3

Tapping cost

The tapping cost of the estate has increased by 24% over the last year due to the increase of labour wage (Table 6).

Table 6. *A break down in total tapping cost for last 5 years*

Cost item	Cost/kg (Rs.) and year				
	2003	2004	2005	2006	2007
Tapping	14.67	21.10	24.31	26.39	33.28
Double tapping	1.33	.54	.17	.09	.07
Overtime on tapping	.18	.22	.28	.36	.27
Over kilos	.48	.31	.33	.54	.60
Extra pay to Kangany	.03	.03	.03	.02	.02
Scrap pay	.36	.39	.61	.88	.86
Incentive pay to Field staff	.09	.20	.22	.25	.23
Total tapping cost (Rs.)	17.14	22.79	25.95	28.53	35.33

Rainguards

Due to the use of rainguards, an additional 109 tapping days were recorded during the year. This contributed to 27% of the total crop yielding an additional profit of Rs.3,496,623.44.

The performance recorded on the use of rainguards during the last 3 years are given in Table 7.

Table 7. *Additional income generated by fixing rainguards (Rs./kg)*

	Year		
	2005	2006	2007
Hectarage (ha.)	31.25	33.66	50.31
No of rain guards fitted	13143	15680	16300
Cost per rain guard (Rs)	15.51	19.08	21.63
Tapping cost (Rs./Kg)	25.95	28.53	35.33
Additional income from rain guard (Rs)	1,036,719.84	1,853,376.00	3,496,676.00
Additional profit per hectare(Rs)	32,677.96	61,500.82	69,501.56
Profit per tree (Rs)	78.88	118.20	214.52
Additional tapping days	88	122	109

Rainfall

Rainfall figures for the last 3 years are given below in Table 8.

Table 8. *Rainfall (mm) distribution during 2005, 2006 and 2007*

Month	Year		
	2005	2006	2007
January	97.2	162.9	133.1
February	192.5	181.3	
March	367.3	243.5	163.8
April	394.6	324.6	462.2
May	342.3	479.7	269.3
June	302.5	450.1	280.1
July	235.4	188.0	306.3
August	152.1	418.9	365.2
September	428.4	298.9	469.5
October	576.5	645.0	527.7
November	652.0	458.2	227.5
December	162.2	149.1	160.5
	3,903.0	4,000.3	3,365.2

The total annual rainfall has decreased during the year.

Annual rainfall figures and the number of wet days for the last five years of the estate are given below:

	Year				
	2003	2004	2005	2006	2007
Rainfall in (mm)	3,981	4,556	3,903	4,100	3,365
Wet days	89	120	103	132	130

Cost of production and profitability

The cost of production has increased by Rs.16.76 per kg when comparing with the previous year (Table 9).

Table 9. *Labour rate (Rs) and the break down of the cost of production (Rs./kg) for the last five years*

	Year				
	2003	2004	2005	2006	2007
Labour rate	109.00	125.00	125.00	170.00	200
Total COP	34.25	55.11	60.31	78.99	95.75
Tapping	17.91	23.54	27.17	29.64	37.68
General charges	11.39	23.20	23.52	37.09	45.11
Upkeep	4.95	8.37	9.62	12.26	12.96
NSA	83.12	104.89	120.58	165.82	202.41
Profit per kg	48.87	49.78	60.27	86.83	106.66

Labour rate per day for the year was Rs.200/= plus an additional incentive of Rs.90.00 per day depending on the attendance.

The profit per hectare has shown a steady increase during the past 5 years (Table 11).

Table 10. *Comparative statement of the mature extent, total profit and profit per hectare for the last 5 years*

	Year				
	2003	**2004**	**2005**	**2006**	**2007**
Mature extent (ha.)	48.83	44.25	47.61	48.61	55.31
Total profit (Rs.)	3,272,921.64	3,070,281.06	4,164,415.92	6,796,618.25	8,973,092.48
Profit/ha. (Rs.)	29,441.74	67,026.86	69,384.88	139,819.34	162,232.73

During the year 2007 a profit of Rs.106.66 on a kilogram and Rs.162,232.73 per revenue hectare were recorded.

Other crops

Tea

A crop of 24,086kg was harvested during the year. The cost of production and the net sale average for the year were Rs.27.57 and Rs.40.18 per kg respectively.

The profit per kg and profit per hectare were Rs.12.61 and Rs.93,719.30 respectively. The total profit made for the year was Rs.304,587.73.

Cinnamon

421kg of Cinnamon was sold during the year from the rubber/cinnamon inter crop experimental area.

Rambutan

21,805 fruits were sold during the year from the rubber/rambutan intercrop experimental area.

Pine apple

14,603.5kg of Pineapple and 27,585 suckers were sold during the year.

Passion fruit

1,867kg Passion fruits were harvested during the year.

Rubber plants

4,246 young budding plants were issued to the smallholders during the year.

Reward

The selected best tappers were rewarded during the year in order to motivate them.

Fertilizer application

Fertilizer application for mature and immature fields were carried out as scheduled.

Meteorological Summary - 2007
Dartonfield Station

Wasana Wijesuriya

A total of 4220 mm of rain experienced during 2007. A slight decrease of about 40 mm was observed in 2007 compared to the previous year. The comparative increase with respect to the long-term average was about 4%. Fig. 1 indicates that the distribution of rainfall during this year followed the usual bimodal pattern. Monthly rainfall values in April, May and October have reached 600mm.

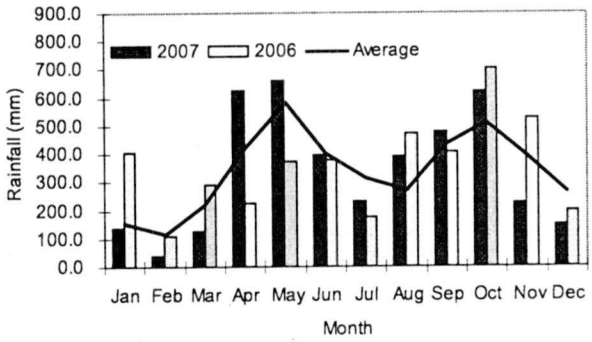
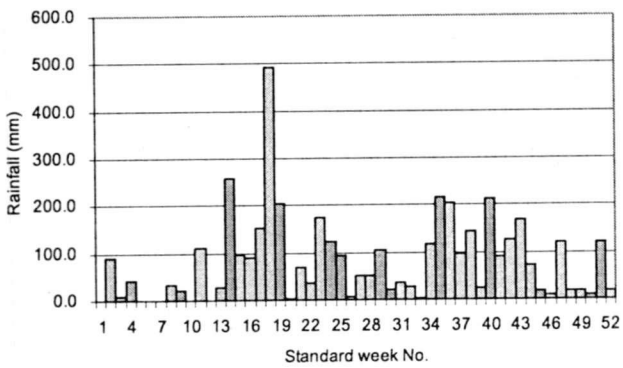


Fig.1 Monthly variation in rainfall

Below average rainfall values were observed for the period from January to March, July, November and December.



The distribution of weekly rainfall is illustrated in Fig. 2. Twelve dry weeks (a week having a total rainfall less than 10 mm) were observed during the year and it was 8 weeks in 2006. The highest weekly rainfall was observed during the 18th standard week, which coincided with late May and early July.

Fig. 2. Weekly variation in rainfall

Start and end of monsoon rains

The successful start of the rains occurred by 29th March and 08th September in 80% of the years for Southwest (SW) and Northeast (NE) rains, respectively when the period from 1964 to 2003 were considered. For the year under review, SW rains commenced successfully by 01st of April, which was very close to the 80% expected. The onset of NE rains in the year was 20th August which was an early start.

Rains have ceased generally by 14th August and 5th January for SW and NE rainy seasons, respectively. For the year under review SW rains ceased by 21st July while NE rains ceased by 14th January. The 1st rain spell lasted for136 days, which is closer to the median, 139 days. The 2nd spell exceeded the median length of 122 days and lasted for148 days.

The amount of rainfall and number of rainy days under low, moderate and high rainfall categories are listed in Table 1. Number of rainy days for the year was 209, which is less than the long-term average of 220 days. Pan evaporation during 2007 was 655.9 mm (1.8 mm/day).

Other meteorological factors

Table 2 depicts the monthly values of some important meteorological observations together with averages for 1980 to 2005. The minimum temperature dropped below 20^0C in 7 days in January, 3 days in November and 2 days in December during this year.

The lowest mean minimum temperature was observed in the month of January. The highest mean maximum temperature of 34^0C was observed in March. The average morning RH was in the range of 86 to 94%. The monthly values of soil temperatures at 4 different depths are given in Table 3.

Table 1. *Monthly variation of rainfall and rainy days at Dartonfield in 2007*

Month	Total rainfall (mm)	Average** (mm)	No of rainy days *	Avg.** days	No. of days under each category			Evaporation (mm)
					0.3-2.5 (mm)	2.6-50 (mm)	>50 (mm)	
January	139.9	(156)	08	(11)	2	5	1	28.7
February	39.6	(114)	03	(09)	-	3	-	67.1
March	128.1	(222)	08	(13)	2	6	-	72.2
April	623.6	(415)	26	(18)	6	16	4	29.8
May	804.3	(584)	18	(24)	3	10	5	63.5
June	393.4	(398)	20	(23)	6	11	3	57.9
July	231.3	(313)	19	(22)	4	14	1	60.2
August	387.4	(268)	24	(20)	6	17	1	60.8
September	477.2	(436)	25	(22)	3	20	2	58.0
October	617.5	(513)	27	(23)	4	20	3	40.9
November	227.7	(387)	17	(20)	2	15	-	64.1
December	149.6	(266)	14	(15)	4	10	-	52.7
Total	4219.6	(4072.0)	209	(220)	42	147	20	655.9

* A rainy day is defined as a day with a rainfall ≤0.3-mm
** Average values for 1980-2005 are shown in parentheses

Table 2. *Variation of observed meteorological factors at Dartonfield – 2007*

Month	(Latitude 6° 32' N; Longitude 80°. 09' E Altitude 65.50mm)								
	Temperature (°C)				Sun shine hours	Relative humidity (%)			Wind speed mean ($kmhr^{-1}$)
	Mean Max	Mean Min	Mean	No. of days Min Temp <20°C		8.30am	No. of days 8.30am >90%	3.30pm	
January	33.0	21.2	27.1 (26.7)	07	5.9	88 (88)	15	62 (68)	1.20
February	33.6	21.6	27.6 (27.1)	-	7.3	86 (86)	12	59 (65)	1.90
March	34.0	22.4	28.2 (27.6)	-	7.3	87 (85)	09	63 (68)	1.40
April	32.7	23.3	28.0 (27.8)	-	4.9	93 (85)	23	79 (75)	1.10
May	31.7	24.0	27.8 (27.6)	-	5.5	92 (88)	22	73 (77)	1.90
June	31.4	23.9	27.6 (26.9)	-	3.7	94 (88)	24	76 (74)	1.90
July	31.0	23.4	27.2 (26.9)	-	5.0	92 (89)	22	74 (75)	2.20
August	30.7	23.2	26.9 (26.6)	-	4.8	92 (88)	22	74 (74)	1.90
September	31.2	23.3	27.3 (26.7)	-	4.5	91 (88)	18	76 (75)	1.70
October	30.4	22.6	26.5 (26.6)	-	3.8	92 (86)	23	79 (77)	1.40
November	33.1	21.9	27.5 (26.6)	03	5.8	86 (85)	06	74 (77)	1.3
December	32.6	22.1	27.3 (26.7)	02	4.8	89 (85)	16	73 (73)	1.30

** Average values for 1980-2005 are shown in parentheses

Table 3. *Soil temperatures recorded at different depths at Dartonfield - 2007*

Month	Temperature (C°) at 08.30 hrs				Temperature (C°) at 3.30 hrs			
	5cm	10cm	20cm	30cm	5cm	10cm	20cm	30cm
January	26.5	25.9	27.1	27.9	33.9	32.4	30.2	28.9
February	28.2	27.8	29.1	30.1	36.9	34.7	32.5	30.6
March	28.8	28.3	29.4	30.3	36.3	34.5	32.9	31.4
April	28.2	27.4	28.5	29.4	33.5	31.9	30.7	29.7
May	28.2	27.4	28.0	29.0	35.9	33.3	30.9	29.6
June	27.8	27.1	28.1	29.0	33.4	31.7	30.3	29.5
July	27.9	27.2	28.1	28.9	33.0	31.4	30.1	29.3
August	27.8	27.2	28.0	28.8	31.9	30.6	29.5	29.1
September	28.0	26.5	27.1	28.0	33.8	31.6	29.8	28.6
October	27.3	26.1	26.7	27.7	32.2	30.3	29.0	28.4
November	28.4	26.4	27.4	28.4	34.2	32.4	30.7	29.2
December	27.3	26.3	27.2	28.0	33.4	31.5	29.9	28.9

LIST OF PUBLICATIONS

Scientific Journals
(Bold type – Rubber Research Institute of Sri Lanka employees)

Griffiths, P.C., Paul, A., Fallis, I., **Wellappili, C.,** Murphy, D.M, Jenkins, R., Waters, S.J, **Nilmini, R,** Heenan, R.K. and King, S.M. (2007). Derivatizing weak polyelectrolytes - solution properties, self-aggregation and association with anionic surfaces of hydrophobically modified poly (ethylene imine). *Journal Coll. Interface Science* **314**, 460-469.

Jayasuriya, K.E. and **Thennakoon, B.I.** (2007). Biological control of *Rigidoporus microporus,* the cause of white root disease in rubber. *Ceylon Journal of Science (Biological Sciences)* **36** (1), 9-16.

Jayasuriya, K.E. and **Thennakoon, B.I.** (2007). First report of *Corynespora cassiicola* on *Codiaeum variegatum* (croton) in Sri Lanka. *Ceylon Journal of Science (Biological Sciences)* **36** (2), 139-142.

Jayasuriya, K.E., Wijesundera, R.L.C. and **Thennakoon, B.I.** (2007). Effect of rubber petiole cell walls and virulence of strains on secretion of pectic enzymes by *Phytophthora meadii. Ceylon Journal of Science (Biological Sciences)* **36** (2), 109-115.

Kudaligama, K.V.V.S., Thurul, W.M. and Yapa, P.A.J. (2007). Possibility of treating rubber factory wastewater in biological reactors using media with low specific surface area. *Journal of the Rubber Research Institute of Sri Lanka* **88**, 22-29.

Nayanakantha, N.M.C. and **Seneviratne, P.** (2007). Tissue culture of rubber: past, present and future prospects. *Ceylon Journal of Science (Biological Sciences)* **36** (2), 117-126.

Pathiratna, L.S.S., Perera, M.K.P. and Balasooriya, C.K. (2007). Cinnamon (*Cinnamomum verum* J. Pres) intercropped under different inter row spacings of rubber (*Hevea brasiliensis* Muell. Arg.): performance after rubber reached maturity. *Journal of Rubber Research Institute of Sri Lanka* **88,** 30-46.

Pathiratne, L.S.S., Wijesuriya, W. and **Seneviratne, P.** (2007). Comparison of yields between budgrafts and mother trees in *Hevea brasiliensis* Muell. Arg. *Journal of the Rubber Research Institute of Sri Lanka* **88,** 47-58.

Rodrigo, V.H.L. (2007). Ecophysiological factors underpinning productivity of *Hevea brasiliensis. Brazilian Journal of Plant Physiology* **19** (4), 245-255.

Rodrigo, V.H.L. (2007). Adoption of different tapping systems in the rubber industry of Sri Lanka with special reference to low frequency tapping. *Journal of the Rubber Research Institute of Sri Lanka* **88**, 1-21.

Senevirathna, A.M.W.K., Wilbert, S., Perera, S.A.P.S. and Wijesinghe, A.K.H.S. (2007). Can tapping panel dryness of rubber (*Hevea brasiliensis*) be minimised at field level with better management? *Journal of the Rubber Research Institute of Sri Lanka* **88**, 77-87.

Wijesuriya, W., Dissanayake, D.M.A.P., Herath, K., Edirisinghe, J. and **Abeywardena, V.** (2007). Some issues related to sustainability in the smallholder rubber sector: a case study of three major rubber growing districts. *Journal of the Rubber Research Institute of Sri Lanka* **88**, 59-76.

Wijesuriya, W., Dissanayake, D.M.A.P., Herath, K., Edirisinghe, J., Wijeratne, M. and **Abeywardene, V.** (2006). Possible causes of low rubber yields in smallholder units in Sri Lanka. *Natural Rubber Research* **19** (1&2), 25-37.

Wijesuriya, W., Thattil, R.O. and Samita, S. (2007). Indices for measuring performance of smallholder rubber units. *Journal of National Science Foundation* **35**(2), 71-79.

Books/Theses

Dharmakeerthi, R.S., Indraratne, S.P. and Kumaragamage, D. (2007). *Manual of Soil sampling and analysis*. Soil Science Society of Sri Lanka, Peradeniya, Sri Lanka.

Nayanakantha, N.M.C. (2007). Development of an efficient micropropagation protocol for *Aloe vera* and molecular typing of *Aloe* accessions using RAPD analysis. *MSc Thesis*. G.B. Pant University of Agriculture and Technology, Pantnagar, India.

Bulletin/Conferences/Seminars/Workshops/Reports

දසනායක, ඩී.ඩී. (2007). සංවර්ධනය, රබර් කර්මාන්ත ක්ෂේත්‍රය සහ පරිසරය. *රබර් ලුවන්* **25**, 61-69.

ධර්මකීර්ති, ආර්.එස්., වදිරිමාන්න, වී.ඉ. සහ චන්ද්‍රසිරි, ජේ.ඒ.එස්. (2007). සාර්වක ලපටි බද්ධ පැල තවානක් සඳහා නිවැරදිව පොහොර යොදමු. *රබර් ලුවන්* **25**, 35-40.

Edirisinghe, D.G., Clarke, J. and Freakley, P.K. (2007). Effect of internal mixer rotor speed and initial mixing temperature of nitrile rubber on the morphology and properties of natural rubber/nitrile rubber/carbon black composites. *International Rubber Conference,* 16 – 18 October 2007, Cleveland, Ohio, USA.

Jayasinghe, C.K. (2007). Disease scenario of the rubber tree: History and current status. 465-473. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Jayasinghe, C.K. (2007). *Plant protection research in the new millennium: Literature guide to maladies of the rubber tree.* International Rubber Research and Development Board, Kuala Lumpur, Malaysia 2007, p.121 (ISBN 978-955-9022-0404).

Jayasinghe, C.K. (2007). *Searchable CD-ROM on plant protection research in the new millennium.* International Rubber Research and Development Board, Kuala Lumpur, Malaysia. 2007.

Jayasinghe, C.K. (2007). Changing scene of the disease scenario of the rubber tree. *Proceedings of the International Rubber Conference and Exhibition* 13th to 15th June 2007, Bali, Indonesia.

Jayasinghe, C.K. (2007). Breeding clones for *Corynespora* resistant and progress made with the IRRDB germplasm collection. *IRRDB Plant Pathology and Plant Breeding Conference* Bali, Indonesia, 11th – 12th June 2007.

Jayasuriya, K.E. (2007). An integrated method for the management of white root disease in rubber plantation in Sri Lanka. pp.446. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia. (Abstract)

Jayasuriya, M.M., Hourston, D.J., **Samarakoon, A., Yapa, S.** and Liyanage, R. (2007). The effect of epoxidised natural rubber content on the physical properties of the NR/ENR blends. pp.603. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Jayasuriya, M.M., Krishantha, D. and **Yapa, S.** (2007). The effect of accelerator combination of the curing system on the physical properties of the natural rubber and ethylene propylene diene monomer rubber blends. pp.604. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Krishantha, G.D.D., Kulathunge, S.S., **Perera, G.M.P.**, Karunanayake, L. and **Siriwardena, S.** (2007). Modification of NR/EPDM/carbon black composites by co-vulcanization using high energy γ-Irradiation: effect of sensitizers. *International Conference focusing on Chemistry and its contribution to the Economy, Environment and Social well-being, CHEMTECH 2007*, Institute of Chemistry, Ceylon, 21st to 23rd June, BMICH, Colombo, Sri Lanka.

Kudaligama, K.V.V.S. and Yapa, P.A.J. (2007). Wastewater treatment in rubber industry with special emphasis on anaerobic systems. *Bulletin of Rubber Research Institute of Sri Lanka* **48,** 49-54.

Kudaligama, K.V.V.S., Thurul, W. M. and Yapa, P.A.J. (2007). Coir: a versatile raw material to produce stationary media for biological wastewater treatment systems. *Bulletin of Rubber Research Institute of Sri Lanka* **48**, 55-60.

Liyanage, K.K. (2007). *Hevea* germplasm and its potential. *Bulletin of the Rubber Research Institute of Sri Lanka* **48,** 16-26.

Munasinghe, E.S., Gunawardena, U.A.D.P. and **Rodrigo, V.H.L.** (2007). Estimation of economic value of rubber plantations: prospects for global carbon markets. *Proceedings of the Twelfth International Forestry and Environmental Symposium 2007 of the Department of Forestry and Environmental Science,* University of Sri Jayawardenapura, Sri Lanka, 56.

Munasinghe, P.K.R.C.E. and **Senevirtna, P.** (2006). Assessment of the condition of rubber nurseries and factors associated with the quality of plants and the productivity of rubber nurseries. *Proceedings of 6th Agricultural Research Symposium.* Wayamba University of Sri Lanka, 311-315.

Nallaperuma, N.A.A.S., **Senevirathna, W.** and Costa, W.A.J.M. (2007). Possibility of detecting high yielding rubber clones at the seedling stage based on physiological and growth parameters. *Twelfth International Forestry and Environment Symposium 2007*: Green Solutions. 30th November – 1st December 2007. Tangerine Beach Hotel, Kalutara, Sri Lanka. P. 74.

Nayanakantha, N.M.C. (2007). Alien invasive plants and their potential threat to biodiversity in rubber plantations. *Bulletin of the Rubber Research Institute of Sri Lanka* **48**, 61-66.

Nayanakantha, N.M.C. (2007). The potted physician *Aloe vera*. *Daily News*, 26th June 2007.

Nayanakantha, N.M.C. and **Seneviratne, P.** (2007). Vulnerability of *Hevea* seed production to climate change; results of an island wide survey done in Intermediate and Wet Zones of Sri Lanka. pp.230-241. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Naynakantha, N.M.C., Shukla, A., Kumar, A. and Singh, B.R. (2007). Influence of various additives on enhancing the efficiency of direct shoot organogenesis of *Aloe vera. Proceedings of the National Seminar on Molecular Approaches for Crop Improvement*, 7-8th February 2007, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, India. P.29 (Abstract).

Naynakantha, N.M.C., Singh, V.K., Marla, S.S., Kumar, A. and Singh, B.R. (2007). Development of electronic green file of plants possessing anti-diabetic properties and its use in preparation of herbal formulations. *Proceedings of the National Seminar on Molecular Approaches for Crop Improvement,* 7-8th February 2007, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, India. P.30 (Abstract).

නුගවෙල, ඒ. (2007). ඉහළ මිලෙන් රබර් ඉඩම් හිමියන් උපරිම ප්‍රතිලාභ ලබා ගන්නවාද?. *රබර් පුවත්* **25**, 41-46.

Pathiratna, L.S.S. (2007). Attributes of the bark cracking disorder in the root stock of bud grafted rubber (*Hevea*) trees. *Bulletin of the Rubber Research Institute of Sri Lanka* **48**, 32-37.

Pathiratna, L.S.S. (2007). Factors affecting bark yield components of cinnamon. *Bulletin of the Rubber Research Institute of Sri Lanka* **48**, 43-48.

Pathiratna, L.S.S., Perera, M.K.P. and Balasooriya, C.K. (2007). Wider inter row spacings for planting rubber (*Hevea*): a concept for conservation, sustainability and profitability. *Bulletin of the Rubber Research Institute of Sri Lanka* **48,** 8-15.

Perera, G.M.P, Edirisinghe, D.G. and Chinthaka, H. (2007). Mechanical Property evaluation of room temperature pre-vulcanized natural rubber latex cast films of different accelerator combination. *International Rubber Conference,* 16 -18 October 2007, Cleveland, Ohio, USA,

පෙරේරා, පී. සහ **එදිරිසිංහ, ඩී.** (2007). රබර් කිරි ආශ්‍රිත නිෂ්පාදන. *රබර් පුවත්* **25**, 19-27.

පෙරේරා, එම්.කේ.පී. සහ බාලසූරිය, සී.කේ. (2007). රබර් සමඟ කුරුඳු අස්වනු සංඝටක. *රබර් පුවත්* **25,** 32-34.

Perera, G.M.P., Edirisinghe, D.G. and Chinthaka, H. (2007). Mechanical Property evaluation of room temperature pre-vulcanized natural rubber latex cast films of different accelerator combination. *International Rubber Conference,* 16 -18 October 2007, Cleveland, Ohio, USA.

Priyantha, K.K.D., **Wellappili, C.J.,** Liyanage, S. and **Samarokoon, A.** (2007). Quality imrovements of Natural Rubber latex through introduction of aluminium hydroxide, *SLAAS,* 2007.

Ratnayake, U.N., Prasad, A.K.D.W., Siriwardena, T.A.S. and **Rohanadeepa, C.** (2007). Effect of metal ion on quality of natural rubber. pp.538. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

රත්නායක යූ. එන්. සහ **උහංඕවිට, එස්.** (2007). ස්වාභාවික රබර් සහ ප්‍රෝටීන අසාත්මිකතාව, *රබර් ප්‍රවෘත්* **25**, 7-9.

Rodrigo, V.H.L., Iqbal, S.M.M., Dharmakeerthi, R.S., Karunasekera, K.B.A. and **Nugawela, A.** (2007). Feasibility of expanding rubber (*Hevea brasiliensis* Mull. Arg.) cultivation to the Eastern Province of Sri Lanka. *Journal of the National Institute of Plantation Management* **22,** 25-36.

සරත් කුමාර පී. එච්. සහ **වර්ණජිත් ප්‍රසාද් ඒ. කේ. ඩී.** (2007). මෙට්‍රොලැක් උපකරණය භාවිතයෙන් කිරි මැනීම නිවැරදිද? *රබර් ප්‍රවෘත්* **25,** 10-18.

සරත් කුමාර පී. එච්. (2007). ක්ෂේත්‍ර රබර් කිරිවල ප්‍රමිතිය සහතික කිරීම සඳහා ගත යුතු පියවර සහ ප්‍රමිති පරීක්ෂාව. *රබර් ප්‍රවෘත්* **25**, 1-6.

සෙනෙවිරත්න, පී (2007). නව රබර් ක්ලෝන නිසි ලෙස භාවිතයෙන් ඔබේ ආදායම තුන්ගුණයකින් වැඩිකර ගතහැකියි. *රබර් ප්‍රවෘත්* **25**, 47-51.

සෙනෙවිරත්න, ඩබ්. (2007). රබර් ගාකයේ පට්ටය වියලීම අවම කරගත හැක්කේ කෙසේද? *රබර් ප්‍රවෘත්* **25**, 28-31.

Senevirathna, A.M.W.K., Seneviratne, P., Weerakoon, U.S., De Alwis, M.N., Zoysa, L., Pathirana, P.D. and Chaminda, J. (2007). Certification of planting material of rubber in Sri Lankan nurseries: process, constraints and requirements. *Bulletin of the Rubber Research Institute of Sri Lanka* **48**, 27-31.

Seneviratne, N.D., Priyanka, U.M.S., Ranjith, S.L.G., Hewage, S. and **Siriwardena, S.** (2007). A comparison of different mixing techniques in preparation of silica incorporated natural rubber field latex masterbatch. pp.599. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Seneviratne, P., De Silva, S.A., Weerakoon, U.S., De Alwis, M.N., Zoysa, L. and Jayalath, C. (2007). Clonal composition of budwood nurseries and its role on the productivity of rubber in Sri Lanka. *Bulletin of the Rubber Research Institute of Sri Lanka* **48**, 1-7.

Seneviratne, W.M.G., Perera, P., Edirisinghe, D.G. and **Seneviratne, D.** (2007). Improvement of storage stability of pre-vulcanized natural rubber latex xoncentrates for commercial applications. pp.598. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

සිරිවර්ධන, එස්. සහ **සිරිවර්ධන, එස්.** (2007). *උසස් තත්ත්වයේ දුම් ගැසූ ෂීට් රබර් නිෂ්පාදනයේදී සැලකිය යුතු කරුණු කිහිපයක්. රබර් ප්‍රවෘත්* **25**, 52-60.

Siriwardena, S. Krishantha, G.D.D., **Edirisinghe, D.G., Perera, G.M.P.** and Karunanayake, L. (2007). Modification of NR/EPDM/carbon black composites by co-vulcanization using high energy γ-radiation: effect of sensitizer concentration. *Proceedings of the International Rubber Conference.* 12-13 November 2007, Siem Reap, Cambodia.

Wellappili, C. and **Denawaka, I.** (2007). Utilization of waste natural rubber (NR) gloves for NR based products. pp.547-554. *Proceedings of the CRRI & IRRDB International Rubber Conference,* November 2007, Siem Reap, Cambodia.

Wijesuriya, W. (2007). Statistics: an essential tool for climate change assessment. *Proceedings of the 8th Annual General Meeting of Applied Statistics Association of Sri Lanka*, SLAAS, Colombo.

Withanage, S.P., Sarath Kumara, I.D.M.J. and **Kariyawasam, L.S.** (2007). The response of yields of clones RRIC 100 and RRIC 121 to the changes in the distribution and amount of rainfall. *Bulletin of the Rubber Research Institute of Sri Lanka* **48,** 38-42.