The Rubber Research Institute of Sri Lanka

Annual Review 1981

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW 1981

CONTENTS

RUBBER RESEARCH INSTITUTE OF SRI LANKA

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(As at 31st December, 1981)

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The Director of Agriculture — Dr C. R. Panabokke, Ph. D.

Representative of the Treasury — Mrs M. N. Mendis

The Rubber Controller — Mr T. P. G. N. Leelaratne

The Director, Rubber Research Institute of Sri Lanka — Dr O. S. Peries, B. Agr. Sc. (Melb), Ph. D. (Bristol), M. I. Biol (*Vice Chairman*)

Nominated Members

Member of National State Assembly under the Rubber Research Ordinance
Mr Merryl Kariyawasam

Member nominated by the Planters' Association of Ceylon
Mr H. G. R. de Mel (*Chairman*)

Members nominated by the Low-Country Products Association of Ceylon
Mr D. Jayasiri Perera
Mr Gunasoma Hettiarachchi

Member representing Smallholders under the Rubber Research Ordinance

STANDING COMMITTEES

Administrative Committee:

Mr H. G. R de Mel (*Chairman*)
Dr O. S. Peries
Mr T. P. G. N. Leelaratne
Mrs M. N. Mendis

Estate Committee:

Mr H. G. R. de Mel (*Chairman*)
Dr O. S. Peries
Mr G. Hettiarachchi
Mr Rajah Salgado
Mr R. C. Peries
Mr R. G. Siriwardene

Scientific Committee:

Mr H. G. R. de Mel (*Chairman*)
Dr O S. Peries
Mr G. Hettiarachchi
Mr D. Jayasiri Perera
Heads of Departments
Mr Douglas de Fonseka
Mr L. H. T. de Mel
Mr W. L. Bogstra
Mr D. C. Gauder
Mr A. B. Weerasekera
Mr A. H. B. Kalpage (*Representing District P.A.A.*)

Provident Fund Committee:

Mr G. Hettiarachchi (*Chairman of P. F. Committee*)
Dr O. S. Peries
Mr D. M. Fernando
Mr A. L. Ratnayake

Secretary to the Board

Mr B. S. Ratnayake

Lawyers

Attorney-General's Department
(Corporation Division)
Hulftsdorp,
Colombo 12.

Auditors

Messrs H. T. Peiris & Co.,
Chartered Accountants,
P. O. Box 499,
Colombo 6.

Bankers

Bank of Ceylon,
York Street, Colombo 1.

Peoples Bank, Matugama.

Registered Office, Laboratories

Dartonfield, Agalawatta.

Colombo Office

Consisting of:

Advisory Services Department &
Economic Research Unit,
Rubber Chemistry Department
Specifications Laboratory
Telawala Road, Ratmalana,
Mt. Lavinia.

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

(As at 31st December 1981)

Director ..... O. S. Peries, B. Ag. Sci. (Melb.), Ph. D. (Bristol), M. I. Biol.

Assistant Director ..... D. M. Fernando, B. Sc. (Cey.), M. Sc (McGill)

RESEARCH DEPARTMENTS

Plant Science

Acting Head of Department ..... Mrs A. C. I. Samaranayake, B. Sc. (Cey.), Ph. D. (Lond.)

Assistant Botanists ..... *R. C. W. M. R. A. Nugawela, B. Sc. (Cey.)
A. G. A. de Soyza, B, Sc. (Lond), M. Sc. (Lond.)

Experimental Officer ..... A. H. R. Jayaratne, B. Sc. (Cey.)

Senior Technical Officer ..... L. S. S. Pathiratne, M. I. Biol.

Technical Officers ..... Miss C. W. Ranasinghe, B. A. (Cey)
Miss G. A. S. Wijesekera
Miss N. D. K. Wickremasinghe
D. K. Angammana
L. S. Kariyawasam
K. A. G. B. Amaratunga
R. P. Karunasena

Senior Experimental Assistants ..... M. C. Perera
R. B. Gunaratne

Experimental Assistant ..... S. Wilbert

Intercropping

Head of Department ..... L. B. Chandrasekera, B. Sc. (Cey.), Dip. Ag Sci. (Cantab.)

Experimental Assistants ..... U. K. D. Lewis
W. A. T. Silva
N. L. D. Ruban

Genetics & Plant Breeding

Head of Department ..... D. M. Fernando, B. Sc. (Cey.), M. Sc. (McGill)

Geneticist & Plant Breeder ..... N. E. M. Jayasekera, B. Sc. Ag. (Cey.), Ph. D. (Birm.)

Experimental Officer	.....	P. Samaranayake
Technical Officers	.....	K. B. A. Karunasekera K. W. Rupatunga
Senior Experimental Assistant	.....	B. M. S. G. Peiris
Experimental Assistants	.....	D. S. Gamage A. K. M. S. Senaratne

Plant Pathology

Head of Department	.....	A. de S. Liyanage, B. Sc. Ag. (Cey.), Ph. D. (Lond).
Assistant Plant Pathologist	.....	C. K. Jayasinghe, B. Sc. (Cey.), M. Sc. (Cey.)
Experimental Officer	.....	Mrs N. I. S. Liyanage, B. Sc. Ag. (Cey.), M. Sc. (Cey.)
Senior Technical Officers	.....	Z. E. Irugalbandara D. M. Dantanarayana
Technical Officers	.....	Mrs J. L. P. Chandrika L. W. Amaratunga A. Dharmaratne W. A. D. D. S. Wettasinghe E. Bharath Fernando S. S. Warnapura E. A. T. Senadeera

Soils & Plant Nutrition

Head of Department	.....	N. Yogaratnam, B. Sc. Ag. (Alhabad), Ph. D. (Lond.)
Agricultural Chemist	.....	M. K. S A. Samaraweera, B. Sc. (Cey.), M. Sc. (Bristol), Ph. D. (Bristol).
Experimental Officers	.....	Miss K. A. D. S. Gunasekera, B. Sc. (Cey. W. C. Dayaratne A. M. A. Perera
Technical Officers	.....	Miss D. I. R. Denawaka Miss S. D. C. K. Maheepala Miss U. G. Dingiriamma Miss N. M. M. de Costa Miss H. V. Kumudinee T. A. C. S. Wasanthadeva J. G. de Mel S. N. Silva P. Karunadasa

Experimental Assistants	.....	W. M. Abeysinghe M. A. Mendis K. A. J. Wijenayake

Rubber Chemistry, Technology & Biochemistry

Head of Department	.....	S. W. Karunaratne, B. Sc. (Cey.), M. Sc. (Aston), A. R. I. C., A. N. C. R. T., F. P. R. I., F. I. C.
Biochemist	.....	P. A. J. Yapa, B. Sc. (Cey.), Ph. D. (Lond.)
Rubber Chemists	.....	A. Coomarasamy, B. Sc. (Cey.), Ph.D. (Aston) W. S. E. Fernando, B. Sc. (Cey.), M. Sc. (Aston), Ph. D. (Aston)
Rubber Chemist/Specification Officer	.....	L. M. K. Tillekeratne, B. Sc. (Cey.), M. Sc. (Aston), Ph. D. (Aston)
Assistant Rubber Chemist	.....	M. C. S. Perera, B. Sc. (Cey.), M. Sc. (Cey.)
Assistant Development Officer	.....	M. D. R. J. Gunatilleke, B. Sc. (Cey.)
Assistant Specification Officer	.....	P. A. D. T. Vimalasiri, B. Sc. (Cey.)
Research Assistant	.....	L. B. K. Silva, B. Sc. (Cey.), LPRI
Experimental Officers	.....	Miss C. P. Wickremasinghe, B. Sc. (Cey.) P. W. Sedirishamy, B. Sc. (Cey.) K. C. Croose, B. Sc. (Cey.) P. P. Jayasinghe, LPRI
Senior Technical Officers	.....	A. S. Dekumpitiya D. D. Medagama S. Kasinathan, M. I. Biol., A. I. Chem.
Technical Officers	.....	Mrs N. A. Baduge, B. A. (Cey.) Mrs H. S. Weeraman Mrs D. Nirmala Mrs M. M. Nilaweera Miss R. L. Perera Miss W. C. M. Perera Miss M. K. Wickremapala W. D. Dharmasena I. H. S. L. Weerasinghe *K. A. R. M. Perera, B. Sc. (Cey.) K. M. U. Mitranande D. G. Samaneris P. H. Sarath Kumara

Specification Assistants (Special Grade)	.....	T. M. Ahamadeen W. A. S. Wijesekera
Specification Assistants	.....	Mrs M. D. K. Gunawardena K. B. Abeysundera G. Wanigatunga T. A. S. Siriwardena R. Wickremaratne P. D. J. Rodrigo K. K. Austin
Clerk/Typist	.....	Miss M. D. I. Premawathie

Statistical Section

Assistant Statistician	.....	*W. N. Wickramasinghe, B. Sc. (Cey.)
Technical Officers	.....	Miss J. D. Nandanie L. T. Peiris R. A. P. Abhayapala

Advisory Services Department & Economic Research Unit including Smallholder Rubber Rehabilitation Project

Head of Department	.....	A. B. Dissanayake. B. Sc. Ag. (Cey.) B. A. (Cey.), M. Sc. (Cey)
Deputy Head of Department	.....	R. P. M. de Zoysa, B. Sc. (Cey.) M. Sc. (Oregon)
Assistant Accountant	.....	A. C. Swaris
Regional Advisory Officers	.....	A. Dahanayake, B. Sc. Ag. (Cey.) A. J. L. de Silva A. S. Widanapathirana, B. Sc. Ag. (Cey.) M. Sc. (Cey.)
Supplies Officer	.....	P. Samarasinghe
Training Officer	.....	I. N. Samarappuli, B. Sc. Ag. (Cey.)
Assistant Training Officer	.....	P. P. S. Perera

Divisional Rubber Extension Officers ..... H. A. D. Ariyaratne
K. I. Ariyaratne
W. S. Dassanayake
A. Sooriyaarachchi
T. B. Herath
R. P. D. J. Wijewardene
M. C. Samarasekera
W. A. S. Wijesekera
M. P. V. P. S. Perera
U. S. Wijepala
H. R. Dias
N. C. Katukurunda
D. D. Dassanayake
W. E. W. de Mel

Rubber Extension Officers ..... K. A. S. Abeygunawardene
D. L. Abeysinghe
U. S. B. Alagoda
B. S. Ananda
C. S. V. O. Anthony
M. Athauda
S. D. Athukorale
R. L. R. U. S. Bandara
P. W. David
K. G. Dayananda
K. W. N. Dayananda
P. A. A. Dharmakeerthi
K D. Dharmasena
P. H. Diyasena
H. A. V. V. S. Eratne
E. A. F. S. Fernando
D. G. L. Gunapala
M. G. N. Gunaratne
W. W. Gunasekera
U. D. V. Gunasinghe
R. K. Gunatilleke
G. Gunawardene
S. A. Gunawardene
S. T. R. J. Gunawardene

Rubber Extension Officers (Contd.) ..... H. K. J. S. B. Heendeniya
D. Hettiarachchi
S. D. Hidellarachchi
D. P. P. Jayakody
T. W. Jayalath
G. K. A. Jayasena
H. H. Jayasinghe
A. K. Jayatissa
L. S. Kasturiratne
N. D. Karunaratne
D. Karunasekera
I. Kiridena
I. P. L. Kithsiri
K. S. Kodikara
D. D. Kotalawela
E. N. Liyanage
T. P Liyanage, B. A. (Cey.)
D. M. Mahindapala
M. T. S. Mendis
W D. T. C. Muniratne
K. V. Nandana Kumara
H. H. Nawagamuwa
D. Palihakkara
Mrs G. N. P. Perera, B. A. (Cey.)
J. A. J. Perera
U. L. C. Perera
U. L. R. A. Perera
D. Podimahatmaya
A. W. Premasiri
S. A. Prematillke
R. W. U. Rajapakse
S C. Rajasinghe
R. W. B. Ranasinghe
R. A. S. K. Ranatunga
R. A. D. Ranawaka
G. Ranwalage
G. S. Ratnayake
J. S. Ratnayake
W. D. D. Rupasinghe
L. L. A. Samarawickrema
S. R. R. B. Senanayake
S. Senawickrema

Rubber Extension Officers (Contd.)	.....	M. R. J. Silva
		S. B. S. Silva
		S. H. B. L. de Silva
		M. Sirisena
		W. C. Siriwardene
		J. Sumanasekera
		H. G. Susil
		W. J. H. Swaris
		H. A. Tillekeratne
		O. M. W. Tillekeratne
		N. G. Yasaratne
		S. S. Waidyakularatne
		S. Weerakoon
		C. Wickrematilleke
		W. M. D. Wijesundera
Senior Processing Advisers	.....	K. Ekanayake
		K. S. Peries, B. A. (Cey.)
Processing Advisers	.....	A. Kalubowilage, B. A. (Cey.)
		K. D. Chandradasa, B. A. (Cey.)
		B. A. D. A. S. Balachandra, B.A. (Cey.)
		P. W. Karunaratne, B. A. (Cey.)
		D. P. K. Gamage, B A (Cey.)
		S Kodikara
		W. A Lionel
Rubber Extension Assistants	.....	P. K. Withana
		U. S. Weerakone
		T. M. P. K. Illangasuriya
		K. M K. A. Samarajeewa
		P. A. Pathmasiri
		K. G. Ranasinghe
		U. M. T. Kularatne
		H. S. S. Jayasinghe
		S. A J Seneviratne
		W H. V. Fernando
		I. Karunadasa
		W. D. Chandrasiri
		A. W. Gunasekera

Cine Film Operator cum Driver	.....	L. Subasinghe
Clerk/Typists	.....	Mrs W. P. M. M. G. Fernando
		Miss S. A. P. Rupanandanie
		Miss P. C. Rodrigo
		Miss K. D. Chandrawathie

Administration Department

Chief Administrative Officer & Secretary to the Board	.....	B. S. Ratnayake, B. A. (Cey.)
Assistant Administrative Officer	.....	Vacant
Office Assistant	.....	T. H. Wijesena
Asst. Medical Practitioner	.....	M. C. Peiris
Personal Assistant to the Director	.....	Vacant
Chief Clerk	.....	W. D. Jayawansa
Clerks (Special Grade)	.....	J. D. Gunaratne
		Mrs D. F. Thambawita
Confidential Clerk/Stenographer		P. H. Seneviratne
Translator/Clerk	.....	D. U. Kannangara
Clerk/Typists	.....	R. G. D. Sakaraja
		Mrs R. S. Amarasekera
		Mrs W. Paul
		Mrs W. S. P. Amarasekera
		Mrs V. Jayasundera
		Miss I. Jayasekera
		G. D. A. S. Abayaratne
		Miss K. A. J. Malkanthie

Internal Audit Unit

Internal Auditor	.....	E. P. D. Roberts, FCBI (Lond.)
Internal Audit Assistant	.....	N. C. de Silva

Administration Unit-Colombo Office

Administrative Officer	.....	W. J. P. Dias, B. Sc. (Cey.)
Office Assistant	.....	A. L. Gunawardena
Chief Clerk	.....	R. E. Perera
Clerk/Typists	.....	Mrs M. A. P. P. Seneviratne
		Mrs I. Swaris
		Mrs H. B. Perera
		Mrs S. A. Paranawithana

Clerk (Accounts)	.....	Mrs L. J. C. Perera
Clerk/Translator	.....	I. L. Sirisena
Artist Clerk	.....	M. J. P. Lusena
Graduate Assistants	.....	B D. Cyril, B. A. (Cey.) Mrs S. Jayasena, B. A. (Cey.) Mrs Y. Sudasinghe, B. A. (Cey.) Mrs J. N. de Silva, B. A. (Cey.) Mrs L. Wijesuriya, B. A. (Cey.)
Telephone Operator/Receptionist	.....	P. Lakshman Perera

Library

Library Assistant & Assistant Publications Officers	.....	Miss L. I T. Ramanaden A. L. A. (Cey.) Mrs V. S. Jayaratne, B. A. (Cey.) D. L. S. (Univ. Kelaniya)
Library Clerk	.....	D. C. Thambawita
Clerk/Typist	.....	Mrs D. T. Dantanarayana

Works Section

Works Superintendent	.....	Vacant
Mechanical Foreman	.....	M. M. Anderson
Transport Assistant	.....	B. D. Ponnamperuma
Clerk (Special Grade)	.....	D. D. D. Adikaram
Clerk/Typists	.....	N. Jayasekera Miss M. Gunawathie Silva
Mechanical Superviser (Workshop)	.....	W. D. Dharmawardena
Building Superviser	.....	K. K. A. S. Kannangara
Electrical Superviser	.....	W. D. Ratnasinghe
Mechanical Superviser	.....	S. D. Gunawardene

Accounts Department

Accountant	.....	D. P. Ashley Perera
Assistant Accountant	.....	A. K. D. Amaradasa
Foreign Order Clerk	.....	K. G. A. K. Dharmawardena
Book-Keeper	.....	K. D. D. Navaratne
Accounts Clerk	.....	A. L. Ratnayake
Storekeeper	.....	P. D. Somadasa

Clerks	.....	D. A. Rajapakse
		G. A. Kannangara
		G. S. Doolwela
Graduate Assistants	.....	Mrs G K Somasiri, B. A. (Cey.)
		Mrs K. K Jagoda, B. A. (Cey.)
Clerk/Typists	.....	W. Kularatne
		Mrs C. C. Silva
		Miss S. Irene
		Miss M. Mullevidana
		Miss M. Rajapakse
Cashier	.....	D. C. A. D. B. de Silva
Assistant Storekeepers	.....	P. L. R. A. W. Cooray
		D. C. P. Pothmitiyage

Estate Department

Estate Superintendent	.....	R. G. Siriwardene
Senior Assistant Clerk	.....	U. D. S. Perera
Checkroll Clerk/Typist	.....	A. A. Ariyaratne
Junior Asststant Clerks	.....	K. K P. Gunawardene
		K. D. Sumanasena
Field Officers	.....	N. L. D. Piyadasa
		A. K. D. Hemapala
		S. K. S. de Silva
Factory Officer	.....	D. C. C. Jayasekara
School Teacher	.....	Miss M. Kalyani
Assistant Factory Officer	.....	D. S. K. Ranaweera
Assistant Field Officers	.....	A. K. D. M. Wickremasinghe
		J. A. Wimalasena

Kuruwita Sub-station

Visiting Superintendent	.....	R. C. Peries
Assistant Estate Superintendent	.....	S. G. Fernando

* On study leave overseas

RUBBER RESEARCH INSTITUTE OF SRI LANKA

DIRECTOR'S REVIEW

By

O. S. PERIES

One of the major events of the year was the organisation and implementation of the World Bank assisted Smallholder Rubber Replanting Project (SRPP), which was carried out by the Rubber Research Institute. All sections of the staff assisted in making this project an outstanding success, so much so that the Government finally decided to operate this project during its initial 5-year period, through the Advisory Services Department (ASD) of the Institute. The World Bank had advocated the organisation of the ASD as a separate institution, with equal status as the Rubber Research Instititute, to implement the replanting project. However, wiser counsel prevailed in the end, and the Government decided to set up the ASD, as a separate organisation under the control of the Rubber Research Board. This is certainly the best solution to the problem; as it enables the links between research and extension to be preserved; so that the innovations developed by the former are rapidly implemented in the field.

GENERAL

Price: The price of natural rubber (NR) was rather disheartening during the year, compared to the unrestricted inflation throughout the world. The Sri Lankan rubber grower was one of the worst affected; as our country, for very good national reasons, has always had a fairly hard taxation system for rubber, so that the local grower gets a lower price for his rubber than his counterparts in other NR producing countries. The Government has studied this problem from time to time and provided certain measures of relief to our growers, which in the context of our country's finances, have been generous.

The major reasons for the stagnation of the rubber market are the serious financial problems that all countries have faced in the last few years which led to a slump in motor car sales and therefore of new tyres, the unprecedented conservation of fuel, particularly in the USA, and the widespread use of rebuilt tyres. These conditions are slowly correcting themselves, and rubber markets should revive during 1982-1983.

At present, the most ominous cloud that hangs over the NR scene is the price of crude oil, the basic raw material of synthetic rubber (SR). The price of crude oil has dropped dramatically from about US $ 40 per barrel to about $ 30, and somtimes to $ 28 in the spot market. If crude oil prices fall further, the competitive position of SR will be strengthened, so that the conditions that prevailed in the early 1970's can occur again, where SR can give NR a really hard time. However, the world is a smaller place now, crude oil supplies are limited and all countries have to learn to co-exist, with mutual help and an awareness of one another's problems. The developed countries must accept that oil is a non-renewable resource and must be conserved. On the other hand NR is a renewable resource and millions of people in the lesser developed countries depend for their very existence on this crop. Therefore, a proper assessment and use of NR is essential for a balanced development of the world.

LABORATORIES AND BUILDINGS

The extension to the laboratories of the Soils and Plant Nutrition Department was completed during the year and the staff of the Department moved into the new premises, leaving their former laboratories for the expansion of the Plant Pathology Department. The third building for the Rubber Chemistry Department is nearing completion in Colombo, and it should be ready for occupation in mid-1982. This will provide sufficient laboratory space for all Departments for the next 10 years at least, except for the Plant Science Department. New buildings are planned for this Department and work will commence, when the present restriction on capital expenditure is rescinded.

Two new creches were built for the estate with UNICEF assistance and a building with sufficient land was provided to the Department of Education to open a suitable school for children resident on the estate. This will assist the parents of those children to a great extent.

Housing for the staff continues to be a constraint: although conversion of the old school into a chummery for ladies, provided some relief during the year. The Rubber Research Board is actively studying this problem and will give priority to it, as soon as funds are available for the purpose.

SELECTED RESEARCH ACTIVITIES

Research students: There were twelve research students, working full time at the Institute, in the various Departments, for higher degrees during the year. All of them were National Science Council scholars or were assisted by the Rubber Research Board, in its scheme of training graduates to carry out research work.

Plant Breeding: Growth and yield of RRIC 103 have been good both in the traditional rubber growing areas such as Kalutara, Kegalla and Ratnapura and in marginal areas such as Bibile, Matale and Moneragala. Therefore, the two outstanding clones for planting in all districts at present are RRIC 100 and RRIC 103. The South American Leaf Blight resistant clone, RRIC 121, has given satisfactory yields; but is not yet ready for large-scale planting.

Plant Science: Experiments have shown that puncture tapping gives relatively low yields in most clones, when compared to the conventional systems. Therefore, these systems are not advocated in Sri Lanka at present, until further experiments are carried out to see whether any such system can be developed which will give high yields together with greater tapping facility.

Stock-scion experiments have indicated that there is specific combining ability between certain rootstocks and scions. Studies on this subject will be expanded to find the most suitable combination of rootstocks for the outstanding clones bred locally, so as to obtain optimum yields.

Intercropping: Field trials and smallholder demonstration plots have shown that banana and passion fruit are very profitable intercrops for young rubber plantations. Passion fruit has given high yields in the Kalutara District proving to be very profitable wherever marketing facilities are available. The only drawback in this crop is that the initial outlay, for posts and wire for training the creepers, is rather expensive. Pine-apple is also a good intercrop for rubber, but should be grown only in flat terrain.

Plant Pathology: White root disease continued to be the most serious disease of rubber trees in Sri Lanka. Cumulative loss of trees within 6 months ranged from 3·6-20·4% under natural conditions. The treatment of freshly cut surfaces of stumps with 2,4, 5-T in diesel helped to increase the rate of decay. Application of sulphur to the soil, after careful removal of infected roots, resulted in lower disease incidence. Sulphur reduces soil pH and encourages the growth of *Trichoderma* spp and *Penicillium* spp, which are antagonistic to the white root disease fungus.

The two species of *Phytophthora, meadii* and *palmivora,* can be easily distingnished from each other on the basis of pedical characteristics, sporangial and sporophore morphology together with chlamydospore frequency, size and colour. Another diagnostic character is the difference in the chromosome number between the two species.

Soils & Plant Nutrition: Significant positive interactions were seen in regard to NK and PK indicating that the effects of N and P were greater in the presence of K. In some experiments, significant interactions between clones and their nitrogen requirements were observed, suggesting that the nitrogen requirements of some of the more vigorous clones like RRIC 100, 101, and 103 can be higher than that of PB 86.

Urea was found to be as effective as ammonium sulphate as a source of nitrogen for rubber, provided that the fertilizer was forked into the soil. Urea is now recommended for all rubber plantations and Sri Lanka is the first country to switch over to the exclusive use of urea, as a source of N for a plantation crop, anywhere in the world.

Rubber Chemistry: The role of nitro- and nitroso- compounds in polymers, during the action of UV light is discussed in the light of research carried out on liquid rubber manufacture and a possible mechanism is suggested in this Review. A new route to bond non-staining antioxidants to NR has been suggested and the products are being evaluated.

The role of milling and the use of peptisers in the reduction of viscosity of rubber is discussed at length and trial lots of CV/RSS and CV/crepe were prepared for evaluation. Skim rubber was used to prepare low viscosity rubber by the same method.

Latex/bitumen and latex/cement compositions were used widely in the waterproofing of concrete roofs and the departmental staff provided the technical advice to several establishments having water seepage problems in concrete roofs.

Education: Messrs N. R. de Silva of the Department of Minerology and V. Abeywardene, Visiting Biometrician, conducted a course of lectures on statistics for research workers. These were well attended and much appreciated by the members of the staff. Our thanks are due to the course supervisors.

STAFF

The Director, the Heads of Departments and all Senior and Intermediate Staff Officers were on duty throughout the year, except where reference is made below.

Dr. O. S. Peries, Director, was away for 1 month in Thailand on a FAO/UNDP assignment to assist the Rubber Research Centre, Thailand, to reorganise its research studies.

Mr. D. M. Fernando, Assistant Director, was on no-pay leave from 30th December working in Mexico as Advisor to the National Institute for Agricultural Research, Mexico.

Mr. A. B. Dissanayake, Head of Advisory Services Department, participated in a Seminar on Aspects of Replanting of Rubber in Thailand from 6 September to 13 September. Mr. Dissanayake also participated in the Second Educational Visit of the Smallholder Rubber Rehabilitation Programme in Malaysia, Thailand and Indonesia from 1 December to 21 December.

Dr. A. Coomarasamy, Rubber Chemist, attended a UNIDO Symposium on Rubber Research in Thailand from 11 - 15 May.

Dr. N. Yogaratnam, Head of Soils and Plant Nutrition Department, attended an Inter-regional Training Course in Austria from 6 April to 5 June.

Dr. L. M. K. Tillekeratne, Rubber Chemist/Specification Officer, who won the 1980/81 Nuffield Foundation Fellowship and carried out Post Doctoral Studies at the University of Aston in Birmingham, returned to the Island in October.

Dr. M. K. S. A. Samaraweera, Agricultural Chemist attended an Inter-regional Training Course on the Use of N^{15} in Soil Science and Plant Nutrition in GDR from 18 May to 12 June. Dr. Samaraweera also attended a FAO/IAEA Consultants Meeting held in Austria from 9 - 13 November.

Mr. W. N. Wickremasinghe, Assistant Statistician, is following a study course in Biometrics leading to the Master's Degree at the Iowa State University, United States of America, commencing 11 August.

Mr. R. C. W. M. R. A. Nugawela, Asst. Botanist, is following a study course leading to the Degree of MSc in Plant Science at Wye College, Ashford, Kent, United Kingdom, from 24 August.

Mr. K. A. R. M. Perera, Technical Officer, is following a Practical Training Course in Rubber Technology at the International Technical Centre for Rubber and Plastics, United Kingdom, from 12 October.

Mr. A. Dharmaratne, Technical Officer, who followed a training course in Fungal Identification at the Rothamstead Experimental Station, Harpenden, Herts, England, from 23 March returned to the Island on 12 December.

The salaried staff of the Institute at the end of the year (1981) was as follows:

Officers in Grades I – VI	36
Officers in Grades VII – XV	265
Officers in Grades XVI – XIX	139
Total	440

Director's Publications:- The following publications were prepared by the Director with the assistance of the Staff members named, for publication during the year:

Peries, O. S. (1981). The management of leaf diseases of *Hevea*. *JI. Nat. Inst. of Pl. Man. 1*, 28–37.

Peries, O. S. (1981). Strategies for development. *Presidential Address to the Sri Lanka Association for the Advancement of Science 1981.*

Peries, O. S. (1980). The rubber replanting scheme of Thailand, its success story. *Rubber Puwath* **8**, 1–6 (in Sinhala)

Liyanage, N. I S., Peries O. S., Liyanage, A. de S. and Warnapura, S. S. (1980). Studies on the spread of white root disease caused by *R. lignosus* in Sri Lanka. *J. Rub. Res. Inst. Sri Lanka* **57**, 26–36.

Liyanage, N. I. S., Peries, O. S. and Liyanage, A. de S. (1980). The role of the basidiospore of *R. lignosus* in the spread of white root disease of *Hevea*. *J. Rubb. Res. Inst. Sri Lanka*. **57**, 37-40.

Abstracts

Peries, O. S. and Liyanage, N. I. S. (1981). Changes in the mycoflora in sulphur amended soils and its effects on antagonism to *R. lignosus*. Proceedings of the 37th Annual Sessions of the SLAAS December 1981, Part 1, p. 25.

Director's Duties: Apart from his day to day research and administrative duties, O. S. Peries served on the following bodies during the year.

General President, Sri Lanka Association for the Advancement of Science.

President of the Institute of Biology, Sri Lanka.

Member of the National Science Council.

Member of the Rubber Research Board.

Member of the Board of Governors, Ceylon Institute for Scientific and Industrial Research.

Member of the Coconut Research Board.

Member of the Board of the National Institute of Plantation Management.

Member of the Rubber Replanting Advisory Board.

Member of the Steering Committee of the Smallholder Rubber Replanting Project.

AWARDS AND PRIZES

O. S. Peries was one of the five recipients of the National Science Council Award for Scientific Achievement during the year, which is the first year the award was made. Mr. M. Nadarajah, former Head of Rubber Chemistry Department, was another of the five award winners. Thus the Rubber Research Institute was the only organisation, research or university, in which two of the staff members won this outstanding merit award in its first year of presentation. This is a significant achievement.

It is a pleasure to record here that Dr. L. M. K. Tillekeratne, Rubber Chemist/ Specifications Officer, won the prestigious Nuffield Foundation Post Doctoral Research Scholarship for 1980/81 and returned to the Island in October 1981, after a successful year of research at the University of Aston in Birmingham.

We are also happy to record that Mrs. Karnika de Silva, a post graduate research student working at the Institute, won a Commonwealth Scholarship for 1980/81. Mrs de Silva was a pass degree graduate and competed with others who had 1st and 2nd class Special Honours degrees; therefore, obviously her work at the RRI had played a major role in her winning one of these coveted awards, and we are justly proud of this achievement.

VISITORS

Visitors to the Institute included:

Dr. V. C. Runeckless, Dept. of Plant Science, University of British Columbia, Canada.

Dr. David Hildebrand, Dept. of Agronomy, University of Illinois, U. S. A.

Prof. Richard Evans Schuttes, Botanical Museum, Haward Univ., Cambridge.

Dr. Gullerrno Hernandex - Bravo, India. S. A. R. H., Mexico, I. D. F.

Dr. P. K. Gopalakrishnan, Kerala.

Mr. Luis Cesar Loper Frias, Merida, Yucatan, Mexico.

Mr. & Mrs. George A. McBride, Washington D. C.

Mr. & Mrs. Ronald Raymond, 14681, Country Line Road, Chagrin Falls, Ohio, U. S. A.

Dr. Michael J. Hartley, Bangkok, Thailand.

Prof. A. Pinazzi, University of LE MANS, France.

Mr. K. Ramamoorthi, Sandoz (India) Ltd., Coimbatoor, India.

Mr. A. Doll, St. Martin Street, 23, 8939 Ettringen, West - Germany.

Mr. W. Gehensel, Tirobruey, 8939, West Germany.

Dr. E. L. Bassam, Federal Republic of Germany.

Prof. A. Koroor, University of Paris (VII).

Mr. F. A. Maipillyanddy, 9/2, King William St. Fitzroy, Vie. Australia.

Dr. Hans Beller, West Germany.

Dr. George W. Robertson, Ottawa, Canda.

Mr. Chokchai Anekachai, Rubber Research Centre, Hat Yai, Thailand.

Mr. Sompong Sookmark, Rubber Research Centre, Hat Yai, Thailand.

Mr. Charoen Siri - Udompas, Rubber Research Centre, Hat Yai, Thailand.

Dr. Paulo Goncalves, RRI Brasil, Brazil.

Mr. Roger Rowe, World Bank, Washington, D. C, U. S. A.

Dr. H. Schrott, H. Shieditc, University of Giessen, West Germany.

Mr. Elaine Mika, Geneva, Switzerland.

Mr. Steve Newman, Open University, England.

REVIEW OF THE PLANT SCIENCE DEPARTMENT

By

CHANDRA SAMARANAYAKE

SUMMARY

Tapping experiments with puncture tapping systems revealed that the yields are relatively low in most clones when compared with yields from conventional tapping systems. Tapping of the unaffected bark of trees affected with brown bast continued to give economic yields.

Experiments on stock-scion relationships indicate that there is specific combining ability between certain rootstocks and scions. Stumped buddings continue to maintain about an year's growth advantage over bareroot budded stumps. Very high success in the establishment of plants in the field was achieved with plants raised in polybags.

In an experiment where the effect of different spacings and densities of plants on growth are studied, the effect of increased density on growth is shown in its fourth year from planting.

DETAILED REVIEW

Staff

Dr (Mrs) A. C. I. Samaranayake, Acting Head of the Department was on duty throughout the year. Dr U. P. de S. Waidyanatha, Botanist resigned his post on 1 May. Mr A. G. A. de Soyza, assumed duties as Assistant Botanist on 2 February. Mr A. Nugawela, Assistant Botanist left for England in September for his post graduate training at Wye College, University of London.

Miss E. M. A. I. Ekanayake, Experimental Officer resigned her post on 24 May. Mr A. H. R. Jayaratne was appointed Experimental Officer on 15 June. The Senior Technical Officer, Mr L. S. S. Pathiratne, Technical Officers, Messrs D. K. Angammana, L. S. Kariyawasam, K. A. G. B. Ameratunge, R. P. Karunasena, Miss C. W. Ranasinghe and Miss G. A. S. Wijesekera, Senior Experimental Assitants, Messrs

M.C. Perera and R. B. Gunaratne and Experimental Assistant S. Wilbert were on duty throughout the year. Mr. W. G. V. Fernando, Senior Technical Officer, retired on 10 August after serving the Institute for 34 years. Messrs I. R. M. Amerakoon and W. A. Ariyaratne, Technical Officers, resigned their posts during the year. Miss N. D. K. Wickremasinghe assumed duties as a Technical Officer in April. Mr. H. A. Sirisena, Laboratory Attendant retired from service and Mr. W. H. Seneviratne was appointed Laboratory attendant.

Research Students

Mr M. H. Mendis and Mr A. H. R. Jayaratne completed their studies for higher degrees, in the Department.

Visits

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

Meetings

Dr (Mrs) Samaranayake attended the following meetings to participate in discussions on "The use of plants grown in polybags" and "The use of Ethrel yield stimulant".

S. L. S. P. C. Planters Seminar - Ratnapura and Kalutara Region

J. E. D. B. Planters Seminar - Avissawella Region

Publications

සමරනායක චන්ද්‍රා. (1930) මුහුකුරා ගිය බද්ධ ගස් පිළියෙල කිරීම සහ සිටුවීම. රබර් පුවත් 8 (2), 7-10

සමරනායක චන්ද්‍රා. (1980) රබර් ප්‍රචාරණයේදී උපයෝගී කරගත හැකි ක්‍රම. රබර් පුවත් 8 (2), 29-37

Abstracts

Samaraweera, M. K. S. A., Samaranayake, Chandra, Kariyawasam, L. S. and de Alwis, W. U. (1981). New growth inhibitors in *Hevea* leaves. *Proceedings of the thirtyseventh Annual session of SLAAS* December, Part 1, 40

Laboratory Investigations

Tissue culture

Clonal stem tissue culture

Six different media were tested for callus initiation. Of these, Murashige and Skoog, modified (MS), Nitsch and Nitsch and Y_3 media proved to be best.

Various methods of obtaining and sterilizing tissue for culture were investigated. The use of a cork borer to obtain core of tissue free of epidermal cell layers greatly speeded up the culture process. Contamination was no greater than in the normal method where the epidermal layers were peeled off.

Callus was also initiated on liquid media. Callus initiation proved to be somewhat faster but it also became necessary to transfer to new media much sooner.

Organ culture

Bud culture was attempted but contamination proved to be a major barrier to success. Despite immersion in very strong sterilizing solutions and frequent transfers, contamination persisted. Embryo culture was successful and whole plants with root and shoots were obtained from decotylised embryos cultured on MS medium.

Embryos treated with colchicine (10% for 60 h) gave rise to plantlets with a variety of abnormalities but none survived, due to contamination, to be tested for the level of ploidy. The cuts in power supply experienced during the 2nd quarter resulted in the discontinuation of all experiments except for the maintenance of a few cultures in an incubator powered by a small generator. With the resumption of continuous power supplies multiplication of clonal stem callus cultures for experiments on morphogenesis was carried out. (A. G. A. de Soyza, Sunitha Wijesekera and Kumari Wickremasinghe)

Endogenous growth substances (GR/77/1)

Preliminary studies on the seasonal variation of growth promoters and inhibitors in *Hevea* leaves were made. Indications were that there is a seasonal variation in the levels of growth promoters and inhibitors and this has to be confirmed by quantitative assessments. (Chandra Samaranayake and L. S. Kariyawasam)

Anatomical studies (CC/77/1)

Studies on the anatomy of the leaf of 10 clones showed that the leaf thickness, thickness of the palisade layer, the number of palisade cells per 0·1 mm differ significantly among different clones. (Chandra Samaranayake and K. A. G. B. Ameratunge)

Field Experiments

Tapping

Tapping experiment, PB 86, 1963 Replantation, Nivitigalakele (T/75/3)

The purpose of this experiment is to ascertain the tappability of PB 86 on the S/2 system at intensities higher than 100% and the effect of recovery tapping (See Ann. Rev. 1979). Yield data for 1981 are summarized in Table 1.

Table 1. *Yield (kg/ha/yr) for 1981 (T/75/3)*

Tapping system	*Yield (kg/ha/yr)*	*Brown bast (%)*
S/2 d/2 100%	1566	5·7
S/2 d/1 200%	2091	17·1
S/2 2d/3 133%	1983	8·6
S/2 d/2 100%+Recovery tapping*	2636	2·9
S/2 d/2 100%+Recovery tapping**	1818	5·7
LSD (5%) =	505	

* Recovery of lost tapping days by daily tapping

** Recovery tappings spaced out so that there are no more than 6 additional tappings per month

S/2 d/2 + recovery tappings to obtain in all 180 tappings for the year have given yields higher than S/2 d/1. S/2 2d/3 133% and S/2 d/2 100% + recovery** tapping have given appreciably higher yields than S/2 d/2 100%. (A. G. A. de Soyza and S. Wilbert)

Tapping experiment, 1970 Replantation, Nivitigalakele (T/77/2)

In this experiment puncture and short cut tappings with stimulation is compared with conventional tapping systems on 8 clones. Yield data for 1981 are summarized in Table 2.

S/2 d/2 tapping has outyielded S/2 d/3 tapping in all clones. Clones RRIC 101, RRIC 100 have yielded more on S/4 d2 + E than on S/2 d/3 tapping, whereas other clones have given comparable yields. Puncture tapping yields were generally poor except for clones PR 252, AV 1734 and IRC1 2. (A. G. A. de Soyza and S. Wilbert)

Tapping experiment, 1970 Replantation, Nivitigalakele (T/77/1)

In this experiment five tapping treatments are tested on five different clones on a randomized block design. Yield data for 1981 are summarized in Table 3.

Table 2. *Yield (kg/ha/yr) and girth increment (cm) (T/77/2)*

Tapping system	*Clone*							
	RRIC 101	RRIC 100	RRIC 13	RRIC 45	PR 252	AV 1734	IRCI 2	WR 101
S/2, d/3 67%	840 (4·1)	1226 (1·6)	673 (2·2)	820 (3·4)	588 (2·2)	420 (3·9)	709 (2·5)	537 (3·4)
S/2, d/2 100%	1251 (2·7)	2021 (1·8)	994 (2·5)	1018 (3·8)	806 (2·9)	603 (3·7)	1011 (2·5)	711 (3·2)
S/4, d/2 50% E*	1108 (2·6)	1419 (2·0)	823 (2.2)	682 (4·1)	641 (3·0)	555 (3·2)	784 (2·3)	667 (4·0)
PT 1m d/3+E*	516 (3·8)	676 (2·7)	483 (2·7)	344 (4·0)	541 (3·5)	388 (4·2)	673 (3·1)	413 (5·2)
PT 1·5m d/3+E*	860 (2·8)	879 (3·0)	592 (2·7)	407 (4·7)	751 (3·4)	560 (4·7)	917 (3·8)	536 (5·1)

Yield LSD (5%) = 190 LSD (1%) = 250 LSD (0·1%) = 320

Girth increment
LSD (5%) = 0·5 LSD (1%) = 0·6 LSD (0·1%) = 0·8

E* = 5% Ethrel applied every 4–5 weeks on puncture bands (1g/metre) and every 2 months on S/4 cuts (1g/cut) girth increments are in parenthesis.

Table 3. *Yield (kg/ha/yr) for 1981 (T/77/1)*

Tapping system	*Clone*				
	RRIC 45	AV 1734	RRIC 101	WR 101	RRIC 100
2S/8 d/3+E	629	417	541	702	1395
S/4 d/3+E	568	1077	845	688	1486
PT 1m d/3+E	863	1077	745	745	1149
PT 1m + 1m d/3+E	1127	1275	1081	832	839
S/2 d/3 67%	879	719	1071	747	1934

The yields did not vary significantly with different tapping systems in clones RRIC 100 and WR 101. Puncture tapping gave higher yields than the other systems in RRIC 45 and AV 1734. Clone RRIC 101 gave comparable yields with puncture tapping and s/2 d/3. (A. G. A. de Soyza and S. Wilbert)

Tapping experiment, RRIC 101, 1969 Replantation, Eladuwa (T/78/1)

The purpose of this experiment is to ascertain suitable tapping systems for clone RRIC 101 which is high yielding, low plugging and hence sensitive to brown bast. The details of treatments and experimental design are given in Ann. Rev. 1979. The yield data for 1981 is summarized in Table 4.

Table 4. *Yield (kg/ha/yr) for various tapping systems (T/78/1)*

Tapping system	*Yield*		*Total*
	L	H	
S/2 d/3 67%	1207		1207
S/2 d/2 100%	2092		2092
S/2 d/2 (2xY/2) 100% – 53 cm H ↑		1829	1829
– do – –105 cm H ↑		1896	1896
S/2 d/2(2 x 2d/4) 100% – 53 cm H ↑	2108	1487	1798
– do – – 53 cm H ↓	2079	1431	1755
– do – –106 cm H ↑	1973	1463	1718
– do – –106 cm H ↓	1903	1436	1670
PT 1m d/3+E			2021
	LSD (5%) = 240		
	LSD (1%) = 322		
	LSD (0·1%) = 423		

L = Lower cut 53, 106 cm = Distance between L & H cuts
H = Higher cut ↑ upward tapped ↓ downward tapped

The S/2 d/2 tapping has significantly outyielded S/2 d/3 tapping. There was no advantage in tapping two panels, shifting from one to the other at each tapping or on an annual basis. The high panels have yielded significantly less than the lower panels. Puncture tapping a/1 m band on d/3 gave yields comparable to S/2 d/2 tapping. (A. G. A. de Soyza, Chandra Samaranayake and M. C. Perera)

Tapping experiment, RRIC 103, 1969 Replantation, Eladuwa (T/78/3)

The conventional tapping systems, puncture tapping, short cut tapping with stimulation and change over of panel systems were tested on clone RRIC 103. Yield data for 1981 are summarized in Table 5.

Table 5. *Yield (kg/ha/yr) for various tapping systems (T/78/3)*

Tapping system	*Yield*		*Total*
	L	*H*	
S/2 d/3 67%	1036	–	1036
S/2 d/2 100%	1536	–	1536
S/2 2d/3 133%	918	–	918
S/2 2d/3 (2x4d/6) 133% – 53 cm H ↓	951	581	804
S/2 2d/3 (2x4d/6) 133% – 106 cm H ↓	1165	698	932
PT 2m d/3 E*			1080
S/4 d/2 50%+E	1490		1496
	LSD(5%) = 221		
	(1%) = 298		
	(0·1%) = 396		

H = Higher cut L = Lower cut
↓ – Tapped downwards
E* – 5% Ethrel applied every 4 – 6 wk
E – 5% Ethrel applied on a band of scraped bark below cut

The S2/ d/2 tapping has out yielded S/2 d/3 and S/2 2d/3 tappings. There is no advantage in separating the two panels from 53 cm to 106 cm. As in the other experiments higher panels have given lower yields than lower panels. (A. G. A. de Soyza, Chandra Samaranayake and M. C. Perera)

Tapping experiment, RRIC 100, 1969 Replantation, Eladuwa (T/78/2)

The conventional tapping systems with and without change over of panels at each tapping were tested on clone RRIC 100. Yield data for 1981 are summarized in Table 6.

Table 6. *Yield (kg/ha/yr) for different tapping systems (T/78/2)*

Tapping system	*Yield*		*Total*
	L	*H*	
S/2 d/3 67%	1726	-	1726
S/2 d/2 100%	2611	-	2641
S/2 d/2 (2x2d/4) 100% - 53 cm H ↓	2638	1808	2223*
- do - - 106 cm H ↓	2583	1801	2015*
		LSD (5%) = 322	
		(1%) = 452	
		(0·1%) = 638	

H - Higher cut L - Lower cut
L - Lower cut ↓ - Tapped downwards
53 cm, 106 cm distance between the two panels.
* mean yield per cut.

S/2 d/2 tapping has outyielded S/2 d/3. Tapping of two panels alternatively gave lower yields than tapping the same panel on the d/2 frequency. There was no advantage in separating the two panels wider apart from 53 to 106 cm. The lower panels gave higher yields than the higher panels. (A. G. A. de Soyza, Chandra Samaranayake and M. C. Perera)

Tapping experiment, PB 86, 1973 Replantation, Dartonfield (T/78/4)

This experiment investigates the effect of three levels of Ethrel, 3 numbers of punctures per band of 1 m length. Two conventional tapping systems S/2 d/4 and S/2 d/2 serve as controls. Yield data for 1981 are summarized in Table 7.

Table 7. *Yield (g/t/t) for 1981 (T/ 78/4)*

Treatment	*Yield (g/t/t)*
Puncture tapping	
0·5 g/tree 5% Ethret (E_1)	20·7
1 0 g/tree 5% Ethrel (E_2)	24·3
2·0 g/tree 5% Ethrel (E_3)	28·7
5 punctures/m band/tree (P_1)	23·9
10 punctures/m band/tree (P_2)	25·4
15 punctures/m band/tree (P_3)	24·5
	LSD (5%) = 2·1

g/t/t - grammes/tree/tapping

Conventional tapping	
S/2 d/2 100%	26·46
S/2 d/4 50%	20·22

Increasing the quantity of Ethrel increased yields significantly. There was no significant increase in yield on increasing the number of punctures from 5 - 15 per 1m/band. (A. G. A. de Soyza and D. K. Angammana)

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

Fifteen clones were planted in randomized blocks with 5 replicates. Each plot accommodates 40 plants. When the plants come to maturity five tapping systems will be introduced. Girth measurements at 4 years after planting are summarized in Table 8.

Table 8. *Mean tree girth (cm) for different clones (CT/97/3)*

Clone	RRIC 100	RRIC 101	RIC 102	RRIC 103	RRIC 104	RRIC 105	RRIC 108	RRIC 109
Girth	40·5	43·0	44.6	41·0	44·4	38·6	37·3	38·0
Clone	RRIC 110	HP 24	RRIC 117	RRIC 113	RRIC 112	RRIM 600	PB 86	
Girth	41·9	42·6	39·1	40·4	42.1	37·1	37·0	

LSD (5%) = 2·51
(1%) = 3·01
(0·1%) = 4·41

The above results show that many of the RRIC clones have significantly outgrown clones PB 86 and RRIM 600. (Chandra Samaranayake and L. S. S. Pathiratne)

Brown bast studies

Tapping Brown bast trees 1961 Replantation, Dartonfield (BB/78/2)

The different treatments given in Table 9 were applied to brown bast affected trees of clones RRIC 89 and PB28/59. The yields for the last three years have shown that exploitation of unaffected bark in brown bast affected trees give economic yields. Yields for 1981 are summarized in Table 9. (A. G. A. de Soyza and D. K. Angammana)

Table 9. *Yield (g/t/t) for 1981 (BB/78/2)*

Treatment	*Yield (g/t/t)*	
	RRIC 89	PB 28/59
1. Tapping virgin bark upwards on V cuts above affected area	30·9	52·6
2. Tapping panel opposite of affected on S/2 d/2 downwards	20·3	38·8
3. Affected bark removed, Kankerdood applied and tapped as in (1)	26·2	36·8
4· Continued tapping of affected panel on S/2 d/2	9·5	21·9
5. Unaffected trees tapped S/2 d/2	22·6	32·5

Rainguards

Rainguard Experiments Eladuwa (RG/77/1) Elston (RG/79/2) and Udapolla (RG/80/3)

In all these trials there were five tapping tasks with rainguards and five as controls. Rainguarded blocks at Elston recorded 19 more tapping days for the year than the controls, with an extra crop of 388 kg dry rubber. RG/77/1/F) Eladuwa recorded 16 more tapping days for rainguarded blocks during 9 months with an extra crop of 237 kg dry rubber. (RG/80/3/F) Udapolla had recorded only 4 extra days for the year. (Chandra Samaranayake and R. P, Karunasena)

Propagation

Stock Scion Relationships

Stock-scion experiment St. George (St.sc/75/4)

In this experiment four scion clones, RRIC 45, 103, PB 86 and Wagga 6278 are budded on to seedling rootstocks of the same clones in various combinations. The trees were brought into tapping towards the latter part of 1981. Girth of scions at 6½ yr are summarized in Table 10.

Table 10. *Mean girth (cm) for various rootstock scion combinations (St.sc/75/4)*

Rootstock clone	*Scion clone*				*Rootstock Mean*
	PB 86	RRIC 45	Wagga 6278	RRIC 103	
PB 86	47·56	55·10	56·42	49·40	52·12
RRIC 45	47·36	53 92	59·34	49 30	52·48
RRIC 103	48·22	53 86	51·62	49·12	50·71
Wagga 6278	46·12	51·26	56 62	48·48	50·62
Scion Mean	47·32	53·54	56·00	49 08	

Stock and Scion Mean LSD (5%) = 1·77 LSD (1%) = 2 35
Interaction Mean LSD (5%) = 3·47 LSD (0·1%) = 3·06

There is a significant stock-scion interaction, clone RRIC 103 grows better on the other three rootstocks than on RRIC 103. As rootstocks PB 86 and RRIC 45 seedlings are better than RRIC 103 and Wagga 6278. Scion clones RRIC 103 and RRIC 45 are more vigorous than PB 86 and Wagga 6278. (Chandra Samaranayake, R. B. Gunaratne and L. S. Kariyawasam)

Stock-scion experiment, Frocester (St. sc/80/6)

Six scion clones RRIC 100, 101 102, 103, 111, RRIC 52 and PB 86 are budded on to seedling rootstocks of the same six clones in various combinations. Girths of scions 1 year after planting are summarized in Table 11.

Table 11. *Mean girth (cm) of various rootstock scion combinations (St. sc/80/6)*

Rootstock clone	*Scion clone*							*Root stock Mean*
	RRIC 100	RRIC 101	RRIC 102	RRIC 103	RRIC 111	RRIC 52	PB 86	
RRIC 100	7·08	7·48	6·54	7·00	7·62	7·75	6·91	7·20
RRIC 101	7·00	7·48	7·46	7·42	6·75	7·83	7·38	7·33
RRIC 102	6·67	6·82	7·56	7·39	7·68	7·50	7·01	7·23
RRIC 103	7·68	7·77	7·95	8·22	7·60	7·62	8·18	7·80
RRIC 111	6·71	9·00	7·20	8·03	8·03	7·93	7·86	7·82
RRIC 52	7·55	8·23	6·70	7·59	7·69	7·97	7·15	7·56
PB 86	7·18	8·29	6·72	8·57	7·39	7·54	6·84	7·50
Scion Mean	7·12	7·87	7·16	7·75	7·54	7·73	7·33	

LSD (5%) = 0·45
(1%) = 0·59

Rootstocks of RRIC 103 and RRIC 111 have been better than the others. Scion clones RRIC 101, 103 & 52 are more vigorous growing than the rest. (Chandra Samaranayake and R. B. Gunaratne)

Stock-scion experiment, Eladuwa (St. sc/78/5)

Clones PB 86, RRIC 13, 48, 52, 94 & RRIC 100 have been budded on to seedling rootstocks of PB 86, RRIC 52, 94 & RRIC 100. Analysis of girth data 3½ yr after planting does not show any significant rootstook effect. (Chandra Samaranayake and K. A. G. R. Ameratunge)

Stock-scion experiment, Moraliya (St. sc/81/7)

Clone RRIC 100, 101, 103, PB 86 & GT 1 are combined as stock and scion in all possible combinations with their seedling rootstocks in this experiment. It was planted in the field in June on a randomized block design with four replicates. (Chandra Samaranayake, R. B. Gunaratne and L. S. Kariyawasam)

Crown Budding

Crown Budding experiment, St. George (CB/75/1)

Clones RRIC 45, 48, 101 and RRIM 600 budded on to seedling rootstocks of Tjir 1 have been crown budded with clones RRIC 45, 48, 101, 102, 117, RRIM 600 and PB 86. Girth data recorded 4 yr after crown budding are summarized in Table 12.

Table 12. *Mean girth (cm) of trunks in crown budded trees (CB/75/1)*

Trunk clone	*Crown*		*Girth (cm)*
RRIC 101	RRIC	101	53·49
	PB	86	46.82
	RRIC	117	47·30
	RRIC	102	55·17
RRIC 45	RRIC	45	45·70
	PB	86	45·94
	RRIC	117	45·06
	RRIC	102	50·45
RRIC 48	RRIC	48	49·95
	PB	86	42·07
	RRIC	117	43·01
	RRIC	102	49·10
RRIM 600	RRIM	600	44·97
	PB	86	41·85
	RRIC	117	43·35
	RRIC	102	50·31

LSD (5 %) = 4·51
LSD (1 %) = 6·00
LSD (0·1 %) = 7·80

Growth in girth of RRIC 101 and RRIC 48 was significantly reduced by PB 86 and RRIC 117 crowns. Growth of RRIC 45 and RRIM 600 trunks was significantly increased by the vigorous growing RRIC 102 crowns. (Chandra Samaranayake and R. B. Gunaratne)

Improvement In Planting Techniques

Plants in polybags, Belmont Estate (RI/78/1)

In this experiment the growth of plants raised in polybags is compared with bare root budded stumps after transplanting in the field. There is a highly significant growth difference between the two types of plants at the end of three years. (Chandra Samaranayake, R. B. Gunaratne and L. S. Kariyawasam)

Use of stumped buddings, Eladuwa Estate (RI/78/2)

Growth of bare root budded stumps and buddings are compared in this experiment after transplanting in the field. Growth in girth of plants at 3½ years shows a highly significant difference between the two types of plants. (Chandra Samaranayake, R. B. Gunaratne and K. A. G. B. Ameratunge)

Large scale experiment with stumped buddings, (RI/81/3)

A stock seedling nursery was planted in 1980 and the seedlings were budded at 6 months with green buds, cut back and the plants allowed to grow in the nursery to prepare stumped buddings to be planted in the field in 1982 May/June. This experiment is to be located in an estate at Kalutara. (Chandra Samaranayake, R. B. Gunaratne and K. A. G. B. Ameratunge)

A comparison of planting techniques, Pallegama (GB/79/2)

In this experiment five different methods of establishing rubber in the field are compared. They are as follows:-

T_1 - Green buddings planted bare root

T_2 - Brown buddings planted bare root

T_3 - Green budded stumps grown in polybags up to leaf whorls and transplanted in the field.

T_4 - Seedling raised, green budded and grown up to two leaf whorls and transplanted in the field.

T_5 - Seedlings budded at stake in the field.

Growth of plants at 1 year from planting shows that treatment 4 is superior to all the other methods. Bare root green budded stumps have shown a signtificantly better growth than bare root brown budded stumps. (Chandra Samaranayake and K. A. G. B. Ameratunge)

A comparison of planting techniques, Peenkande (GB/79/2)

This experiment is similar to that at Pallegama (GB/79/2). The same methods of establishing rubber in the field were studied.

Growth of plants at 1 yr from planting indicates that budding at stake with green buds is superior to all the other methods. There is no difference in growth between bare root green and brown budded stumps. (Chandra Samaranayake and L. S. Kariyawasam)

Green buddings in polybags and bare root stumps, Elston (PB/81/3)

Green budded stumps of clone RRIC 102 prepared with 5- month old rootstock were planted in the field on a randomized block design in June, 1981. At the same time another set of plants was planted in polybags and these were transplanted in the field in September, 1981.

Establishment success of 99% was achieved with polybag plants on transplanting in the field. With bare root stumps establishment success was 87%. (Chandra Samaranayake, R. B. Gunaratne and L. S. Kariyawasam)

Brown buddings in polybags and bare root stumps, Gallewatta (PB/81/4)

The performance of brown buddings raised in polybags for 6 months and bare root brown budded stumps on transplanting in the field is compared in a large scale field experiment. Plants were established in the field on a randomized block design in September 1981. (Chandra Samaranayake, R. B. Gunaratne and S. Wilbert)

Comparison of planting techniques, Geekiyanakande (PB/81/5)

In this experiment bare root green and brown budded stumps are compared with green and brown budded stumps raised in polybags for 9–10 months.

Green and brown budded stumps were prepared in the nurseries and one set of plants was planted in the field in June 1981 on a randomized block design. At the same time another set of plants was planted in polybags. These plants will be grown for 9–10 months in the bag and then transferred to the field in 1982. Advantages of using this advanced planting material will be assessed. (Chandra Samaranayake and K. A. G. B. Ameratunge)

Use of growth substances in propagation

IBA as a root inducing agent, Ubapolla (PT/80/3)

Budded stumps were graded according to the size of the stump and three concentrations of a powder formulation of IBA in Kaolin were prepared and a slurry of these in water was applied on the roots of budded stumps before they were planted in the field (See Ann. Rev. 1980).

IBA had no significant effect on the rate of emergence of buds in small and medium sized stumps. The largest stumps treated with 2000 ppm IBA sprouted earlier than the controls.

Growth in height of plants at 6 months showed a significant increase in plants treated with IBA over the untreated controls.

However, the growth in girth at one year showed no significant difference due to treatment. (Chandra Samaranayake and R. B. Gunaratne)

Two proprietary formulations of IBA and a mixture IBA and NAA marketed as a root inducing agent for *Hevea*, were used in different concentrations and two field experiments were established in the field during the N. E. planting season. Observation on emergence of buds and growth of plants are being recorded. (Chandra Samaranayake, R. B. Gunaratne, S. Wilbert and L. S. Kariyawasam)

Clone Characters

Field observations, Eladuwa (CC/77/1)

The purpose of this study is to investigate a number of clones in order to identify criteria if any, that could be used in early selection of clones.

Ten clones of varying yield potentials were selected and a field experiment was established in 1977 (See 1978 Ann. Rev.).

Clone RRIC 101 was the most vigorous in growth followed by RRIC 52, 100, 88, 45, IRCI 2 and GT 1. Clones PB 86, LCB 870 and RRIM 600 were slower in growth than the rest.

Microtapping yields gave the same trend as in previous years; the accepted high yielding clones giving high yields. (Chandra Samaranayake, A. H. R. Jayaratne, L. S. Kariyawasam and C. W. Ranasinghe)

Tree Spacing and density

Effect of tree spacing and density (CD/77/1)

Clones RRIC 101, 103, PB 86 were established in June-July 1977 at six spacings and densities on a 3 x 6 factorial experiment with three replicates. Of the six spacings adopted four were contour plantings and the other two were triangular plantings. Each plot accommodates 64 to 156 plants depending on the density. The two outer rows in each plot are considered as guard rows. Girth of trees at the age of 4 yr is summarized in Table 13.

Table 13. *Plant spacing, density and girth (cm) in December 1981*

Spacing (m)	*Density* (trees/ha)	*Girth* (cm) PB 86	RRIC 101	RRIC 103
2·5x10·0	400	36 0	47·3	41·7
2·5x7·5	533	39·8	44'1	45·4
2·5x6·0	666	36 0	43 6	43·6
2·5x5·0	800	36·1	42 9	43 6
Triangular - 3·87	771	36·3	42·6	42 9
Triangular - 3·54	920	34·9	41 6	41·7

LSD (5%) = 2·6

There is a significant decrease in girth with increasing density and also a significant clone and spacing interaction indicating that the effect on girth, with increasing densities, varies with the clones. (Chandra Samaranayake and L. S. S. Pathiratne)

Forage Grasses and Legumes

Growth of Hevea in areas intercropped with forage grasses (FP/75/ 1/F)

Forage grasses were introduced into this plantation in 1975 (See Ann. Rev. 1979). The dry matter yields of forage greatly decreased due to heavy shading by the closing rubber canopy and at the end of 1980 harvesting of forage was terminated. Only the tree growth measurements were continued.

Analysis of girth data shows that there was a significant reduction in girth of rubber trees in plots where *Panicum maximum* and *Brachiaria brizantha*; the grasses which gave very high forage productivity were grown earlier, with or without legumes. (L. S. S. Pathiratne and N. D. Yawanis)

Growth of rubber where different grass varieties were intercropped (FP/75/2)

In this experiment 10 varieties of grass were established in 1975. Forage was harvested until the end of 1980, when the dry matter yields became very low. Analysis of girth data at the end of 1981 indicated that there is no difference in growth of rubber in different treatments. (L. S. S. Pathiratne and N. D. Yawanis)

Productivity of P. maximum and effect on Hevea (FP/3/77)

In this experiment *P. maximum* and *Pueraria* were grown singly or in combination, rubber tree leaving a vacant space of 1·0 or 1·5 m. radius at the bole of the tree (See Ann. Rev. 1979). Plots with uncut *Pueraria* cover served as controls.

There was no significant difference in forage productivity among grass and grass + legume plots. The growth of *Pueraria* in grass + legume plots was sparse. On the whole productivity of forage was very much lower than in the previous year.

Growth in girth of rubber in all the pasture plots was significantly reduced when compared with the controls. (L. S. S. Pathiratne and N. D. Yawanis)

REVIEW OF THE INTERCROPPING DEPARTMENT

By

L. B. CHANDRASEKERA

SUMMARY

Field trials and smallholder demonstration plots have shown banana and passion fruit to be highly successful intercrops for planting between rows of young *Hevea* plants. Of these two, passion fruit plantings in the Kalutara District have given the highest returns. Coffee, though it could be grown among young rubber has so far not proved to be as profitable nor give as early returns as banana and passion fruit. Pineapple could be successfully intercropped on comparatively flat terrain. Other crops under test are papaw and pepper.

DETAILED REVIEW

Staff

Mr. L. B. Chandrasekera, Head of Intercropping Department, Messrs. U. K. D. Lewis, N. L. D. Ruban and W. T. Silva, Experimental Assistants were on duty throughout the year.

Visits

The technical staff of the Department paid advisory visits to estates and small-holdings. Routine maintenance visits to experimental areas were also made.

Meetings

The Head of the Department gave a talk on "Intercropping among rubber" at a seminar organized by the Kalutara District planters at Tebuwana. He also participated in a training programme organized for the Rubber Extension Officers.

Publications

Chandrasekera, L. B. (1981) Promising intercrops for smallholder rubber in Sri Lanka, *IRRDB Symposium*, May, 1981

Chandrasekera, L. B. (1980) Crown budding with clone LCB 870. *Rub. Res. Inst. Sri Lanka Bull.*, **15**

Chandrasekera, L. B. (1980) Ground covers in *Hevea* plantations in Sri Lanka, *Rub. Res. Inst, Sri Lanka Bull.*, **15**

Chandrasekera, L. B. (1980) Tapping experiments. *Rub. Res. Inst. Sri Lanka., Bull*, **15**

Reports

Chandrasekera, L. B. (1980) Review of the Intercropping Department.

Field Experiments

Intercropping with banana, passion fruit and coffee (IC/80/1, IC/80/2 and IC/80/3)

Three field trials were set down in 1980 in order to study these three crops for their suitability as intercrops among rubber. They are located in three climatically different rubber growing districts, namely Kalutara, Ratnapura and Kegalle.

The design of each trial is a randomised layout with the four treatments banana, passion fruit, coffee and a control replicated six times. A single row of banana, passion fruit and coffee are planted centrally between each pair of rubber rows (planted at spacings of 2·4 m x 9 m) spaced 3·6 m, 6·0 m and 2·4 m along the row, respectively.

The banana clumps were thinned out periodically to leave only three to four suckers of varying ages so as to maintain continuity of production. The passion fruit creepers are trained along a horizontal wire stretched across wooden posts at approximately 2 m above ground level. Temporary shade was provided for the young coffee seedlings by planting three sticks of *Gliricidia maculata* approximately 1 m in length round each coffee seedling. The fertilizer schedules followed for the three crops are given on pages 36 - 38 in the Annual Review for 1980.

Passion fruit and banana began to bear at the end of 1 year in 1981. The yields recorded during 1981 are given in Tables 1 and 2.

Table 1. *Yield of passion fruit (IC/80/1, IC/80/2, IC/80/3)*

District	*Estate*	*Field Exp. number*	*Number of plants*	*Yield (kg)*	*Mean yield (kg/plant)*
Kegalle	Pallegama	IC/80/3	142	310	2·18
Ratnapura	Kiribatgalla	IC/80/2	109	697	6·39
Kalutara	Eladuwa	IC/80/1	99	575	5·81

Table 2. *Yield of banana (IC/80/1, IC/80/2, IC/80/3)*

District	*Estate*	*Field Exp. number*	*No of trees*	*No of bunches*	*Estimated value (Rs)*	*Mean value per bunch (Rs)*
Kegalle	Pallegama	IC/80/3	240	42	307	7·30
Ratnapura	Kiribatgalla	IC/80/2	180	156	3218	20·63
Kalutara	Eladuwa	IC/80/1	180	111	1946	17·53

None of the coffee plots were in bearing during the period under review. Owing to the difficulty in preventing thefts, inspite of the employment of watchers, the following procedures were adopted for estimating yields in experimental plots.

Banana: all bunches were numbered before they were mature, and records were made of the variety, the number of fruits per bunch and the estimated value at maturity.

Passion fruit: before maturity the fruits were counted at 2 wk intervals and the fruits thus counted were marked with paint in order to prevent a recount at harvest. The weight of a representative sample of 50 fruits were taken from each plot and the yields from each plot estimated in terms of weight.

In the case of passion fruits, the yields were lowest in the Kegalle District with a mean yield of only 2·18 kg fruit per plant. This could probably be due to the relatively dry climatic conditions in the district. These weather conditions appear to have had an adverse effect on the growth and yield of bananas as well. The lowest number of bunches and the lowest mean value per bunch were recorded for the Kegalle District. In all three trials, the bunch size of banana was small as this was the first crop obtained from the original suckers planted in the field. (L. B. Chandrasekera, N. L. D. Ruban and W. T. Silva)

Experiments with banana/coffee combined (IC/80/5)

Owing to the difficulty experienced in establishing coffee under direct sunlight, an experiment was set down at Elston Estate, Puwakpitiya, where coffee is planted among bananas. The treatments are as follows:

1. Control
2. Banana spaced 3·0 m along the row.
3. Banana spaced 3·6 m along the row.
4. Banana spaced 3·6 m along the row, with a single row of coffee planted between each pair of banana plants.

The rubber is spaced at 3·6 X 6·0 m. The treatments are replicated five times.

In this trial too the bananas came into bearing at the end of 1 year in 1981. Table 3 gives a summary of the yields recorded in the first year.

Table 3. *Yield of banana (IC/80/5)*

Number of trees	*Number of bunches*	*Estimated Value* (Rs.)	*Mean Value per bunch* (Rs.)
720	108	1749	16·19

Here too, the mean value of Rs. 16·19 per bunch reflects the average size of the bunches in the first crop and compares favourably with the other wet districts Kalutara and Ratnapura. (L. B. Chandrasekera and W. T. Silva)

Experiments with papaw (IC/80/4, IC/81/4)

At Udapolla Group, Deraniyagala, in the Kelani Valley District, a trial (Field Exp. No. IC/80/4) was set down, where papaw seedlings are inter planted among rubber planted at spacings of 2·4 m x 9 m in 1980. The treatments are as follows.

1. Control.
2. One row of papaw spaced 2·4 m along the row.
3. One row of papaw spaced 3·0 m along the row.
4. Two rows of papaw spaced 2·4 m along the row.
5. Two rows of papaw spaced 3·0 m along the row.

The experimental design is a randomised layout with five replications.

The papaw seedlings were raised in polybags and plants of uniform growth were selected for planting in the experimental plots. However, their subsequent growth was observed to be very uneven, inspite of regular and uniform application of fertilizer. Out of a total of 665 papaw plants originally planted, only 35% came into bearing at the end of one year in 1981.

In view of the unsatisfactory growth of papaw in the trial at Udapolla Estate, a second small scale experiment was set down in November 1981 (Field exp. No. IC/81/4) in a smallholding in the Kalutara District to evaluate the response of papaw seedlings to different rates of application of fertilizer. The rubber is planted at spacings of 3·6 m x 6·8 m and a single row of papaw seedlings is planted centrally between each pair of rubber rows spaced 3 m along the row. The experimental design is a randomised layout with three tree plots, six treatments and five replications. The following are the treatments.

1A Fertilizer mixture A - 500 g/plant every 3 months (control).
2A Fertilizer mixture A - 400 g/plant every 2 months.
3A Fertilizer mixture A - 200 g/plant every 1 month.
4B Fertilizer mixture B - 500 g/plant every 3 months.
5B Fertilizer mixture B - 400 g/plant every 2 months.
6B Fertilizer mixture B - 200 g/plant every 1 month.

The above treatments are selected as the productiveness of a papaya plant is described as dependent upon it being kept in a state of constant growth, so that fertilizers and organic matter should be applied at frequent intervals and at high rates (Tropical and Subtropical Agriculture. Ochse, Soule, Dijkman, vol. 11,593).

Fertilizer mixture A

Parts by weight

8 - Ammonium sulphate
8 - Conc. super phosphate
8 - Muriate of potash
2 - Epsom salt

Fertilizer mixture B

Parts by weight

10 - Ammonium sulphate
6 - Conc. super phosphate
8 - Muriate of potash
2 - Epsom salt

At planting time, 250 g of the fertilizer mixture A or B that is appropriate to each treatment was incorporated into the soil. During the first two months after field planting, the seedlings were watered weekly with a starter solution made up of 28 g of fertilizer mixture B in 1 gallon water. Different fertilizer treatments commenced from the third month after planting. (L. B. Chandrasekera, U. K. D. Lewis and W. T. Silva)

Experiments with pepper (IC/81/2)

An experiment involving the interplanting of rubber with pepper during the immature phase was set down at Eladuwa Estate, Paiyagala, in the Kalutara District.

Hevea clone PB 86, was planted in June 1981 at spacings of 2·4 m x 9 m. Pepper was planted in the inter-row area and trained on to *Gliricidia* posts approximately 2·5 m in height. The various treatments are as follows:

1. No pepper (control).
2. 1 row of pepper planted centrally between each pair of rubber rows spaced 2·4 m along the row.
3. 2 rows of pepper planted between each pair of rubber rows spaced 2·4 m along the row and 2·4 m between rows.

The experimental design is a randomised layout with the three treatments replicated eight times. The plot size is 9 m x 24 m which would include three rubber rows 10 trees wide. (L. B. Chandrasekera and N. L. D. Ruban)

Experiments with pineapple (IC/81/3)

Preliminary small scale experiments in the wet zone have shown that pineapple could be successfully intercropped during the immature phase of rubber. However, pineapple is a crop that requires clean weeding and hence is more suitable for relatively flat land due to problems of soil erosion.

A large scale trial was set down at Sorana Estate, Horana in 1981. *Hevea* clone PB 86 was planted in June 1981 at spacings of 3·7 m x 6·0 m. The treatments in this trial are as follows :

Treatments

T_1 – Pineapple – 1 row.

T_2 – Pineapple – 2 rows.

T_3 – Pineapple – 3 rows.

T_4 – Pineapple – 4 rows.

T_5 – No pineapple – control.

The pineapple is planted spaced 0·5 m along the row and 0·6 m between rows. Where there are four rows of pineapple, there is a central path 1·5 m wide between each pair of pineapple rows. The pineapple rows are kept clean weeded and the following fertilizer mixture was applied at the rate of 28 g per plant per application, three times a year.

Fertilizer mixture

Parts by weight

4·5 – Urea

2·25 – Conc. super phosphate

7·25 – Sulphate of potash

0·5 – Epsom salt

The experimental design is a randomised layout with five treatments replicated six times. The plot size consists of four rubber rows with ten trees along the row. (L. B. Chandrasekera and N. L. D. Ruban)

Experiments with cacao (IC/81/1)

The planting of cacao has so far been confined to the relatively drier parts of the country receiving an average annual rainfall of around 2500 mm. However, a few small scale plantings of cacao have been carried out in the wet zone quite successfully in the past, the main factors determing such success being the incidence of light, and disease control.

An experiment was therefore initiated at Eladuwa Estate, in the Kalutara District in 1981 where rubber is planted at two spacings, viz. 1·8 m x 12 m and 2·4 m x 9 m, so as to provide different degrees of shade for the cacao, without sacrificing the normally planted stand of rubber per hectare. Banana is planted as temporary shade for cacao and the cacao will be planted at a later stage as a single row between each pair of rubber rows. The treatments in this trial are as follows:

1. Rubber only planted at 2·4 m x 9 m.
2. Rubber only planted at 1·8 m x 12 m.
3. Rubber spaced 2·4 m x 9 m + cacao spaced 2·4 m x 9 m.
4. Rubber spaced 1·8 m x 12 m + cacao spaced 2·4 m x 40 m.

The experimental layout is a split plot design with six replicates, the main plots being allocated the planting systems. (L. B. Chandrasekera and N. L. D. Ruban)

Smallholder trials

These plantings are essentially small scale demonstration plots located in various parts of the country. The rubber in all instances is planted at spacings of 2·4 m x 9 m. A single row of the intercrop is planted centrally between each pair of rubber rows spaced 3·6 m and 2·4 m for banana aud coffee, respectively. Passion fruit is spaced 6 m along the row. (L. B. Chandrasekera and U. K. D. Lewis)

Table 4 gives a summary of the yields and income derived by a few smallholders who have been given assistance by the Institute to intercrop their rubber holdings.

Table 4. *Smallholder demonstration plots intercropped with banana and passion fruit in 1981*

District	*Village*	*Year planted*	*Crop*	*Extent (ha)*	*Expenditure (Rs.)*	*Income (Rs.)*	*Profit (Rs.)*
Galle	Pitigala	1979	Banana	0·5	780·00	1185.00	405·00
Kalutara	Welipenna	1979	Banana	0·5	809·64	2128·90	1319·26
Kalutara	Gamagoda	1980	Banana	0·8	1668·48	3890·90	2222·42
*Kalutara	Palatota	1981	Banana	0·8	—	—	—
*Kalutara	Palatota	1981	Passion fruit	1 ha	—	—	—
Kalutara	Bulathsinhala	1979	Passion fruit	0·4	865·00	5633·75	4768·75

* Planted in November 1981

In smallholdings, intercropping with passion fruit in the Kalutara District has given the highest financial return.

Weedicides

Where two pre-emergent weedicides Lasso and Diuron 80% have been used in pineapple plots in 1979 at Dartonfield Estate, Agalawatta, no long term toxic effects of the weedicides in pineapple have been observed.

REVIEW OF THE GENETICS AND PLANT BREEDING DEPARTMENT

By

N. E. M. JAYASEKERA

SUMMARY

Growth and yield of RRIC 103 in clone trials conducted in traditional rubber growing areas (Kalutara, Ratnapura and Kegalle Districts) and in marginal areas such as Moneragala, Bibile and Matale have been very satisfactory.

RRIC 121 which is resistant to South American leaf blight (SALB) has given promising yields.

The genotype-environment interaction trial which is conducted in six planting districts has conclusively shown that PB 86 is a slow grower when compared with other clones, such as RRIC 100, RRIC 101 and RRIC 103.

The analysis of the rootstock-scion experiment indicated a significant stock effect for the number of days taken for the budgraft to sprout. The rootstock-scion interaction component of variability was found to be not significant.

In the hand pollination programme for 1981, a success rate of 1·6% (number of pods expressed as a percentage of the total number of pollinations done) was achieved.

DETAILED REVIEW

Staff

Mr D. M. Fernando, Head of the Department and Dr N. E. M. Jayasekera, Geneticist and Plant Breeder were on duty throughout the year.

Dr I. A. U. N. Gunatilake, Geneticist and Plant Breeder, resigned from the Institute on 29 January 1982.

Mr P. Samaranayake, Experimental Officer, Mr B. M. S. G. Peiris, Senio Experimental Assistant, and Messrs K. B. Karunasekera, K. W. Rupatunge, Technical Officers and Messrs D. S. Gamage and A. K. M S. Senaratne, Experimental Assistants, were also on duty throughout the year.

Mr D. A. Brahmana, Experimental Assistant who was transferred to this Department from the Plant Science Department retired from service in October, 1981.

Mr T. G. Nandasena was appointed in May 1981 as a Technical Officer and resigned from the post on 16 October 1981.

Research students

Mr L. C. Wijetilake completed his research work and submitted his thesis for the M. Sc. degree, at Sri Jayawardenapura University.

Visits

Research staff made regular visits to all the experimental areas to collect data and for observations.

Mr D. S. Gamage inspected the budwood nurseries and rootstock nurseries, established by the Sri Lanka State Plantation Corporation (SLSPC) and the Janatha Estate Development Board (JEDB) estates, which have agreed to supply planting material for the Smallholder Rubber Rehabilitation Project (SRRP).

Meetings

Dr N. E. M. Jayasekera visited the Faculty of Agriculture, Ruhuna University College, Kamburupitiya, and conducted a course of lectures on some aspects of Genetics and Plant Breeding.

Publications

Goncalves, P. de S., Fernando, D. M. and Rossetti, A. G. (1981). A nursery progeny test of SALB resistant hybrids in interspecific crosses of *Hevea*. *J. Rubb. Res. Inst. Sri Lanka* **57**, 13–21.

Fernando, D. M. and Liyanage, A. de S. (1981). South American leaf blight resistance studies on *Hevea*. *J. Rubb. Res. Inst. Sri Lanka* **51**, 41–47.

Abstracts

Fernando, D. M., Wickramasinghe, W. N. and Peiris, B. M. S. G. (1981). The performance of RRIC 100 series cultivars in differing agroclimatic zones in Sri Lanka. *Proceedings of the thirty-seventh annual session of SLAAS*, December 1981, Part I, 23.

Fernando, D. M. (1980). Annual review of the Genetics and Plant Breeding Department for 1980.

Field Experiments

Clone trials

Clone evaluation in Clodagh Estate, Matale (VC/65/10)

In this small scale clone trial five clones are evaluated. The growth and yield of RRIC 103 (Table 1) were well above those of the other clones. (D. M. Fernando and D. S. Gamage)

Table 1. *Mean girth and yield of clones (VC/65/10)*
(Tapped S/2, d/2. 100%)

Clone	*Trees Tapped*	*Mean Girth* (cm)*	*Mean Yield** (g/t/t)*	
			1980	*1981*
RRIC 103	10	71·1	33·5	36·15
RRIC 118	76	56·6	22·3	31·61
IAN 45/710	67	61·4	21·3	26·14
RRIC 116	53	67·2	20·2	21·59
1108	34	63·3	15·7	22·26

* Girth was recorded at 150 cm above the highest point of the bud union unless otherwise specified.

** g/t/t - grams per tree per tapping.

Clone evaluation in Wariapola Estate, Matale (V/65/25)

In this experiment seven clones are evaluated for their growth and yields. It is interesting to note that the clone IAN 45/710 has given the best yield and has the highest girth when compared with those of ther clones, especially RRIC 103 (Table 2).

Table 2. *Mean girth and yield of clones (V/65/25)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t)*	
			1980	*1981*
RRIC 101	25	49.9	29·9	38·1
IAN 45/710	50	58·5	33·2	33·7
RRIC 102	50	53·5	23·7	29·8
RRIC 100	50	49·0	27·4	27·5
RRIC 45	50	55·5	20·4	23·2
RRIC 103	25	51·9	27·8	21·8
1004	50	54·4	18·4	15·4

The performance of IAN 45/710 in both aspects, growth and yield (Table 1), was poor in the experiment in Clodagh Estate. (D. M. Fernando and B. M. S. G. Peiris)

Clone evaluation trial in Kumarawatta State Plantation, Moneragala (V/65/9)

Eight clones are included in this expriment with 3 replicates per clone. Mean girth and yield (Table 3) of RRIC 103 are well above the two control clones, RRIM 623 and RRIC 45. (D. M. Fernando and D. S. Gamage)

Table 3. *Mean girth and yield of clones (V/65/9)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*
RRIC 103	18	69·4	23·69
RRIC 102	16	63·2	24·54
RRIC 112	21	64·2	15·12
RRIM 623	29	64·3	15·49
RRIC 101	23	60·5	17·71
IAN 45/710	27	60·9	13·85
RRIC 104	19	67·4	18·39
RRIC 45	24	63·7	12·80

Clone evaluation trials in Bibile Estate, Bibile (V/67/20 and V/73/37)

In both experiments RRIC 103 has out yielded the other clones (Tables 4 and 5).

Table 4. *Mean yield of clones (V/67/20)*
(Tapped S/2, d/2, 67%)

Clone	*Trees Tapped*	*Mean Yield (g/t/t)*
RRIC 103	50	67·7
RRIC 100	75	58·5
RRIC 101	75	50·3
RRIC 112	75	45·7
IAN 45/710	75	44·0
RRIC 45	75	38·6

Table 5. *Mean girth and yield of clones in Bibile Estate, Bibile (V/73/37)*
(Tapped S/2, d/2, 67%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*
RRIC 103	161	57·5	37·1
RRIC 112	326	57·6	37·0
RRIC 110	118	56·9	29·8
RRIC 102	135	57·0	24·1
RRIC 117	24	56·6	22·6
RRIC 105	79	58·4	18·8
RRIC 104	133	58·2	16·3

Girth data are available only for V/73/37. It is evident that the growth of RRIC 103 is satisfactory in Bibile District where slow growth is expected due to dry climatic conditions. (D. M. Fernando and B. M. S. G. Peiris)

Clone evaluation in R. R. I. (Sub-station), Nivitigalakele (VC/67/14)

In this experiment three RRIC 100 Series clones are evaluated with RRIM 623 as the control clone. The yields of RRIC 101 and RRIC 102 are better than the yield of the control clone (Table 6).

Table 6. *Mean girth, yield and dry trees of clones (VC/67/14) (Tapped S/2, d/2, 100%)*

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 102	302	71·7	43.51	16
RRIC 101	310	70·0	43·06	30
RRIC 111	392	76·7	37·48	16
RRIM 623	145	71·7	30·03	11

The incidence of brown bast in RRIC 101 is high, which is a defect sometimes found in this clone. (D. M. Fernando and D. S. Gamage)

Clone evaluation in Hedigalla State Plantation, Lathpandura (VC/67/19 and VC/68/23)

In these experiments clones RRIC 103 and RRIC 101 are compared with the control clone RRIC 45. In both experiments RRIC 103 showed the best average yield and growth (Tables 7 and 8).

Table 7. *Mean girth yield and dry trees of clones (VC/67/19) (Tapped S/2, d/2, 100%)*

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 103	214	78·1	39·1	11
RRIC 45	212	60·5	21·5	27
RRIC 101	98	63·6	22·5	5

Table 8. *Mean girth, yield and dry trees of clones (VC/68/23)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 103	306	76·7	42·7	11
RRIC 45	273	59·7	21·0	17
RRIC 101	236	64·7	28·9	28

On an average the incidence of brown bast was higher on RRIC 101 and RRIC 45 than on RRIC 103. (D. M. Fernando and W. D. Armon)

Clone evaluation in Sirikandura Estate, Matugama (VC/69/26)

In this experiment three RRIC 100 series clones, RRIC 101, RRIC 102 and RRIC 103 are planted with RRIC 45 as the control clone. From the 1981 yield data (Table 9) it is evident that yields of RRIC 103 and RRIC 102 were the best while the control clone RRIC 45 gave the lowest yield.

Table 9. *Mean girth, yield and dry trees of clones (VC/69/26)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 101	139	60·8	22·57	30
RRIC 102	181	67·5	25·77	3
RRIC 103	170	68·7	26·37	1
RRIC 45	171	58·6	17·21	1

The number of dry trees observed in RRIC 101 was very high when compared with that of other clones included in the experiment, showing the susceptibility of RRIC 101 to brown bast. (D. M. Fernando and D. S. Gamage)

Clone evaluation in Dartonfield Estate, Agalawatta (VSM/68/8)

Girth and yield of the clones included in this experiment are given in Table 10.

Table 10. *Mean girth, yield and dry trees of clones (VSM/68/8) (Tapped S/2, d/2, 100%)*

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 102	7	70·9	33·1	1
RRIC 103	10	81·0	39·0	3
RRIC 114	13	63·3	36·9	6
RRIC 117	14	81·4	41·1	–
RRIM 623	12	73·8	36·0	5
IAN 45/710	13	78·6	43·3	2
RRIC 121	13	90·0	63·4	2
RRIC 45	13	78·3	22·0	2

The SALB resistant clone RRIC 121 shows the best yield and growth. (D. M. Fernando and K. D. Sumanadasa)

Clone evaluation in Peenkande State Plantation, Nivitigala (VC/67/17)

The girth and yield of clones planted in this experiment are given in (Table 11).

Table 11. *Mean girth, yield and dry trees of clones (VC/67/17) (Tapped S/2, d/2, 100%)*

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*	*Dry trees*
RRIC 100	399	81·9	55·8	63
RRIC 101	408	72·4	38·7	63
1004	287	86·3	47·6	48
RRIC 111	387	95·7	58·3	43
RRIM 623	393	77·4	42·4	42
RRIC 45	305	68·7	36·6	45

Girth

LSD (5%) 7·0 — between RRIC 101 and any other clones
(1%) 9·7
(0·1%) 13

Yield

LSD (5%) 13·5 — between RRIC 101 and any other clone

The analysis of variance showed highly significant differences, between clones, for girth while the yield differences between clones were significant only at the 5% level. Therefore, the selection among clones for girth will be more effective than the selection for high yields. (D. M. Fernando and D. S. Gamage)

Clone evaluation in R. R. I. (Sub-station), Kuruwita (VSM/67/5, VSM/68/21 and VSM/69/28)

In experiment Nos. VSM/67/5 and VSM/68/21, RRIC 121 which is resistant to South American leaf blight disease has given the highest yield (Tables 12 and 13). The issue of budwood of this clone which started in 1980, was continued in 1981.

Table 12. *Mean girth and yield of clones (VSM/67/5)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*
RRIC 121	19	90·3	76·1
RRIM 623	13	67·8	56·2
10570	15	76.8	52·3
10727	16	74 6	48·4
7281	15	75 0	48·1
8794	7	76·7	46·9
5682	22	76·3	46·6
8501	12	86·6	30·2
8798	19	100·1	19·0

Table 13. *Mean girth and yield of clones VSM/68/21)*
(Tapped S/2, d/2, 100%)

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*
RRIC 121	17	100·9	92·5
RRIC 131	13	80·2	80·2
RRIC 102	17	76·9	78·8
RRIC 110	16	74·8	76·3
RRIC 130	15	71·3	74·6
5 — 90	14	93·9	73.0
RRIC 104	22	91·7	72·8
RRIC 123	13	79·0	70·2
RRIC 112	18	74·5	67·1
RRIC 45	19	66·4	66·6
7263	21	79·6	57·0
RRIC 113	17	76·3	52·6
6 — 541	17	80·1	51·3
RRIC 120	18	68·3	44·1

In experiment No. VSM/69/28, out of the 14 clones (RRIC 45 is the control and the other 13 are new clones), RRIC 128 (Table 14) yielded the highest and also had the best girth. (D. M. Fernando and B. M. S. G. Peiris)

Table 14. *Mean girth and yield of clones (VSM/69/28)*

Clone	*Trees Tapped*	*Mean Girth (cm)*	*Mean Yield (g/t/t) 1981*
RRIC 128	25	78·8	78·8
RRIC 124	18	67·5	71·4
RRIC 129	22	69·8	67·9
6 — 746	13	70·7	61·6
RRIC 126	25	77·1	60·6
7 — 1415	21	68·3	59·9
7 — 1077	23	75·3	58·7
RRIC 127	11	67·3	58·5
RRIC 45	07	66·1	57·3
RRIC 125	19	60·0	57·1
7 — 1413	18	72·5	55·8
7 — 1189	22	65·4	51·2
7 — 1176	25	75·5	50·8
7 — 1218	23	73·9	39·0

Hand pollination and selection

Selection of 1974 and 1975 hand pollinated (H. P.) seedlings (HPS/74-75/1)

In 1974 selections, girth measurements were recorded from the five small scale clone trials estabished in 1980, in order to evaluate the 52 genotypes selected from the 1974 H. P. seedlings (see 1980 Annual Report).

Seventeen genotypes from the 1974 selections were not included in the 1980 small scale trials due to lack of sufficient budwood. These selections have been budgrafted and polybag plants have been established to start a small scale trial at Kuruwita Sub-station.

In the 1975 selections, out of 41, budwood was available in sufficient quantities, only from 26 selections and these will be included in small scale trials next year. Plants required for these trials have been established in polybags and experimental sites have been selected at Sorana and Padukka State Plantations. Excess plants, after establishing these trials, will be used in another experiment to be planted at Clyde State Plantation. (N. E. M. Jayasekera, K. B. Karunasekera and P. Samaranayake)

Selections from 1976 H.P. seedlings (HPS/76/2)

Arrangements have been made to multiply these 52 selections in budwood nurseries. (N. E. M. Jayasekera and K. W. Rupatunge)

Hand pollination programme for 1979 (HPS/79/2)

The diameter of the seedlings planted at Eladuwa State Plantation was measured. (N. E. M. Jayasekera, K. B. Karunasekera and K. W. Rupatunge)

Hand pollination programme for 1980 (HPS/80/1)

H. P. seedlings derived from the 1980 hand pollination programme were included in a fully randomized experiment planted at Eladuwa State Plantation. (N. E. M. Jayasekera, A. K. M. S. Senaratne, K. B. Karunasekera and K. W. Rupatunge)

Hand pollination programme for 1981 (HPS/81/1)

The hand pollination programme for 1981 was carried out at Clyde State plantation and Miriswatta State Plantation (Kanana Division). The number of crosses made, pollinations done, pods harvested and the seedlings available are given in Tables 15 and 16.

Table 15. *Details of the hand pollination programme at Clyde State Plantation (HPS/81/1)*

Cross	*No. of pollinations*	*No. of pods*	*No. of seedlings*
1. PB 28/59 x RRIC 52	566	13	31
2. PB 28/59 x IAN 45/710	1016	24	50
3. PB 28/59 x RRIC 102	1214	35	67
4. PB 28/59 x RRIC 121	245	12	29
Site total	3041	84	177

Table 16. *Details of the hand pollination programme at Miriswatta State Plantation (HPS/81/1)*

Cross	*No, of pollinations*	*No. of Pods*	*No. of seedlings*
1. RRIC 100 x PB 28/59	483	05	–
2. RRIC 52 x RRIC 121	206	01	–
3. RRIC 52 x IAN 45/710	966	17	04
4. RRIC 52 x PB 28/59	2870	50	26
5. RRIC 102 x IAN 45/710	235	01	02
6. RRIC 102 x RRIC 121	876	03	01
7. RRIC 102 x PB 28/59	2134	09	13
Site total	7990	86	46

Although 10831 crosses were made, only 222 seedlings have been successfully established in polybags and will be planted in the field as a fully randomized experiment at Eladuwa State Plantation in 1982. (N. E. M. Jayasekera and A. K. M. S. Senaratne)

Miscellaneous experiments

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

A girth measurement was recorded during May–June and it was decided to tap all the trees which had a girth of 48 cm or above at a height of 91 cm (3 ft) above the highest point of the bud union.

In five experimental areas 50% of the trees of at least five clones (out of ten) reached a tappable girth. Therefore, only these experimental areas were tapped during the 3rd and 4th quarter of 1981. The areas tapped and their first date of tapping are given in Table 17.

Table 17. *Areas that were brought into tapping and their first date of tapping* (*GE/95/1*)

Estate	*Planting District*	*First date of tapping*
Bentota S. P.	Galle	17-08-81
Monrovia S. P.	Galle	01-09-81
Hunuwella S. P.	Ratnapura	01-09-81
Densworth Estate	Kelani Valley (KV)	01-10-81
Kanana Division (Miriswatta S. P.)	Kalutara	01-11-81
Golinda Estate	Kegalle	28-12-81
Bibile Estate	Bibile	to be tappped

Three months after the first date of tapping, monthly individual tree yields were recorded for each site.

Percentage of tappable trees based on May-June girth measurements are given in Table 18, with the planting district in parenthesis. It is evident from the Table 18, that RRIC 52 and the RRIC 100 series clones have done well in all the areas.

Table 18. *Percentage of tappable trees based on May–June girth measurement (GE/75/1)*

Clone	*Estate*						
	Bentota (Galle)	Monrovia (Galle)	Golinda (Kegalle)	Kanana (Kalutara)	Densworth (K. V.)	Hunuwella (Ratnapura)	Bibile (Bibile)
RRIC 100	76·4	64·0	32·0	66·6	51·8	48·6	7·4
RRIC 101	88·2	92·3	58·0	96·5	95·8	91·4	45·0
RRIC 102	86·6	59·3	12·5	77·4	86·2	94·5	18·6
RRIC 103	81 2	82·1	41·1	86·1	65·2	91·8	56·2
RRIC 52	95·4	84·0	40·0	90·0	86·2	90·6	54·1
RRIC 36	59·3	41·1	15·1	30·7	14·8	19·4	7·6
RRIM 600	68·9	30·5	38·7	38·8	37·0	43·2	5·4
RRIM 623	65·2	80·5	24·3	64·5	64·5	55·0	15·7
PB 86	32·3	31·5	48·3	34·3	8·0	30·7	0·0
IAN 45/710	44·4	26 6	44·1	63·8	27·5	44·7	18·3

Two exceptions being the performance of RRIC 100 and RRIC 102 in Bibile. Another important feature to note is the poor performance of PB 86, generally in all areas when compared with RRIC 103 and especially in Bibile which is considered to be a marginal area where growth is slow. The only exception is in Golinda where PB 86 had a slightly better percentage of tappable trees than RRIC 103 and other clones except RRIC 101.

Another girth measurement was recorded during the November–December period of 1981. It was observed that the Golinda and Bibile sites had the minimum requirement of 50% of trees of at least 5 experimental clones reaching the tappable girth. Therefore, the Golinda experiment was opened for tapping during the 4th quarter of 1981 while Bibile will be tapped in January, 1982.

The mean girth of ten experimental clones, worked out from the November–December girth measurements, are given in Table 19.

Table 19. *Mean girth based on November-December measurement (GE/75/1)*

Clone	*Estate*							
	Densworth (K.V)	Kanana (Kalutara)	Hunuwella (Ratnapura)	Golinda (Kegalle)	Bentota (Galle)	Monrovia (Galle)	Bibile (Bibile)	Clone *Mean*
RRIC 36	49·1	48·3	44·2	43·6	54·4	51·7	43·2	47·7
RRIC 52	61·4	63·4	60·1	48·2	68·5	60·6	52·5	59·2
RRIC 100	52·7	55·0	51·5	42·8	57·7	52·5	45·5	51·1
RRIC 101	62·7	58·4	56·4	49·2	60·1	58·0	50·1	56·4
RRIC 102	59·4	57·4	59·4	43·1	58·6	54·9	42·4	53·6
RRIC 103	55·3	59·9	58·3	49·3	60·3	56·7	49·6	55·6
RRIM 600	51·4	51·1	49·6	46·6	54·1	49·1	39·6	48·7
RRIM 623	55·7	54·8	52·2	46·0	57·4	55·6	41·1	51·8
PB 86	48·0	48·9	48·6	46·3	50·0	48·6	37·7	46·8
IAN 45/710	51·0	54·6	51·6	52·7	49·5	44·5	44·3	50·5
Site mean	54·6	55·1	53·1	46·5	57·3	53·7	44·6	52·1

It is clear that RRIC 52, RRIC 101 and RRIC 103 had a better growth, when averaged over all areas, than other clones. Bentota area had the highest mean when averaged, over all clones. thus indicating that Bentota is the best area for growth. (N. E. M. Jayasekera, P. S umaranayake and K. W. Rupatunge)

Diallel progeny (GEN/78/1)

The following three characters recorded in the diallel experiment were analysed.

a) Seed weight at the time of sowing for germination.
b) Four diameter measurements recorded at 6 month intervals, starting from 1½ yr after planting.
c) Two micro-tapping records, taken at monthly intervals, starting from 6th August 1980.

Results of the analysis, which show the significance levels of General Combining Ability (GCA), Specific Combining Ability (SCA) and Reciprocal Differences (RD) are given in Table 20, for each character separately.

Table 20. *Significance levels of GCA, SCA and RD (GEN/78/1)*

	Seed weight	*Diameter* I	II	III	IV	*Microtapping* I	II
GCA	***	N. S	*	N. S	N. S	N. S	N. S
SCA	***	N. S	N. S	N. S	N. S	N. S	N. S
RD	***	N. S	N. S	N. S	N. S	*	N. S

* Significant at 5%
*** Significant at 0·1%
NS Not significant

Seed weight shows highly significant GCA, SCA and RD among 16 diallel families. Highly significant RD component for seed weight is not surprising because this character, to a great exent, depends on the mother clone (seed parent) on which the seed develops. Therefore, it is expected that the mother parent contributes more to the seed weight than the pollen parent (male parent).

Other general features evident from these results are the non-significance of the GCA, SCA components for most of the characters under consideration.

The significant RD observed in microtapping I only just reaches significance but is not significant in microtapping II. Therefore, it could be regarded as a random error effect. (N. E. M. Jayasekera, P. Samaranayake, K. B. Karunasekera and K. W. Rupatunge)

Rootstock-scion interaction studies (SC/76/1)

The number of days taken for the budgraft to sprout, recorded in 1978, after planting in the field was analysed. The results for the combined analysis of Block I and Block II are given in Table 21.

Table 21. *Results of the analysis of variance of data on sprouting (SC/76/1)*

	The number of days to sprout		
Source of variation	*D.F*	*M.S*	*P*
Stocks	3	574·18	***
Scions	3	2223·56	***
Stocks x Scions	9	149·07	N.S
Error	335	100·33	

*** Significant at 0·1% level

NS Not significant

It is evident from these results that the number of days taken for the bud patch to sprout was influenced by both the root-stock and the scion. The rootstock-scion interaction component of variability was found to be not significant. (N. E. M. Jayasekera, P. Samaranayake and K. B. Karunasekera)

Variability in mono-clonal stands of Hevea (VAR/78/2)

This experiment was concluded in December 1981 and the data will be analysed to determine the cause of variability in monoclonal stands of *Hevea*. (N. E. M. Jayasekera, K. B. Karunasekera, K. W. Rupatunge and W. D. Armon)

Testing of RRIC 100 series clones (CET/79/1)

A diameter measurement was recorded in this experiment. (N. E. M. Jayasekera, K. B. Karunasekera and K. W. Rupatunge)

International clone trial at Belmont Estate (ICT/79/3)

The highest girth (Table 22) in this experiment was recorded for the SALB resistant clone RRIC 121. (D. M. Fernando and D. S. Gamage)

Table 22. *Mean girth of clones in the International clone trial (ICT/79/3)*

Clone	*Girth (cm)*
RRIM 717	11·1
BPM 24	11·4
RRIC 100	13·4
RRIC 118	10·6
RRIC 101	13·6
RRIM 71	11·1
RRIC 117	10·5
RRIC 107	12·9
RRIC 121	14·5
RRIM 600	10·6
BPM 22	13·2
BPM 3	11·4

REVIEW OF THE PLANT PATHOLOGY DEPARTMENT

By

A. de S. LIYANAGE

SUMMARY

The incidence of leaf diseases caused by *Oidium heveae, Colletotrichum gloeosporioides* and *Phytopthora meadii* was low. There were a few reports of the occurrence of pink disease caused by *Corticium salmonicolor,* in the Kelani Valley area. White and black root diseases in wet and dry rubber growing areas, respectively, still continue to be the major problem in the plantations. Scale insects and cockchafer grubs caused damage in several seedling nurseries and immature rubber plantations, respectively.

P. meadii can be readily distinguished from *P. palmivora* on pedicel characteristics, sporangial and sporangiophore morphology, together with chlamydospore frequency, size and colour. Further, the chromosome number was also different between the two species.

Tapping panels remained susceptible to bark rot infection 72 h after injury. Rapid colonisation of pods occurred during rainy periods. Wet conditions also helped to retain the viability of zoospores for longer periods. Over-mature pods did not support sporulation for extensive periods. Such pods were rapidly colonized by secondary fungi.

In preliminary field trials application of Difolatan gave better control than Ridomil, when applied more frequently.

Inoculation with small rubber roots (0·6 and 2·5 cm diameter) caused only external infection in 6 months. Most of them also lost their viability during this period. Larger roots on the other hand caused internal spread and also retained the viability for a longer period. Cumulative loss of trees within 12 months ranged from 3·6–20·4% under natural conditions. The spread of the disease was greater in the wet than the dry areas.

The treatment of freshly cut surfaces of stumps with 2, 4, 5-T in diesel helped to enhance their decay. Removal of infected debris resulted in the reduction of the disease in the new stand. Application of sulphur after the proper removal of the infected roots,

around the border of infected patches, led to reduced incidence of the disease in the replanting. Amendment of soil with sulphur resulted in the increase of soil acidity, which was retained for about 44 weeks. Antagonistic species of *Trichoderma* and *Penicillium* were more abundant under acidic condition.

Changing the planting distance between replanting cycles helped to reduce the incidence of white root disease in the new stand. Fumigation of soil with methyl bromide helped to kill the fungus within 10 days, when pieces of infected roots were buried at a depth of 0·5 m.

The results of a preliminary survey indicated that the losses caused by brown bast ranged from 3·3–36·8%.

Colletotrichum gloeosporioides was identified as the causal organism of spike rot in black pepper.

Tri butyl tin oxide was very effective in controlling blue stain fungi in boron treated rubber wood.

Scale insects attacking rubber seedlings in the nurseries were controlled by the application of Fosferno.

The *Thielaviopsis* state of *Ceratocystis paradoxa*, was isolated from oil palm at Nakiadeniya.

Training classes were held in 44 estates throughout the rubber growing area to educate the Field Officers and labourers on the pre-planting, planting and post-planting practices which are essential to reduce the incidence of white root disease.

DETAILED REVIEW

Staff

The Head of the Department, Dr. A. de S. Liyanage, and Mr. C. K. Jayasinghe, Assistant Plant Pathologist, were on duty throughout the year.

The Experimental Officer, Mrs. N. I. S. Liyanage, Senior Technical Officers, Messrs. Z. E. Irugalbandara and D. M. Dantanarayana and the Technical Officers Messrs. W. Amaratunga, S. Wettasinghe, B. Fernando, S. S. Warnapura, E. A. T. Senadheera and Mrs. J. L. P. Wettasinghe were on duty throughout the year.

Mr. A. Dharmaratna, Technical Officer who left the island on the 21 March resumed work on the 28 December, after completing a training course at Rothamsted Experimental Station in England.

Research students

Messrs. P. K. Samaradeewa and L. C. Wijetilaka submitted their theses for the M. Sc. degree at Sri Jayawardenapura University. Mr. V. Perera continued his studies on a scholarship sponsored by the National Science Council.

Visits

The following visits were undertaken by the departmental staff.

Experimental	255
Advisory	33
Miscellaneous	170
Total	458

Meetings

The Head of the Department attended a meeting of the Steering Committee of the Smallholder Rubber Rehabilitation Project, funded by the World Bank.

Mr C. K. Jayasinghe attended a workshop on nitrogen fixation at Marga Institute. He also addressed some students on diseases of rubber and the future of rubber plantations.

Training programmes on the control of white root diseases were conducted in eleven estates in the Kalutara, Ratnapura and Kegalle Districts. Altogether 44 estates participated in this programme and the trainees included mainly Field Officers and labourers, although some Superintendents and Assistant Superintendents were also present.

Publications

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Liyanage, N. I. S., Peries, O. S. and Liyange, A. de S. (1980). The role of the basidiospore of *R. lignosus* in the spread of white root disease of *Hevea*. *J. Rubb. Res. Inst. Sri Lanka* **57**, 37-40

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Abstracts

Jayasinghe, C. K. and Liyanage, A. de S. (1981). Scale insect infestation of seedling nurseries of *Hevea*. *Proceedings of the thirty-seventh annual session of the* SLAAS, December, 1981, Part I, 28-29.

Liyanage, A. de S. (1981). Scanning electron Microscopy of South American leaf blight. *Proceedings of the thirty-seventh annual session of the* SLAAS, December, 1981 Part I, 20.

Liyanage, A. de S. and Amaratunga, W. (1981). Effect of methods of clearing land on the incidence of white root disease and growth of rubber (*Hevea brasiliensis*). *Proceedings of the thirty-seventh annual session of the* SLAAS, December, 1981, Part I, 20.

Liyanage, A. de S. and Fernando, B. (1981). The effect of different factors on the incidence of bark rot of *Hevea brasiliensis*. *Proceedings of the thirty-seventh annual session of the* SLAAS, December, 1981, Part I, 20.

Peries, O. S. and Liyanage, N. I. S. (1981). Changes in mycoflora in sulphur amended soils and its effect on antagonism to *R. lignosus*. *Proceedings of the thirty-seventh annual session of the* SLAAS, December, 1980, Part I, 25.

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General

The weather conditions throughout the year were not conducive for development of leaf diseases. The perfect stage of *Colletotrichum gloeosporioides* (*Glomerella cingulata*) was observed for the first time from a sample sent for identification. Pink disease caused by *Corticium salmonicolor* was reported from a few estates in the Kelani Valley region. White root disease caused by *Rigidoporus lignosus* is still the major disease problem in rubber plantations in the wet districts, while black root disease caused by *Xylaria* spp., appears to be causing some concern to Planters' in the dry areas. Several large nurseries were heavily infested with Scale insects. Cockchafer grub attack on roots of immature rubber was also wide spread. For the first time a borer attack was noticed in roots of budded stumps. Stain fungi, especially species of *Penicillia* were affecting boron treated rubber wood.

Laboratory Investigations

Diseased specimens

The following specimens were sent to the Institute, for identification.

	Identity of the disease	*Number of specimens*
Fungi	*Fusarium solani*	1
	Glomerella cingulata	1
	Botryodiplodia theobromae	1
	Rigidoporus lignosus	1
	Penicillium spp., (processed rubber)	2
	Colletotrichum gloeosporioides (on pepper spikes)	1
	Ceratocystis paradoxa (on oil palm)	1

Biology

Oidium heveae

Susceptibility of cultivars (0/76/1)

Abaxial and adaxial surfaces of clones RRIC 45 and 52 were inoculated with conidia of *O. heveae*. The germination and germtube growth on the tolerant clone, RRIC 52 was less than that on the susceptible clone RRIC 45. (A. de S. Liyanage, S. Wettasinghe and J. L. P. Wettasinghe)

Factors affecting germination and growth (0/76/1)

Conidia of *O. heveae* were dusted on clean glass slides and placed in humid chambers maintained at different humidities. High percentage germination was noted even at 0% relative humidity (RH) but better germination and growth was recorded at high RH. Best growth and germination occurred at temperatures between 25-30°C. (A. de S. Liyanage, S. Wettasinghe and J. L. P. Wettasinghe)

Phytopthora meadii

Nomenclature (P/76/1)

Based on pedicel characteristics, sporangial and sporangiophore morphology together with chlamydospore frequency, size and colour, *P. meadii* was readily distinguished from *P. palmivora*, having compared the Sri Lankan isolates with several tropical *Phytopthora* spp., reported from rubber, cacao and coconut maintained at the Commonwealth Mycological Institute as type cultures. Cytologically *P. meadii* with a chromosome count of 9 = 16-18 differed from *P. palmivora* which had 9-12 chromosomes and this is an additional diagnostic character separating the two species. Further, *P. palmivora* grew on Lima Bean Agar producing a brownish tinge in the medium which was absent when *P. meadii* was grown on the same medium.

Of the 36 isolates from rubber, only one isolate was identified as *P. palmivora* and the rest conformed to *P. meadii* having both A_1 and A_2 compatibility types, with A_1 being predominant. *P. meadii* is a good species occurring as the principal pathogen while *P. palmivora* occurs rarely on this host in Sri Lanka. All other isolates from cacao (3) and coconut (1) conformed to *P. palmivora*. (D. M. Dantanarayana, O. S. Peries and A. de S. Liyanage)

Rhizobia spp.

Isolation of bacterial strains (N/81/1)

Rhizobia spp., were isolated from nodules of *Pueraria* using Yeast Manitol Agar. Actidion and Congo Red were incorporated in appropriate concentrations to avoid fungal contaminations and recognize *Rhizobia* spp., amongst other bacterial strains.

Pueraria seeds were inoculated with ten exotic strains of *Rhizobia*, to establish *Rhizobia* legume symbiotic associations and also to reactivate the bacteria.

Bacteria isolated from *Pueraria* were re-inoculated on to the same host under sterile conditions to ensure that the isolated bacteria are *Rhizobia* spp. (C. K. Jayasinghe and A. de S. Liyanage)

Host - parasite relationships

Phytopthora meadii

Histopathology of leaf, pod and bark infection (P/75/2)

Artificially inoculated rubber leaves, petioles and naturally infected bark samples were sectioned to study the mode of penetration and the host reaction. These studies are in progress.

Naturally infected bark samples did not show any evidence of the presence of the fungus in the tissue. (O. S. Peries and Z. E. Irugalbandara)

Brown bast

Histology of brown bast affected tissue (BB/81/1)

Bark plugs were removed from trees showing various stages of brown bast and also from healthy trees, were sectioned. It was observed that the number of rows of latex vessels in affected tissue was less than in healthy bark of comparable age. Further, the corky layer was thicker than in normal healthy tissue. No fungal structures were evident. (A. de S. Liyanage, O.S. Peries, N. I. S. Liyanage, Z. E. Irugalbandara and J. L. P. Wettasinghe)

Rhizobia spp.

Nodule structure (N/81/1)

Nodule structure of *Pueraria phaseoloides* was studied under the light microscope using microtome sections. (C. K. Jayasinghe)

Control

Rigidoporus lignosus

Amendment of soil with sulphur (F/78/8)

Addition of 114g of sulphur to the soil increased the acidity at 0-3, 15-18 and 30-33 cm depths. The lowest pH was recorded 6 wk after the application of sulphur. Initially, the decrease was sharp and this was maintained for a few weeks after which the pH remained around 4·0-4·2 for about 44 wk.

The fungal population before and after the addition of sulphur was highest in the surface layer. There was a gradual reduction in the number of fungi with increase in depth. *Trichoderma* spp., was the predominant fungus after amendment with sulphur, their number being almost doubled. However, the number of *Penicillium*, *Aspergillus* and unidentified species of fungi declined. There was an increase in the number of colonies of *Penicillium*, at both 15 and 30 cm depths, with the number of *Trichoderma* spp., remaining almost constant.

The change in soil pH was monitored at 0-10 and 30-40 cm depths after the addition of 228g on the surface of the soil. This experiment was laid down in seven estates. The acidity increased in the first month after application and this was maintained for nearly 18 months. The pattern of pH change was similar to the change that occurs after the addition of the recommended dosage, except that the application of 228g gave a slightly lower pH. It returned to the original level in 2 yr.

Since the decrease in soil pH was sharp at the initial stages after amendment with sulphur, another experiment was carried out to study the change of soil pH and fungal population every week. It was observed that the fungal population changed within the first wk after amendment with sulphur. The population of *Trichoderma* spp, increased gradually in the surface layer and this continued up to about 12 wk. Species of *Penicillia* occurred in the deeper layers. The change in soil pH was also rapid, initially.

Isolates of *Trichoderma* and *Penicillia* were obtained and tested for antagonism to *R. lignosus* by pairing them with the latter on Malt Agar on slide cultures. It was observed that species of *Trichoderma* grew over *R lignosus* colonies and smothered them, with some of them causing lysis of *R. lignosus* mycelia. Most of the *Penicillium* spp., inhibited or prevented the growth of *R. lignosus* cultures showing definite antagonistic zones with some causing lysis. (N. I. S. Liyanage and O. S. Peries)

Efficacy of fungicides (*MO/79/1*)

Penicillium spp., was the predominant fungus isolated from stained boron treated rubber wood planks. Four fungicides were tested viz. Dowcil, Tecto (2-(4 thiazolyl)-benzimidazole), Proxel GXL (1,2 - benzisothiazolin 3-one) and tri butyl tin oxide (TBTO). Observations taken 7 days after treatment indicated that Dowcil was ineffective at all concentrations tested and supported numerous colonies of the test fungus. Proxel GXL was effective at 1·5% and 2% concentrations, with a few colonies being observed at 1%. Tecto was effective at concentrations above 0·5%, a few colonies being observed at 0·25% and 0·1%. TBTO was highly effective even at 0·05%. When TBTO was incorporated into an agar medium poor growth was recorded at 12·5 and 25 ppm, but fungal growth did not occur at 50 and 100 ppm. (A. de S. Liyanage, C. K. Jayasinghe and N. I. S. Liyanage)

Field Experiments

Host-parasite relationships

Oidium heveae

Defoliation on the yield of dry rubber (*OGP/77/1*)

Twenty-five rubber trees in each case were artificially defoliated to remove 100%, 75%, 50% and 25% of the leaves in the canopy. The results shown in Table 1 indicate the yield figures up to the end of October. It was observed that there was a marked reduction in the yield above 25% defoliation. The difference between the control and the 25% defoliation level was not very marked. (A. de S. Liyanage and E. A. T. Senadheera)

Table 1. *Effect of artificial defoliation of leaves on the yield of dry rubber (OGP/77/1)*

Level of defoliation (%)	*Mean yield* (*g/t/t*)
100	3·7
75	16·3
50	14·3
25	26·7
control	27·7

Phytopthora meadii

Effect of Panel scrap on infection (P/76/2)

Several trees were incoulated at 24 h intervals with and without removal of scrap after tapping with the Michie-golledge and Jebong knives. It was observed that there was no infection at 96 h after inoculation, when the scrap was retained. However, when it was removed infection occurred even at 96 h after inoculation but was absent at 120 h. A similar pattern was observed after injury with both types of knives. The area colonized was less when the scrap was not removed. (A. de S. Liyanage and B. Fernando)

Puncture tapping on infection (P/76/2)

Puncture tapped trees were inoculated at 24 h intervals. The trees did not show any infection 72 h after inoculation, when the scrap was retained. (A. de S. Liyanage and B. Fernando)

Infection of tapping panel (P/76/2)

Injury of trees after dipping the tapping knife in an active zoospore suspension with and without removal of excess inoculum, resulted in panel infection. (A. de S. Liyanage and B. Fernando)

Tapping height and infection (P/76/2)

Inoculation of virgin bark at different heights indicated that there was a slight reduction in the area colonized by the fungus at a height of 1·9m than at 0·7m from the union. (A. de S. Liyanage and B. Fernando)

Epidemology

Oidium heveae

Wintering and incidence of Oidium (0/74/1)

The pattern of wintering and incidence of *Oidium* leaf fall were recorded on the clone RRIC 45. The onset of wintering occurs later in this than in other clones. (A. de S. Liyanage)

Trapping of Oidium spores (0/74/1)

The conidia were trapped on sellotape at the beginning of February and their number steadily increased reaching a maximum on 9 March. Maximum germination also occurred on that date. The second peak occurred on 9 April. (A. de S. Liyanage and E. A. T. Senadheera)

Phytopthora meadii.

Viability of sporangia on rubber pods (P/77/1)

A series of artificial pod inoculations were done during the period 25 June–3 August, to study the effect of various factors, especially rainfall on the viability of *Phytopthora* sporangia. It was observed that rain during the period of incubation enhanced rapid colonization of the pod surface and also helped to retain the viability of spores, which was longer with well distributed rain. However, the pod substrate also influenced the viability of spores. Over-mature pods did not release spores for long periods even when weather conditions were ideal. Such pods had a tendency to be rapidly colonized by secondary fungi particularly *Colletotrichum gloeosporioides* and *Fusarium* spp. *Botryodiplodia* spp., seem less important, although they were associated with other species. These fungi usually colonized the pods when rains occur during and soon after the incubation period. (A. de S. Liyanage and D. M. Dantanarayana)

Rigidoporus lignosus

Spread from a known source of inoculum (F/76/5)

Several infected pieces of roots of different sizes were placed against lateral roots. The results presented in Table 2 indicate that the smaller roots (0·6 cm diameter) caused only external infection, 6 months after placement, by which time their viability is lost, as they generally decay. A similar pattern was observed with 2·5 cm diameter roots. Inoculation with roots larger than 5 cm diameter caused internal spread of the pathogen. Although viability of the fungus was lost on pieces of roots of different sizes, the fungus remained viable for extended periods on a majority of the large root pieces. (A. de S. Liyanage, O. S. Peries, N. I. S. Liyanage, S. S. Warnapura and E. A. T. Senadheera)

Table 2. *Viability, decay, external and internal spread of R. Lignosus on artificially inoculated lateral roots (F/76/5)*

Inoculum diameter (cm)	*Viability* (%)	*Decay* (%)	6 months after inoculation				*Viability* (%)	*Decay* (%)	12 months after inoculation			
			EI		II				EI		II	
			TC	AC	TC	AC			TC	AC	TC	AC
0·6	0	93·3	27·8	28·7	0	0	0	84·6	0	0	0	0
2·5	41·7	41·7	28·0	30·3	0	0	0	84·6	0	0	0	0
5·0	31·3	56·3	62·8	53·3	0	0	0	44·5	41·8	26·6	4·0	5·0
7·6	69·2	0	56·3	57·0	0	0	0	62·5	82·0	61·8	16·0	31·0

EI = External infection TC = Towards collar
II = Internal infection AC = Away from collar

Natural spread (F/76/5)

The rate of natural spread was measured on several infected rubber trees. It was observed that the rate of spread of the disease under natural conditions vary from estate to estate (Table 3).

Table 3. *Natural spread of white root disease in 12 months (F/76/5)*

Estate	*Cumulative increase*	
	infection (%)	dead (%)
Rilhena	12·7	9·5
Elston	22·1	21·7
Udabage	8·5	6·5
Panawatta	21·5	20·4
Pallegama	10·0	9·6
Golinda	6·1	6·1
Pitiyakanda	11·9	9·5
Yatadola	6·6	5·0
Culloden	13·3	13·3
Heatherly	6·8	6·5
Elpitiya	18·2	18·3
Padukka	5·8	3·6

Losses were greater in wet than dry areas. (A. de S. Liyanage, O. S. Peries, N. I. S. Liyanage, S. S. Warnapura and E. A. T. Senadheera)

Decay and viability of food bases (F/76/5)

Pieces of infected roots were placed under different covers to study their decay and viability. Covers enhanced rapid decay of inoculum. (V. Perera and O. S. Peries)

Control

Oidium heveae

Efficacy of fungicides (O/77/2)

The effect of three fungicides viz. Benlate (0·1%), Nimrod (1%) and sulphur was compared with a control, to determine their efficacy in reducing the incidence of flower infection. The application of fungicides commenced with the emergence of flowers. Sulphur gave the best control followed by Benlate and Nimrod. However, with the increase in the spore numbers the concentration of Benlate was increased to 1%. At this concentration Benlate was superior to sulphur. (A. de S. Liyanage)

Phytopthora meadii

Efficacy of fungicides (P/77/3)

In a preliminary replicated trial Difolatan (0·8%) Ridomil (0·4%), Aliette (1·6%), and two other oil based formulations of Aliette (mixture 1928 and 1929) were applied on the tapping panels every alternate day and every fourth day commencing 2 wk after inoculation of the panel. This was compared with a control. There were 10 applications, with 10 ml of fungicide being applied on each tree, after each tapping. Trees were rested for 4 wk after the application of fungicides, infected bark was removed, lesion area traced and measured. There was better control when water miscible formulations were applied more frequently. There was only a slight difference between the two oil-based formulations but were better than the water miscible formulation. Difolatan was more effective than Ridomil and Aliette W. P. (A. de S. Liyanage, B. Fernando, and D. M. Dantanarayana)

Rigidoporus lignosus

Clearing and disease incidence (F/75/1)

Growth measurements, assessment of rate of decay and the incidence of white root disease were continued in trials located at Woodend (2), Yogama, Moralioya, Hatbawa, Muwankanda and Dartonfield Estates. The treatment of fresh cut surfaces of stumps with 2, 4, 5-T, in diesel, significantly enhanced the decay. Borax and urea had little effect. Growth measurements did not indicate a difference between different treatments viz. stumps uprooted and burnt, treated with borax, urea, 2, 4, 5-T and untreated stumps. The incidence of the disease was less when the stumps were uprooted and burnt. The spread of the disease was low in dry districts than in wet districts. (A. de S. Liyanage and W. Amaratunga)

Vigour and disease incidence (F/76/3)

Growth measurements were continued in the plants grown in the nursery, to determine the effect of vigour on white root disease incidence. (C. K. Jayasinghe and A. de S. Liyanage)

Treatment of infected patches and disease incidence (F/76/4)

Sulphur was added at the recommended dosage to areas after removal of infected debris, around vacant patches. A reduction in the incidence of the disease was noted when soil was amended with sulphur following proper removal of sources of infection. Inadequate or improper removal of the sources of infection led to an increase in the incidence of the disease, especially when sulphur was not used. The infection in the new stand starts at the border of infected patches, due to the presence of active viable inoculum. Addition of sulphur without proper removal of infected debris, especially at the border of infected patches had little effect in reducing the losses due to the disease. This emphasizes the need to eliminate as much of the infected debris as practical, at the time of land preparation. (A. de S. Liyanage, S. S. Warnapura and E. A. T. Senadheera)

Application of sulphur and disease incidence (F/76/7)

A sprinkling 114g of sulphur on the surface after planting; mixing the same quantity of sulphur with soil at filling; sprinkling 57g of sulphur after half filling with soil and adding the balance 57g on the surface of soil after filling and sprinkling 57g on the surface after half filling the hole and mixing the remaining 57g with the top layer of soil, gave good control (0%) compared to the untreated control (71·4%). The viability of the fungus was markedly reduced when sulphur was applied but decay was unaffected. (A. de S. Liyanage and S. S. Warnapura)

In another experiment, different amounts, methods and frequencies of sulphur application are being tried under natural and artificially inoculated conditions. These trials are in progress. (V. Perera and O. S. Peries)

Chemical drenching (F/76/7)

The use of several water miscible fungicides as a soil drench to control *R. Lignosus* is being evaluated under field conditions and also in pot trials. (V. Perera and O. S. Peries)

Control in mature and immature rubber (F/76/7)

Mature and immature rubber trees were treated with several fungicides to evaluate their efficacy in controlling *R. Lignosus*. Yield records were also taken at weekly intervals following fungicide application. (V. Perera and O. S. Peries)

Biological control (F/76/7)

The effect of species of *Penicillium, Aspergillus and Trichoderma,* as antagonists are being tried in soils amended with sulphur and urea. This trial is in progres. (V. Perera and O. S. Peries)

Planting distance and disease incidence (F/80/1)

Four planting distances were used in a trial conducted in two estates to assess the spread of white root disease.

Table 4. *Infection and loss of rubber trees of different planting distances (F/80/1)*

Estate	*Planting distance* (m)	*One year after planting* Infection %	Losses (%)
Peenkanda	4·6 x 4·9 (15′ x 16′)	2·6	2·6
	3·7 x 6·1 (12′ x 20′)	1·7	1·6
	*3·1 x 7·3 (10′ x 24′)	2·5	2·5
	2·4 x 9·2 (8′ x 30′)	0·3	0·3
Mapalagama	4·6 x 4·9	0	0
	*3·7 x 6·1	1·5	1·5
	3·1 x 7·3	1·1	1·1
	2·4 x 9·2	0·7	0·7

* Spacing of the old stand

The incidence of the disease was lower when the planting distance was increased at the time of replanting. The incidence was highest when the replant was spaced at the same distance of the old stand. This is probably due to the rapid establishment of root contact with the food base, when replanting on the old sites. (A. de S. Liyanage, S. S. Warnapura and E. A. T. Senadheera)

Urea and the incidence of disease (F/81/12)

The effect of applying a normal and a double dose of ammonium sulphate and urea with and without the application of sulphur, on the soil pH, fungal population, viability of inoculum and tree losses was determined. There was a marked reduction

in the soil pH with the normal and double the dose of ammonium sulphate and urea, and in the presence of sulphur. This trial is still in progress. (A. de S. Liyanage and S. S. Warnapura)

Control of white root disease (F/81/13)

Mixing Basimid (3, 5 dimethyl - 1, 3, 5 - hydrothiadiazine thione) with the soil at the rate of 500 and 1000 g/m³ had little or no effect in reducing the viability of inoculum buried at a depth of 30 cm, after 4 months. (C. K. Jayasinghe, A. de S. Liyanage and S. S. Warnapura)

Fumigation and R. lignosus (F/81/13)

None of the infected root pieces had viable inoculum, 10 days after fumigating the soil with methyl bromide (1000 g/9m³). This effect was observed up to a depth of 0·5 m. Infected roots buried in treated soil were heavily colonized by *Trichoderma* spp. (C. K. Jayasinghe, A de S. Liyanage and S. S. Warnapura)

Brown bast studies (BB/81/1)

Surveys carried out at eight estates in different rubber growing districts revealed that the losses due to brown bast ranged from 3·3-36·8%. A majority of "infected" trees were scattered as single trees but some were in groups of 2-7 in the row. Infection was generally not confined to patches or rows.

Latex and bark samples from brown bast affected and healthy trees were sent to Rothamsted Experimental Station in England for electron microscope studies. (A. de S. Liyanage, N. I. S. Liyanage, Z. E. Irugalbandara and J. L. P. Wettasinghe)

Diseases of intercrops (INT/80/1)

Colletotrichum gloeosporioides was established as a pathogen responsible for causing spike rot of pepper. (A. de S. Liyanage and D. M. Dantanarayana)

Thirty four cultures of *Phytopthora* spp., were isolated from cacao pods collected from six estates in the Matale District. These were purified and kept with a view to establish the specific epithet of the causal organism and pathogenicity which may help to screen planting material particularly in intercropping systems. (A. de S. Liyanage and D. M. Dantanarayana)

Miscellaneous Investigations

Control of scale insects in seedling nurseries

Field experiments carried out at Frocester Estate, Govinna, showed that Thiodan, Fosferno and Roger - 40 were ineffective at concentrations below (2ml/1) when the insecticides were sprayed at 4-day intervals. A similar result was obtained when these

were sprayed (3 rounds) on to individual seedlings at weekly intervals. However, when the concentration was increased to 5 ml/l Fosferno performed best, killing the scale insects completely.

Some parasitic insects and fungi were observed on the scales. (C. K. Jayasinghe and A. de S. Liyanage)

Diseases of oil palm

The *Thielaviopsis* state of *Ceratocystis paradoxa*, a pathogen reported to have devastated the oil palm plantations in West Africa was isolated from oil palm in Nakiadeniya State Plantation. The trials to check the pathogenicity of these isolates on oil palm seedlings are in progress. (A. de S. Liyanage and D. M. Dantanarayana)

Diplodia die-back

Several trees in a 4·5 ha block of land planted in 1978 with PB 86 were killed due to infection caused by *Botryodiplodia theobromae*. It is possible that the fungus would have gained entry through the cracks that have developed as a result of wind damage. (A. de S. Liyanage and D. M. Dantanarayana)

REVIEW OF THE SOILS AND PLANT NUTRITION DEPARTMENT

By

N. YOGARATNAM

SUMMARY

The study of the responses of rubber trees to factors affecting the supply of nutrients and water to them and to soil management practices has been the main concern of the Department.

Growth analyses of immature plants in replantings continued to indicate a significant linear response to applications of potassium and curvilinear response (diminishing returns) to applications of nitrogen and phosphorus. These data also showed significant positive interactions with regard to NK and PK, indicating that the effects of N and P were greater in the presence of K. In some experiments, significant interactions between clones and their nitrogen requirement were observed, suggesting that the nitrogen requirements of some of the vigorously growing clones, such as RRIC 100, 101 and 102, can be higher than that of PB 86.

Yield data obtained from several field experiments showed variable results, thus emphasizing the importance of the use of fertilizers in mature areas on a discriminatory basis, taking into consideration such variable factors as soil type, clone, age of the plant and management practices.

Urea was found to be as effective as ammonium sulphate as a source of nitrogen for rubber, provided that the fertilizers were forked into the soil, thus supporting the previous year's recommendation that urea could be used as a nitrogen fertilizer for rubber plantations in Sri Lanka, without causing any adverse effect. Similar results were observed with regard to other locally available fertilizers such as Eppawela rock phosphate and Dolomite as sources of P and Mg, respectively.

Some soil management practices, such as establishment of legumes and fertilizing them with phosphate continued to show their long-term beneficial effects on growth and yield of rubber. But with regard to potassium fertilizer, its application direct to the rubber tree appears to be as efficient as its application to the ground covers, especially on K deficient soils such as the *Boralu* series.

The soil and foliar surveying programme for discriminatory fertilizer recommendations was implemented in all the State Plantations. N and K fertilizers were recommended to nearly all the plantings, but P and Mg to few plantings only. Urea was used as the nitrogen fertilizer in 75% of the plantings.

DETAILED REVIEW

Staff

Dr N. Yogaratnam, Head of the Department, and Dr M. K. S. A. Samaraweera, Agricultural Chemist, were on duty throughout the year. The Assistant Soils Chemist Mr L. Ratnapala, resigned his post to join the Ruhunu University College, Matara, as a Lecturer in the Department of Biology.

Mr A. M. A. Perera, Senior Technical Officer, was promoted as an Experimental Officer in February 1981. He was in charge of all routine chemical analyses. Miss H. V. Rodrigo and Mr P. Karunadasa joined the Department as Technical Officers in April and July respectively.

Messrs D. P. Panditharatne, P. Samarakone, L. J. Wickramasinghe and B. Arsacularatne resigned their posts to join the Coconut Research Institute, State Distilleries Corporation and to proceed to Saudi Arabia to work as Analytical Assistants, respectively. All other staff were on duty throughout the year.

Research students

Mr W. M. Jayatilaka Bandara continued his studies in preparation for the M. Sc degree of the University of Peradeniya.

Mr N. Jayasooria from the Department of Chemistry, University of Colombo, and Miss Ajantha Wickremaratne form the Department of Agronomy, Ruhunu University College, were accepted to work in the Department on short term projects.

Visits

N. Yogaratnam paid 48 experimental visits, 6 advisory visits and 26 other visits. M. K. S. A. Samaraweera, L. Rathnapala, Experimental Officers and Technical Officers paid advisory visits to plantations and routine visits to experimental areas where necessary.

Meetings

The research staff served on the following working groups and committees:

N. Yogaratnam - Head of the Department

Co-ordinating Committee on 'fertilizer supplies' of the Ministry of Plan Implementation.
Technical Committee of the Tender Board of the Ceylon Fertilizer Corporation.

Technical Committee of the Bureau of Ceylon Standards of the Ministry of Industries and Scientific Affairs.

Agriculture Group of the Atomic Energy Authority (AEA) of Sri Lanka.

Working Group on 'Studies related to the use of neutron moisture probe for assessing availability and conservation of soil water in plantation crops in Sri Lanka, sponsored by the AEA of Sri Lanka.

Working group on 'Phosphate fertilizer efficiency studies' sponsored by the AEA of Sri Lanka.

Sub-committee, for internal co-ordinated programme on the use of 15_N in soil/plant studies, of the AEA of Sri Lanka.

Executive committee of the Soil Science Society of Sri Lanka.

M. K. S. A. Samaraweera – Agricultural Chemist

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

Executive Committee of the Soil Science Society of Sri Lanka.

Sub-committee for fertilizer analysis, National Fertilizer Secretariat, Ministry of Plan-Implementation.

Committee for Standardisation of Analytical Methods sponsored by the Centre for Analytical Research and Development, Department of Chemistry, Colombo University.

The council, Institute of Biology, Sri Lanka.

Sub-committee, for internal co-ordinated programme on the use of 15_N in soil/plant studies, of the AEA of Sri Lanka.

The research staff also participated in the following:

N. Yogaratnam - Head of the Department

Inter-regional training course on the use of 'Isotopes and radiation techniques on studies in Soil/Plant relationships held at the IAEA Laboratory, Vienna, Austria.

SLSPC Planter's seminar held in Kalutara and addressed the Estate Superintendents on 'Fertilizers for rubber'.

M. K. S. A. Samaraweera - Agricultural Chemist

Inter-regional training course on the use of 15_N in soil science and plant nutrition held at the Central Institute for Isotope and Radiation Research, Leipzig, GDR.

The FAO/IAEA consultants meeting on the use of nuclear techniques, in improving fertilizer and water management techniques for tree crops, held in Austria.

M. L. Rathnapala - Assistant Soils Chemist

Workshop on 'Spectrophotometry' organized by the Institute of Chemistry, Sri Lanka.

Publications

Yogaratnam, N., Allen, M. and Greenham, D. W. P. (1981). The phosphorus concentration in apple leaves as affected by foliar application of its compounds. *J. hort. Sci.* **53** (3) (in press)

Yogaratnam, N. and Greenham, D. W. P. (1981). Supplementing the nutrition of Bramley's seedling apple with phosphorus sprays. I. Effects on leaf composition, *J. hort. Sci.* (in press)

Yogaratnam, N. and Sharples, R. O. (1981). Supplementing the nutrition of Bramley's seedling apple with phosphorus sprays. II. Effects on fruit composition and storage quality. *J. hort. Sci.* (in press)

Yogaratnam, N. and Greenham, D. W. P. (1981). The application of foliar sprays containing nitrogen, magnesium, zinc and boron to apple trees. I. Effects on fruitset and cropping. *J. hort. Sci.* (in press)

Yogaratnam, N. and Johnson, D. S. (1981). The applieation of foliar sprays containing nitrogen, magnesium zinc and boron to apple trees. II. Effects on the mineral composition and quality of the fruit. *J. hort. Sci.* (in press)

Yogaratnam, N. (1981). Urea as a nitrogen fertilizer for rubber plantations in Sri Lanka. I. Review and preliminary observations. *J. Rubb. Res. Inst. Sri Lanka.* (in press).

Yogaratnam, N. and Perera, A. M. A. (1981). Urea as a nitrogen fertilizer for rubber plantations in Sri Lanka. II. Agronomic Investigations. *J. Rubb. Res. Inst. Sri Lanka* (in press).

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Abstracts

Jayatilaka Bandara, W. M., Samaraweera, M. K. S. A., and De Silva, N. R. Procedures for accurate determination of some trace metal contents in *Hevea* leaves. *Proceedings of the thirty – seventh annual session of SLAAS*, December, 1981, Part I, 19–20

Jayatilaka Bandara, W. M., Samaraweera, M. K. S. A., and De Silva, N. R. Optimum conditions for destruction of Organic matter in *Hevea* tissues for simultaneous determination of N, P and K contents. *Proceedings of the thirty–seventh annual session of SLAAS*, December, 1981. Part I, 21

Jayatilaka Randara, W. M., Samaraweera, M. K. S. A , and Silva, S. N. Distribution of potassium and complexes of calcium and magnesium in *Hevea* latex. *Proceedings of the thirty–seventh annual session of SLAAS*, December, 1981, Part I, 21–22

Samaraweera, M. K. S. A. and De Costa, N. M. Leaf analysis as a guidance to nutritional status of rubber plants. *Proceedings of the thirty-seventh annual session of SLAAS*, December, 1981, Part I, 22

Samaraweera, M. K. S. A., Samaranayake, C., Kariyawasam, L. S. and De Alwis W. H. New growth inhibitors in *Hevea* leaves. *Proceedings of the thirty-seventh annual session of SLAAS*, December, 1981, Part I, 40

Reports

Samaraweera, M. K. S, A. Research in mineral nutrition and hormones of rubber and associated cover crops. Inter-regional training course on the use of 15_N in Soil Science and Plant Nutrition, Central Institute for Isotope and Radiation Research, Leipzig, GDR, June 1918

Samaraweera, M. K. S. A. (1981). "Use of isotopes in developing countries for the study of *Hevea* and other tree crops". (Proceedings of consultants meeting on the use of nuclear techniques in improving fertilizer and water management techniques for tree crops Vienna 1981), IAEA, Vienna (in press)

Yogaratnam, N. Annual review of the Soils and Plant Nutrition Department.

Yogaratnam, N. Some agromanagement practices under *Hevea* in Sri Lanka, Inter-regional training course on the use of isotopes and radiation techniques on studies in Soil/Plant relationships, IAEA laboratory, Vienna, April 1981.

Laboratory Investigations

Analytical Chemistry

Routine Analyses

Routine chemical analyses of survey, experimental and advisory, soil and leaf samples of the Department were done. Requests from research departments of the Institute, other research institutions, the University, the Janatha Estates Development Board and the Ceylon Fertilizer Corporation were also considered. (N. Yogaratnam, M. K. S. A. Samaraweera, A. M. A. Perera, I. Denawaka, C Mahipala, D. A Udaratagedara and H. V. Rodrigo)

Table 1. *Details of the analysis of samples*

Department/Institution	*Sample*	*NPK Ca Mg and Mn*	*Trace elements Fe Cu Zn Mn*	*Mechanical analysis Org. C, CEC, pH and Moisture*
Soils & Plant Nutrition	Leaf	5320	80	20
	Soil	300	—	—
Plant Science	Leaf	200	—	—
Plant Pathology	Leaf	36	Crude fibre 8	
	Soil	14	—	—
	Rubber pads	8	—	—
Rubber Chemistry	Water samples	—	45	—
	Nexo bleach (RRI 7)	4	—	—
	Stearate samples	—	8	—
	Diammonium phos.	—	1	—
Biochemistry	Bark samples	60	—	—
	Serum samples	21	—	—
Factory	RRI 7	—	2	—
CRI	Leaf	—	40	—
University of Peradeniya				
Botany Department	Litter	120	—	—
Chemistry Department	Soil available P	120	80	—
Ceylon Fer. Corp.	Fert. Mgo Cao	12	—	12
Chemanex Ltd.	Nexobleach (RRI 7)	—	4	—
Nakiadeniya SPC	Oil palm leaves	8	—	—
State Plantation Corp.	Fertilizer	4	—	—

Analytical methods

Leaves: Optimum conditions for destruction of organic matter was evaluated by using the following methods:

1. Dry ashing; the variables were:
   (a) Ashing temperature (Four levels)
   (b) Ashing time (Three levels)
   (c) Presence or absence of ashing aids

   This experiment was done in triplicate.

2. Wet ashing

(i) HNO_3: $HCLO_4$ digestion mixture. The variables were:

(a) Composition of acid mixture (Four levels)

(b) Digestion time (Three levels)

(c) Digestion temperature (Three levels)

(ii) H_2SO_4 : Se: H_2O_2 digestion mixture. The variables were as in (i).

Destruction was performed in triplicate.

Optimum conditions for efficient recovery of N, P, K, Ca, Mg, Mn, Zn, Cu and Fe have been evolved. Other digestion mixtures would also be used in order to find their efficiencies in extracting nutrients from *Heava* leaves. (M. K. S. A. Samaraweera and W. M. Jayatilaka Bandara)

Latex: The chemical forms and the mobility of cationic elements are important aspects in the study of the mineral nutrition and physiology of latex flow in rubber plants. It has also been accepted that polyvalent cations have an effect on the latex flow. The total content of such elements, however, may not be a reliable index because a part may exist in non-ionic forms. It was therefore, decided to study the composition of cationic elements in latex. Latex collected from healthy trees of the clone PB 86 was used. The nutritional composition of latex was determined by analysing dried samples of latex and the results are shown in Fig. 1.

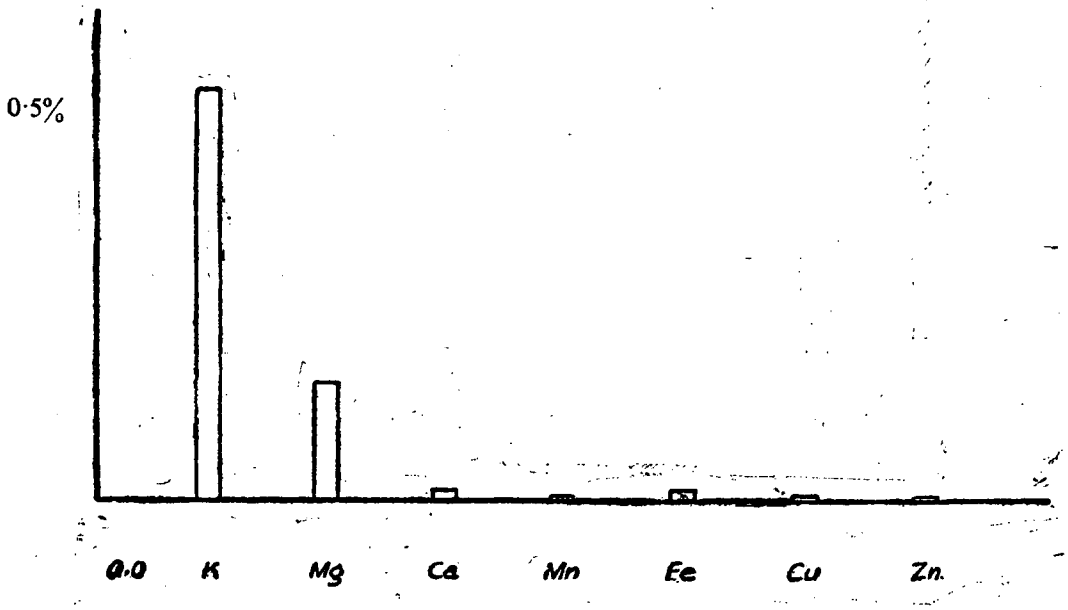


Fig 1. Nutrient composition of dried latex

Sub-samples of latex were centrifuged at 12000 rpm for 40 minutes and the composition of the three phases of centrifuged latex (ie. rubber cream, serum and the bottom fractions) were determined. Some interesting results are shown in Fig. 2-4.

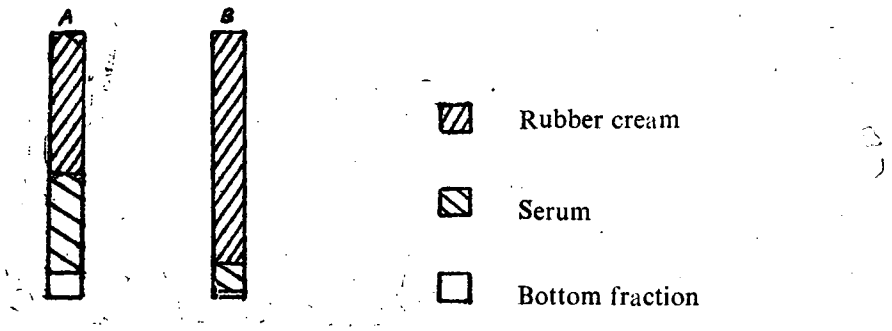


Fig 2. Percentage distribution of three phases in centrifuged latex
A. Fresh weight B. Dry weight

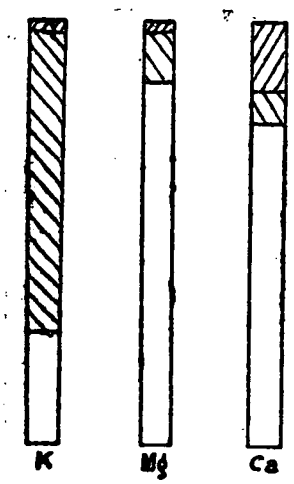


Fig 3. Concentration of cationic nutrients in different phases of centrifuged latex (Dry weight basis)

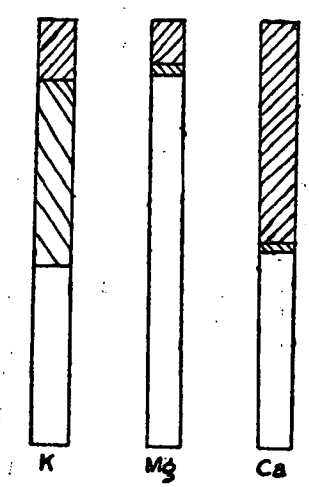


Fig 4. Concentration of cationic nutrients in different phases of centrifuged latex (Fresh weight basis)

The emphasis was mainly on K, Ca and Mg as they are the major cationic elements in latex. It can be seen that, in latex, while most of the potassium is water soluble, calcium and magnesium occur as water insoluble compounds.

Latex samples were treated with dilute acids, ammonia and salts such as oxalates, phosphates and ethylene diamine tetra acetic acid (EDTA) that can form complexes with some nutrients and precipitate or extract some others. They were then centrifuged at 12,000 rpm and the composition of phases was determined. Except in the case of addition of acid, the addition of other chemicals did not alter the pattern of distribution of fresh and dry matter in the different phases of centrifuged latex. Nevertheless, addition of chemicals had affected the nutritional composition of different phases, and the results are shown in Fig. 5-7.

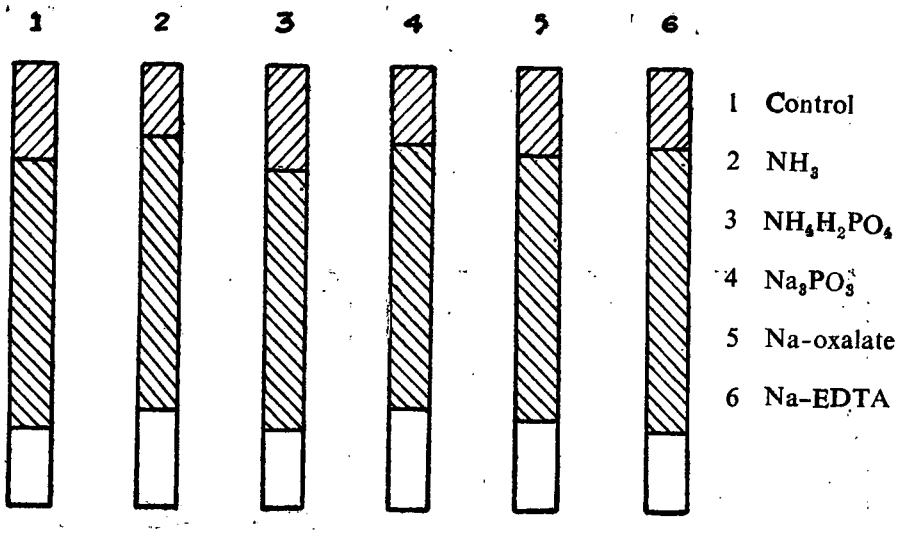


Fig 5. Effect of addition of chemicals on the distribution of K in different phases of centrifuged latex

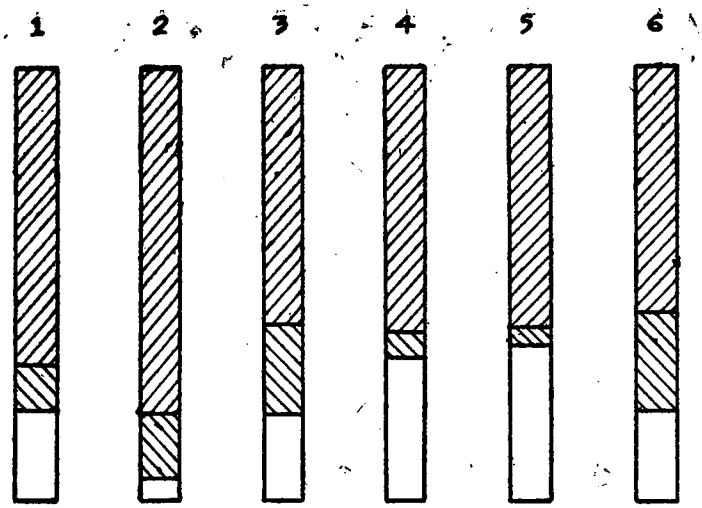


Fig 6. Effect of addition of chemicals on the distribution of Ca in different phases of centrifuged latex

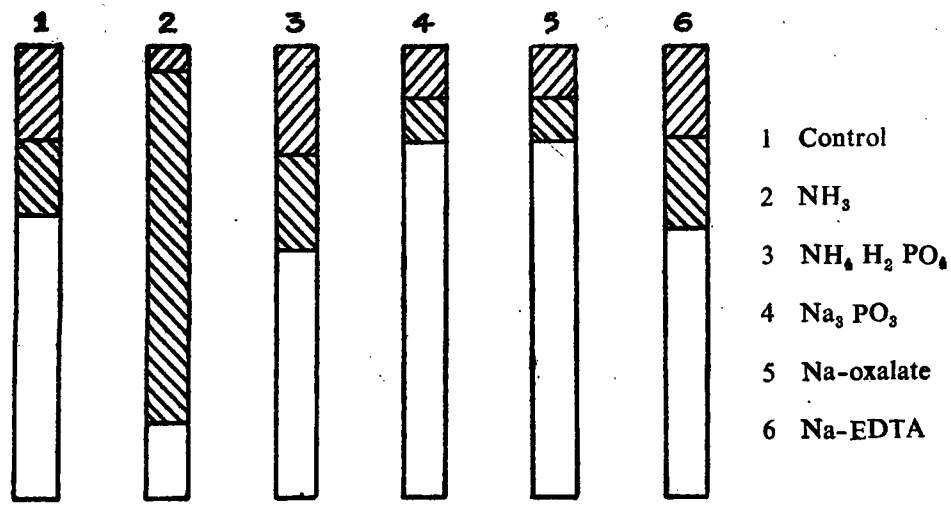


Fig 7. Effect of addition of chemicals on the distribution of Mg in different phases of centrifuged latex

Whereas the addition of salts did not alter the distribution pattern of potassium, it had altered the distribution of calcium and magnesium. (M. K. S. A. Samaraweera, S. Nandasiri Silva and W. M. Jayatilaka Bandara)

Sand Culture

Rubber seeds of the clone PB 86 were germinated in nutrient free sand. Seedlings of uniform height were transplanted in pots containing nutrient free sand. Four seedlings were planted in a pot. The plants were treated with modified Hewitt's solutions and there were eight treatments replicated five times. Two sets were given all the nutrients, the source of N for one set was NH_4^+ and for the other it was NO_3^-. The remaining six were given all nutrients except N, P, K, Ca, Mg and S, respectively, in each. The source of N to those plants not receiving S was NO_3^-.

The leaves were collected at different stages. Visual deficiency symptoms were photographed and nutritional compositions (i.e. N, P, K, Ca, Mg & S contents in all tissues) determined. Relationships between the chemical composition and visual symptoms were established. The growth of the plants not receiving N, P, K or Mg was very poor. The results are given in Table 2.

Table 2. *Nutrient composition in deficient leaves*

Treatment	*deficient nutrient content* (%)
—N	1·63—2·22 (N)
—P	0·10—0·25 (P)
—K	0·08—0·67 (K)
—Ca	0·28—0·80 (Ca)
—Mg	0·05—0·26 (Mg)

As it was also noticed that NO_3^- uptake by rubber plants depends on the pH of the solution, more experiments will be carried out to examine this in detail using ^{15}N labelled compounds. (M. K S. A Samaraweera, M. de Costa and S. Gunasekera)

Soil Fertility

Yogaratnam *et al* (1980) have reported the effects of fertilizer applications on rubber trees grown under different agroclimatic conditions. Particularly, the response to phosphorus was interesting because in a N, P, K, Mg 3x3x3x2 factorial experiment, at

Muwankande Estate, Mawathagama, there was no significant difference in the performance of the trees grown under varying P levels. Hence, soil samples were collected from N_o, P_o, K_o, Mg, N_o, P_1, K_o, Mg and N_o, P_2, K_o, Mg plots and nutrient compositions were determined. Results are shown in Table 3.

Table 3. *Nutrient composition of soils (15 samples per block), collected at Muwankanda*

Block	*Nutrient concentration m. eq/g dry weight*				
	Po_4	$Cax10^{-3}$	$Mgx10^{-2}$	Alx10	Fe(III)x10
$N_o P_o K_o Mg_o$	$0{\cdot}27 \pm 0{\cdot}03$	$0\,29 \pm 0{\cdot}04$	$0{\cdot}16 \pm 0{\cdot}01$	$0{\cdot}71 + 0{\cdot}03$	$0{\cdot}23 + 0{\cdot}01$
$N_o P_1 K_o Mg_o$	$0{\cdot}31 \pm 0{\cdot}04$	$0{\cdot}68 \pm 0{\cdot}08$	$0{\cdot}16 \pm 0{\cdot}01$	$0{\cdot}90 \pm 0{\cdot}04$	$0{\cdot}38 \pm 0{\cdot}02$
$N_o P_2 K_o Mg_o$	$0{\cdot}44 \pm 0{\cdot}03$	$3{\cdot}05 \pm 2{\cdot}51$	$0{\cdot}11 \pm 0\,01$	$0{\cdot}94 \pm 0{\cdot}03$	$0\,38 \pm 0\,02$

This indicates either that P in the soil must have exceeded the threshold value for rubber or the P in these soils must be in immobile forms. It is intended to make a detailed chemical and electro-chemical analysis of the soil and of the soil solutions from such experiments. Emphasis will be on the different forms of phosphorus compounds present and their binding powers. Losses of P compounds due to leaching surface run off will also be studied. (M. K. S. A. Samaraweera, Sumithra Gunasekera and S. Nandasiri Silva)

Field Experiments

Response to fertilizers

N, P, K, Mg and growth of immature plants (F/76/1, F/76/3, F/76/4, and F/76/5)

Experiment, F/76/1, started at Pembroke Estate, compares the effects of 5 levels of N, P, K, and Mg on clone PB 86 growing in Boralu series, in a central composite second order design. This experiment was designed to study the response surface of the nutrients N, P, K and Mg by fitting the function Y (girth response) $= b_o \pm b_1 N \pm b_2 P \pm b_3 K \pm b_4 N^2 \pm b_5 P_2 \pm b_6 K_2 \pm b_7 NP \pm b_8 NK \pm bg\ PK$. Analysis of the girth measurements made at the end of 1981 continues to indicate a significant linear response to application of potassium and curvilinear response (diminishing returns) to applications of nitrogen and phosphorus as reported in the previous year. Girth data also showed significant positive interaction with regard to NK and PK; indicating that the effects of N and P were shown in the presence of K. This result therefore confirms our previous observations that application of fertilizers would give beneficial results in Boralu soils. (N. Yogaratnam and W. G. Dayaratne)

In two other experiments, F/76/3 and F/76/4, the rate of growth of all RRIC clones was greater than that of PB 86 and there was a significant response to application of potassium (Table 4 and 5). This effect was similar in all the clones tested.

Table 4. *Effect of three levels of N and P on the growth of PB 86 RRIC 101 and RRIC 102 (F/76/3)*

Level of N	*Girth* (cm)	*Level of P*	*Girth* (cm)
n_0	37·38	p_0	36·40
n_1	39·02	p_1	40·81
n_2	43·78	p_2	42·97
LSD (5%)	3·76	LSD (5%)	3·76

In this and all other Tables statistical evaluations indicated by *, ** and *** which denote that the treatments are significantly different from the control at P=0·05, 0·01 and 0·001, level, respectively. NS denotes that the treatment differences are not significant.

Table 5. *Effect of three levels of nitrogen on growth of PB 86, RRIC 100, 101 & 102 on Boralu soils (F/76 /4)*

Clone	*Girth* (cm)	*Level of Potassium*	*Girth* (cm)
PB 86	35·80	K_0	36·86
RRIC 100	39·89	K_1	41·17*
RRIC 101	43·47*	K_2	42·52*
RRIC 102	42·09		
	LSD (5%) 1·16		

But the effect of nitrogen on growth of plants (Table 6), has been significantly different between clones, the responses in RRIC 100 series clones in particular in the RRIC 102 was higher than that in PB 86. This indicates that the N requirement of the RRIC 100 series clones is higher than that of PB 86.

Table 6. *Effect of three levels of nitrogen on growth (girth in cm) of PB 86, RRIC 100, 101 and 102 (F/76/4)*

Clone	*Level of nitrogen*		
	n_0	n_1	n_2
PB 86	33·97	36·98	36·45
RRIC 100	38·10	40·48	41·08
RRIC 101	41·22	43·55	45·67
RRIC 102	37·56	42·93	45·78
	LSD (5%) 2·33		

In experiment, F/76/5, analysis of girth measurements made at the end of 66 months from planting (Table 7) showed a significant response to application of potassium. (N. Yogaratnam and J. G. de Mel)

Table 7. *Effect of three levels of potassium on growth of PB 86, RRIC 100 and 102 on Boralu series (F/76/5)*

Clone	*Girth (cm)*	*Level of K*	*Girth (cm)*
PB 86	37·99	k_0	39·30
RRIC 100	43·86	k_1	43·30
RRIC 101	45·26	k_2	44.50
	NS	LSD(5%)	1·46

Different levels of NPK, Mg on Yield of rubber (F/61/1, F/61/2, F/76/6, F/76/8 to 11)

Six experiments studying the effects of fertilizers on growth and yield of mature rubber are in progress covering Boralu, Agalawatte and Parambe series soils. Yield data obtained from experiments *F/61/1* and 2 in progress at the Kuruwita sub-station showed (Table 8), that applications of fertilizers at the currently recommended rates are likely to give yield increases in the order of 6%, 5%, and 27% with regard to N, P and K respectively and that increasing the levels of N and P beyond the currently recommended rates is not likely to be beneficial.

Evaluation of the efficiency of Eppawela rock phosphate using ^{32}P (P 32/79/1)

In this experiment 5 treatments viz: (1) Nil phosphate (2) Eppawela phosphate, Level 1 (3) Eppawela phosphate, level 2, (4) Imported rock phosphate, level 1 (5) Imported rock phosphate, level 2, are being compared in a randomized block design, treatments replicated six times. ^{32}P labelled super phosphate was applied according to the experimental design. (N. Yogaratnam and B. Arsekularatne)

Cover and cover management

Eight experiments were in progress studying the effects of ground covers and cover management practices on the growth of immature *Hevea*.

Types of covers (C/72/2 and C/77/1 to 5)

In experiment, C/72/1, an attempt was made to determine whether legumes are superior to naturals in promoting growth of immature rubber. If so, whether application of extra nitrogen to non-legume covers could improve growth during the immaturity period and the yield during early maturity.

Table 11. *Effect of covers on the growth of immature rubber*

Treatment	*Mean girth (cm)*	*Yield (kg/ha)*
Naturals (control)	53·21	1028
Legumes	58·16	1582*
Elimination of nonlegumes	57·46	1344*
Naturals with extra nitrogen	57·34	1401*
Naturals with extra nitrogen based on leaf analysis	54·60	1040
LSD (5%)	2·65	322

Girth measurements made in November 1981 (Table 11) indicate that plants that were associated with legumes are still superior to the ones that were in naturals. Yield data also indicated similar tendencies. (N. Yogaratnam and J. G. de Mel)

Studies on the effect of various leguminous covers viz: *Pueraria phoseoloides, Calapogonium muconoides, Desmodium ovalifolium, Mimosa invisa, Centrosema pubescens* and *Stylosanthus guyanensis* (*gracilis*) on growth and production of rubber were in progress at three sites. The control plots in these experiments are in naturals. Girth

Table 10. *Effect of imported rock phosphate and Eppawela rock phosphate on the growth of immature rubber*

Treatment	*Mean Girth* (%)	*Relative Girth* (%)
Nil phosphate	49·28	100
Eppawela rock phosphate :		
Level 1	52·25*	106
Level 2	51·23*	104
Imported rock phosphate :		
Level 1	52·68*	107
Level 2	54·31	110
LSD (%)	1·64	3·33

Magnesium : In experiments (F/76/2 and F/76/12), assessments made at the end of 66 months after the commencement of the experiment did not reveal any significant differences either on the growth or in the yield due to different sources of magnesium. This confirms our previous year's findings that even a sparingly soluble form of Mg such as dolomite could be used in replantings. (N. Yogaratnam, W. C. Dayaratne and J. G. de Mel)

Foliar nutrition

Different concentrations of trace elements on nutrient uptake and growth (FN/77/1 to 5)

Experiments on the effects of foliar nutrient sprays containing different concentrations of Zn, B, Fe, Mn and Mo on the nutrient uptake and growth of immature PB 86 did not show any significant effect of treatments on growth. It appears that none of the trace elements tested are likely to be limiting growth of young rubber in in Boralu soils. (N. Yogaratnam and W. C. Dayaratne)

Tracer – Aided studies

Root activity pattern of Hevea (P-32/79/2)

An experiment was laid down at Clyde State Plantation to test ten combinations of fertilizer placement viz: two vertical depths, 0–15 cm and 15–30 cm and five lateral distances 0·75m, 1·5m, 3·0m and 3·75m. As a routine fertilizers were applied to all the experimental plants and ^{32}P labelled super phosphate was also applied according to the experimental design. (N. Yogaratnam and B. Arsekularatne)

rock phosphate, Eppawela rock phosphate and concentrated super phosphate and three forms of Mg, viz: commercial Epsom salt, dolomite and kieserite on the growth PB 86 in Boralu soils. Girth measurements made 66 months after planting did not indicate any significant effect of nitrogen on the growth of rubber plants. Therefore, no comparison is being made between the sources of nitrogen.

Experiment, F/72/2, compared two sources of N and two methods of placement for mature PB 86 in Boralu series. Yield data obtained from this experiment which has been in progress for the last 9 years showed (Table 9) that urea is as effective as sulphate of ammonia with regard to its effect on the yield of rubber in *Boralu* soils. Other experiments also indicated similar effects.

Table 9. *Effect of nitrogenous fertilizers on yield of PB 86 on Boralu soils (F/72/2)*

Treatment	*Yield (kg/ha)*	*Relative Yield (%)*
Nil nitrogen	1645	100
S. of Ammonia	1852	113
Urea, broadcast	1702	104
Urea, forked-in	1876	114

Phosphorus : Experiment F/73/1, in progress at Dartonfield Estate, Agalawatte compared the effects of imported rock phosphate and Eppawela apatite on growth of immature RRIC 101. Girth measurements made at the end of 8 years from planting did not indicate any treatment differences on growth of rubber.

The effects of the same two sources of phosphate were compared at three levels of R in experiment F/76/17, on the performance of RB 86 in Boralu soils. Girth measurements recorded at the end of 66 months after the commencement of this experiment indicates (Table 10) a significant positive response to application of phosphate fertilizers irrespective of the source of phosphate applied to immature rubber in *Boralu* soils. Increasing the concentration of P to level 2, however did not have any beneficial effect on growth, suggesting that P availability may not be increased with increase in the levels of phosphates beyond the presently recommended rates. Yield data did not indicate any treatment effect on yield.

Table 8. *Effect of two levels of nitrogen, phosphorus and potassium on yield of PB 86 in Borulu soils (F/61/1)*

Treatment	*Yield (kg/ha)*	*Relative yield (%)*
n_0	1837	100
n_1	1940	106
p_0	1839	100
p_1	1937	105
k_0	1665	100
k_1	2112**	127

Yield data obtained from experiments started in 1976 in different agroclimatic zones showed variable results. This therefore, emphasizes the importance of the use of fertilizers in mature areas on a discriminatory basis taking into consideration various factors such as soil type, climatic pattern, clone, age of the plants and other management practices. (N. Yogaratnam and W. C. Dayaratne)

Stimulation

Levels of NPK in relation to stimulation (F/72/1, F/78/1 and F/80/1)

Different levels of N, P and K in relation to stimulation with Ethrel were examined in these experiments. There were no significant effect of fertilizer treatments on the yield in relation to stimulation with Ethrel in the third year of these experiments. (N. Yogaratnam, M. Abeysinghe and M. A. Mendis)

Intercrops

Feasibity and economics of growing coffee under rubber (FI/79/2)

Three levels of nitrogen and phosphate and two spacings for coffee (9·2 x 2·4 m and 4·6 x 2·4 m) are compared in this experiment, which is in progress on Parambe soils using clone PB 86. Assessments made at the end of two years have not revealed any treatment effect on growth of rubber plants. (N. Yogaratnam and M. A. Mendis)

Efficiency of fertilizer utilization

Full benefits from fertilizers can only be achieved if they are efficiently applied. Experiments are in progress to study the effects of sources of nutrients, method and time of their application.

Sources and placement of nutrients (F/76/2, F/72/2, F/73/1, and F/76/17)

Nitrogen : Experiment, F/76/2, compared the effects of three forms of N, viz : sulphate of ammonia, urea and ammonium chloride, three forms of P, viz : imported

measurements made 54 months after planting (Table 12) indicated that in general growth of trees with legume covers was superior to the trees in naturals. (N. Yogaratnam, B. Arsekularatne and J. G. de Mel)

Table 12. *Effect of leguminous covers on the growth of immature rubber*

Treatment	*Mean girth (cm)*		
	C/77/1	C/77/3	C/77/6
Naturals	30·75	36·75	28·26
Pueraria	32·82	39·33	34·39
Calapogonium	31·63	37·10	32·28
Desmodium	31·51	37.88	32·83
Mimosa	28·53	34·35	32·45
Stylosanthus	30·28	36·79	30·69
Centrosema	31·03	–	33·84
LSD (5%)	NS	1·96	3·28

Nutrition of legumes (*G/70/2, C/77/8*)

Phosphate : The influence of phosphate application to covers was studied in an experiment *C/70/2* at Pussalla Estate, Parakaduwa. The ground cover treatments ceased to exist from 1974 and the phosphate treatments were also discontinued from 1974. Rubber trees that received phosphate still continued to show superiority in growth (Table 13) over the trees that did not receive any phosphate during the immature phase. This effect was shown irrespective of the type of cover grown. Moreover, application of P to cover continued to show their long term residual effect beneficial to the growth and yield of rubber in comparison with P application direct to the rubber tree. (N. Yogaratnam and M. Abesinghe)

Table 13. *Effect of phosphate application on growth and yield of rubber* (*C/70/2*)

Treatment	*Mean girth (cm)*	*Mean yield (kg/ha)*
Nil phosphate	60·96	1050
P to rubber	62·63*	1136
P to cover	65·41***	1222*
P to rubber and cover	65·37***	1227*
LSD (5%)	1·63	135

Potassium : The influence of potassium application to the ground covers was investigated in an experiment (*C/77/8*) on *Boralu* series. Results obtained at the end of 54 months after planting (Table 14) indicate that, unlike phosphate application, potassium application direct to the rubber trees appears to be as efficient as its application to the ground covers, especially on potassium deficient soils such as Boralu series. (N. Yogaratnam and B. Arsakularatne)

Table 14. *Effect of potassium on the growth of immature rubber in Boralu Series (C/77/8)*

Treatment	*Mean girth (cm)*
Rubber	
Nil potassium	32·84
Potassium to rubber	36·05**
LSD 1%	2·21
Cover	
Nil potassium	30·88
Potassium to cover – level 1	35·39**
Potassium to rubber – level 2	37·08***
LSD (1%)	3·84
LSD (0·1%)	5·19

Soil chemistry and fertility

Micronutrients

Studies on the factors influencing the micronutrient status of the rubber growing soils and their effect on nutrient concentrations in the leaf were continued. (N. Yogaratnam and M. A. Perera)

Sulphur (F/72/2)

The effect of fertilizers on the sulphur status of the soil as indicated by the SO_4^{2-} content in the soil was assessed in samples collected from experiment F/72/2. The results showed (Table 15) that the SO_4^{2-} content in the plots treated with ammonium sulphate was higher than in the other plots. (N. Yogaratnam, M. A. Perera and I. Denawaka)

Table 15. *Effect of nitrogen fertilizers on SO^{2-}_4 content of the soil (F/72/2)*

Treatment	*SO^{2-}_4 content (mg/kg soil)*	
	Depth (cm)	
	0–15	15–30
Control	92·4	130·5
Ammonium sulphate	141·0*	378·0*
Urea forked-in	97·2	188·7
Urea broadcast	101·3	146·1
LSD (5%)	30·2	67·5

Weed control

A new pre-emergent herbicide (Goal) was tested for reducing manual weeding costs when establishing legume covers in replantings. Three different concentrations 0·9, 1·8 and 2·7 l per ha were tested in an experiment at Eladuwa State Plantation. Effects of these treatments on legume cover seed germination and their growth were also assessed. It appears that this herbicide is effective in suppressing weed growth, but it also, at the concentration tested, interfered with the normal germination and growth of leguminous cover plants such as *Pueraria* and *Desmodium*.
(N. Yogaratnam and W. C. Dayaratne)

Soil moisture

A pilot study was conducted in order to determine a suitable sampling technique for the assessmet of leaf water potential in *Hevea* using a pressure bomb. The variables included in this study were: time of the day (based on different rates of transpiration), 0900 to 1000, 1300 to 1400 and 1700 to 1800 h, position of the leaves (exposed to sunlight and shaded leaves), and age of the leaves (tender, intermediate and mature leaves).

Results of this study appear to show that the time interval 0900 to 1000 h and 1700 to 1800 h are liable to give high values of coefficient of variation in comparison to the interval 1300 to 1400 h. It also appears that sampling of exposed leaves in the mature stage is likely to give more consistant results. (N. Yogaratnam and L. J. Wickramasinghe)

This study was extended to include other variables such as clones, RRIC 36, 52, 100, 101, 102 and 103, RRIM 600 and 623, IAN 45/710 and PB 86 and soil types. (L. Ratnapala and P. Karunadasa)

Other investigations

Brown bast

An attempt was made to study the nutritional and chemical aspects associated with this physiological disorder. Latex samples were collected from healthy, slightly affected and fully affected trees of highly susceptible clones as well as from healthy trees of less susceptible clones, and the following analyses were done:

(1) Composition of nutrients in latex system

(2) Distribution of substances in centrifuged latex

(3) Nutrient composition of different phases of centrifuged latex

(4) Effects of addition of chemicals such as acid, ammonia, salts that can extract, precipitate or form complexes with some nutrients in latex, on the distribution pattern of nutrients in different phases of centrifuged latex. (M. K. S. A. Samaraweera, S. Nandasiri Silva, M. Costa and N. Jayasooriya - vacation student)

Extension

Foliar survey for discriminatory fertilizer recommendations

The foliar survey programme for 1981 commenced in the first week of June. Estates covering an approximate area of 6472 ha were surveyed this year. Of these areas 747 ha were new surveys and 5725 ha were resurveys. Fertilizer recommendations to all these estates were sent in December. In general N and K fertilizers were recommended to almost all the plantings but P and Mg to a few plantings only. Urea was recommended as the source of nitrogen for 75% of the plantings. (N. Yogaratnam and W. C. Dayaratne)

REVIEW OF THE RUBBER CHEMISTRY DEPARTMENT

By

S. W. KARUNARATNE

SUMMARY

The Department worked with a depleted staff during the year. Frequent power cuts during the first half of the year was a major hindrance to the progress of the work. Departmental staff continued to give assistance to a UNIDO sponsored project on the development of thermoplastic natural rubber (TPNR).

The role of nitro and nitroso compounds in polymers during the action of UV light is discussed in the light of research carried out with reference to liquid rubber manufacture and a possible mechanism is suggested.

A new route to bond non staining antioxidant to NR has been suggested and the products are being evaluated.

Thc role of milling and the use of peptisers in the reduction of viscosity of rubber is discussed at length and trial lots of CV/RSS and CV/crepe were prepared for evaluation. Skim rubber was used to prepare low viscosity rubber by the same method.

Work on cyclised rubber is being continued and several firms were assisted in the formulation of compounds using cyclised rubber.

New preservative systems for latex were tried out which would qualify for specialized applications.

Latex/bitumen and latex/cement compositions were used widely in the water proofing of concrete roofs and the departmental staff provided the technical know how to several establishments having water seepage problems.

Several encapsulating agents were tried out in the preparation of granular rubber. These were synthesized by free radical polymerisation. It was also possible to build in antioxidant groupings to the encapsulating agents.

Several new antioxidants based on Mannich bases and dithiocarbamates were synthesized and tried out with NR. They showed considerable promise as antioxidants for NR.

The Specifications Unit and the Crepe Rubber Development Unit (CRDU) functioned as usual. The CRDU handled most of the advisory work connected with raw rubber manufacture. Problems connected with the bleaching agent in crepe manufacture were investigated in several instances. Further small scale trials were carried out on solar drying of crepe rubber.

Biochemical research was carried out separately at Dartonfield. Changes in protein pattern during latex flow were studied by electrophoresis with reference to a few selected clones.

DETAILED REVIEW

Thc work of the Department is described under five main sections. The Rubber Chemistry section is mainly concerned with studies oriented towards chemical modification of natural rubber; Rubber Technology is concerned with technological studies; the Specifications Unit is involved mainly with analysis of raw rubber; the Crepe Rubber Development Unit (CRDU) gives advice on the manufacture of crepe rubber and the Biochemistry Unit is concerned with biochemical studies.

Staff

A separate elcctronic servicing laboratory was constructed during the course of the year. This will also function as a separate unit within the Department.

Mr S. W. Karunaratne, Head of the Department, Dr P. A. J. Yapa, Biochemist, Dr A. Coomarasamy, Rubber Chemist, Mr M. C. S. Perera, Assistant Rubber Chemist, Mr M. D. R. J. Goonatilake, Assistant Development Officer and Mr P. A. D. T. Vimalasiri, Assistant Specifications Officer were on duty throughout the year. Mr K. C. Croose, Mr P. W. Sedirishamy and Miss C. P. Wickremasinghe continued to work as Experimental Officers throughout the year. Messrs A. S. Dekumpitiya, D. D. Medagama and S. Kasinathan served as Senior Technical Officers throughout the year. Technical Officers, Messrs D. G. Samaneris, W. D. Dharmasena, K. N. U. Mithrananda, Mrs D. Nirmala, Mrs Manel Neelaweera, Mrs N. Baduge, Mrs S. Weeraman and Misses W. C. M. Perera, R. L. Perera and M. K. Wickramapala were on duty throughout the year. Specification Assistants, Messrs W. A. S. Wijesekara, T. M. Ahamadeen, T. A. S. Siriwardene, G. Wanigatunga, R. Wickremaratne, K. B. Abeysundara and Mrs D. K. Goonawardena were on duty throughout the year.

Dr N. C. C. Walpita was appointed Visiting Senior Research Officer (Chemical/ Mechanical Engineer) and assumed duties in October.

Assistant Rubber Chemists, Mr H. K. P. Abeywardena, Miss S. Salam and Miss G. D. S. Abeywickrema joined the Institute at the beginning of the year. Miss S. P. S. I. Senanayake assumed duties as a Technical Officer in the Biochemistry section in April, this year. Mr. P. U. Sarath Kumara joined as Technical Officer in September 1981. Mr P. D. J. Rodrigo joined as Specification Assistant in April 1981. Mrs L. Rukmani joined as Stores Assistant in October 1981.

Mr L. B. K. Silva was promoted as Research Assistant to work in the central electronic servicing laboratory with effect from 1 October 1981. Mr P. P. Jayasinghe was promoted as Experimental Officer in July 1981. Messrs M. D. C. Seneviratne and K. K. Austin were promoted as Specification Assistants in August 1981.

Mr I. H. S. L. Weerasinghe, Technical Officer was transferred to the department with effect from 30 November 1981.

Rubber Chemist, Dr M. R. N. Fernando resigned on 30th June 1981. Assistant Rubber Chemists, Mr H. K. P. Abeywardena and Misses S. Salam and G. D. S. Abeywickrama resigned towards the end of the year. Technical Officers, Mr Anura de Silva and Miss D. Nalika resigned in September and December respectively.

Research students

Three students, on National Science Council (NSC) grants continued their research projects leading to the M. Sc. degree supervised by departmental staff. Two others completed their projects.

Miss A. M. I. Jayawardena's project on 'Synthesis of new types of antioxidants for NR' was supervised by Dr A. Coomarasamy and Mr S. W. Karunaratne. Miss M. Angammana's project on 'The effect of metal salts of higher fatty acids on sulphur vulcanisation of NR and its blends' was supervised by Dr W. S. E. Fernando and Dr A. Coomarasamy.

Mrs W. Goonawardena's project on 'Liquid NR and chemical modification thereof' was supervised by Dr L. M. K. Tillakeratne and Dr A. Coomarasamy.

Mrs Karnika de Silva completed her project on 'Some aspects of modification of NR' in October this year. Th s project was supervised by Dr A. Coomarasamy.

Mr S. P. Prematillake completed his studies in April, on serum proteins under the guidance of Dr P. A. J. Yapa.

Vacation assignments were given to Mr A. W. E. Wijesooriya (Peradeniya University), Mr H. P. C. K. Jayawickrema (Colombo University), Mr K. Premachandra (Moratuwa University), Miss R. Ratnasingham (Jaffna University), Mr D. A. S. M. Arsecularatne (Peradeniya University) and Miss G. Munasinghe of the Ruhunu University College.

Visits

Dr W. S. E. Fernando, who proceeded to U. K. in June 1980 to work at the MRPRA on a UNIDO sponsored Project for the development of Thermoplastic Natural Rubber returned in July 1981, after completing his assignment.

Dr L. M. K. Tillakeratne, who was in U. K. on a Nuffield Foundation Scholarship returned in October 1981. He was attached to the University of Aston and carried out research on the use of nitro, nitroxy and nitroso compounds as antioxidants, under the guidance of Professor Gerald Scott.

Mr K. A. R. M. Perera, Technical Officer proceeded to U. K. in August 1981 on a C-Plan Scholarship to undertake studies on rubber processing at RAPRA.

Meetings

A. Coomarasamy attended a symposium, sponsored by UNIDO and held in Thailand on the 14th and 15th of May on the preparation and uses of powdered rubber, thermoplastic rubber and liquid natural rubber.

The departmental staff followed a residential course in Statistics held at Dartonfield from the 20th to 23rd July 1981. S W. Karunaratne participated at a Seminar on Rubber Products held at the I. D. B. in August 1981. S. W. Karunaratne and P. P. Jayasinghe assisted the NIBM in conducting a training programme for small and medium scale industrialists on the 25th and 26th of August 1981. M. C. S. Perera followed a seminar on quality management at the NIBM. He also participated in the Technical Exhibition (1981) fair and congress held at the BM1CH. M. C. S. Perera read a paper on the use of solar energy in the drying of rubber. S. W. Karunaratne delivered a talk on NR research and development at the regional seminar conducted by the SLAAS at Peradeniya on the 4th and 5th of September 1981. S. W. Karunaratne and M. C. S. Perera organized and participated in a training programme sponsored by the NIPM/SPC for Superintendents and Rubber Factory Officers attached to plantations in the Galle District. This training programme was held in Galle in September 1981. S. W. Karunaratne participated in a workshop on trade in RSS organized by the Export Development Board on 24th April 1981.

M. C. S. Perera and M. D. R. J. Goonatilake participated in several planters' conferences organized by the J. E. D. B. Several seminars were conducted in the department during the year on current topics of interest.

The research staff served on the following committees:

S. W. Karunaratne – Head of the Department

Drafting Committees organized by the Bureau of Ceylon Standards, to set up standards for rubber and rubber products.

Member of the Rubber Advisory Committee set up by the Export Development Board.

Technical services centre for rubber development of the Industrial Development Board and the Education Committee of the PRI.

M. C. S. Perera - Assistant Rubber Chemist

Secretary to the General Research Committee of the SLAAS.

P. A. J. Yapa – Biochemist

Hony, Secretary for the SLAAS committee on 'Popularisation of Science'. Member of the Faculty of Applied Science of Sri Jayewardenapura University, attended 8 meetings. A member of the editorial sub – committee for Vidya Viyapthi Magazine.

L. M. K. Tillakeratne – Rubber Chemist and Specification Officer
Served as Director of SRMC during the year.

S. W. Karunaratne was given a World Bank assignment for 3 months (September to November 1981) to assist in drawing up a programme of training in the processing of rubber.

Lectures in Polymer Chemistry and Technology and Biochemistry were given by our officers to students preparing for the National Diploma in Technology (NDT, Moratuwa University), Applied Science course (Moratuwa University), and M. Sc. course in Biochemistry (Colombo University).

Publications

Coomarasamy, A., de Silva, K. and Wijesinghe, N. P. (1981). Preparation of free flowing granular natural rubber. *J. Rubb. Res. Inst. Sri Lanka* (in press)

Coomarasamy, A., Perera, P. P. and Nadarajah, M. (1981). Preparation and uses of cyclised rubber obtained from papain coagulated rubber. *J. Rubb. Res. Inst. Sri Lanka* (in press)

Fernando, W. S. E. and Perera, M. C. S. (1981). Mastication and green strength of *Hevea* rubber. *J. Rubb. Res. Inst. Sri Lanka* (in press)

Goonatillake, M. D. R. J. and Jayasinghe, P. P. (1981). Technological properties of sole crepe.

Abstracts

Jayawardena, I., Coomarasamy, A. and Karunaratne, S. W. (1981). Synthesis of antioxidants for natural rubber from hindered phenols and amines. *Proceedings of the thiry-seventh annual sessions of SLAAS*, December, 1981, Part I.

Goonawardena, W., Coomarasamy, A. and Tillekeratne, L. M. K. (1981). Effect of nitrobenzene and other photoactivators on the photo chemical reactions of natural rubber and model olefines. *Proceedings of the thirty-seventh annual sessions of SLAAS*, December, 1981, Part I.

Prematillake, S. P. and Yapa, P. A. J. (1981). Behaviour of proteins during latex flow of *Hevea brasiliensis*, *Proceedings of the annual sessions of the Institute of Chemistry.*

Reports

Karunaratne, S. W. A report was submitted to the World Bank, on the processing of smallholder rubber.

Coomarasamy, A. A report on a visit to Thailand to attend the UNIDO International symposium on powdered, liquid and thermoplastic NR.

Tillekaratne, L. M. K. A report on the activity of organic nitro and nitroso compounds during the UV and thermal ageing of polymers, October, 1981.

Thesis

de Silva, K. (1981). Studies on the use of carboxyl group containing polymers as encapsulating agents for natural rubber.

Research and Technology

Preparation of liquid natural rubber

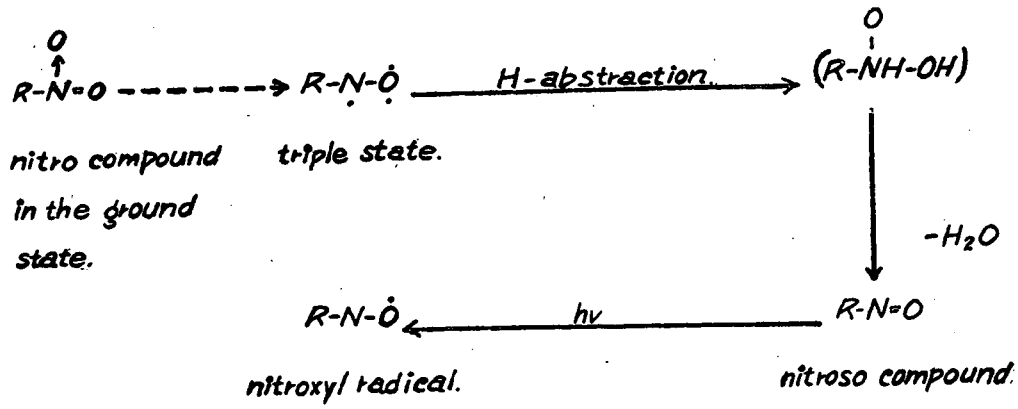
It has been shown earlier that nitrobenzene could be used as a photoactivator for the preparation of liquid rubber by sunlight irradiation. In order to study the mechanism involved in the oxidation, experiments were carried out with model compounds such as 1-methyl cyclohexene and cyclohexene in the presence of nitrobenzene, benzophenone and ferric acetyl acetonate. The product analysis by GLC using poly ethylene glycol 20 M column revealed that the highest value for ketone to alcohol ratio was obtained when nitrobenzene is used as the photoactivator. It was also found that azo benzene is formed when nitrobenzene is used as the photoactivator. The formation of azobenzene in nitrobenzene catalysed reactions indicates a new mechanism of chain scission which involves direct participation of nitrobenzene in a reaction at the double bond, resulting in the formation of carbonyl compounds and azobenzene.
(Wijayanthi Goonawardena and A. Coomarasamy)

Nitro and nitroso compounds in polymers with UV light

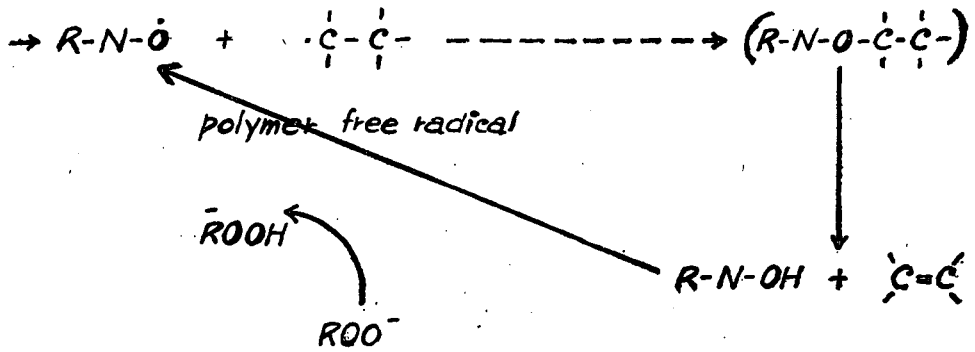
Simple alkyl nitro and nitroso compound were mixed with polypropylene powder in the torque rheometer and the film samples obtained by compression moulding of the mixed polymer were exposed to UV radiation in the SB Cabinet.

Infra red spectra were recorded at different lengths of exposure to UV radiation to study the changes in functional groups occuring during the reaction. Melt flow index determination was also carried out with the exposed samples along with the checking of the films for embrittlement.

Results obtained indicated that alkyl nitro compounds stabilize polyolefines more than the stabilization caused by the aryl nitro compounds, which according to the literature acts via the nitroxyl radical intermediate. The nitro compound was also seen to act through the same nitroxyl radical intermediate. Hence the following mechanism was proposed to explain the activity of the alkyl nitro compound in the polymer under the influence of UV light.



The nitroxyl radical thus formed stabilizes the polymer from degradation by scavenging the free radicals formed during irradiation; and regenerated by the following mechanism. Further work in this project is in progress. (L. M. K. Tillakeratne)



A new route to bond non – staining antioxidant to NR

An attempt was made to use a phenolic antioxidant derivative containing a carbonyl reagent to improve its retention in vulcanized rubber. This is a follow up to the work conducted at MRPRA which showed that NR when masticated with the derivative (IPHR) at 90°C for 4 min is capable of retaining 80% of the material.

Centrifuged latex and latex crepe IX have been used in this investigation and oven ageing studies are in progress.

Two samples of latex crepe containing 1 phr each of Nonox WSP and the experimental antioxidant were despatched to M/s Weber & Schaer, Germany for evaluation. These have been directed to producers of special rubber threads and surgical rubber goods. Our claim for viscosity stabilization of crepe in addition to antioxidant activity of this chemical was supported by trials conducted in Germany. A request has been made for immediate delivery of 12 kg rubber for further evaluation.

Centrifuged latex containing 1 phr Nonox WSP and the experimental antioxidant were prepared for further investigation. The success in surgical applications of this modification not only depends on the performance of the antioxidant but also of its approval by the Federal Drugs Administration. (W. S. E. Fernando, K. M. U. Mitranananda and W. D. Dharmasena)

Manufacture of CV rubber

An attempt was made to incorporate readily available peptisers, Renacit 7, RRI 7 and Rupepa 37 to reduce the viscosity of raw rubber. Trials carried out at Mawanella indicated that the rubber of any desired Mooney viscosity could be prepared using these three peptisers. By incorporating 1·5% hydroxyl amine, neutral sulphate it is possible to stabilize viscosity at the desired value. A 500 kg sample was sent to M/s. Weber & Schaer, West Germany, for evaluation of its quality. (L. M. K. Tillakeratne, P. A. D. T. Vimalasiri and G. A. de Silva)

Manufacture of low viscosity skim rubber

Incorporation of peptisers together with viscosity stabilizer into skim latex was achieved at Mawanella Block Rubber Factory, to produce low viscosity skim rubber. This could be coagulated using conc sulphuric acid or formic acid. Since drc of skim latex is 5-6% the coagulum formed was too soft to be crumbled by hammer milling. Therefore crumbling was done in a two roll mill using a crumbling agent. Formic acid coagulated latex showed better physical properties and drying characteristics. A 100 kg sample of this grade of rubber of Mooney viscosity 30± was sent to Weber & Schaer for evaluation of its quality. (P. A. D. T. Vimalasiri and G. A. de Silva)

Manufacture of peptised low viscosity CV rubber

Trials carried out at Mawanella Block Rubber Factory indicated that constant viscosity rubber of low Mooney viscosity could be produced by incorporating RRI 7 and Renacit 7 together with hydroxyl amine neutral sulphate. Renacit 7 was found to be very effective in reducing the viscosity at 100°C which is the drying temperature of TSR According to its viscosity TSR could be categorized into 3 new grades such as rubber of Mooney viscosity 20, 30-40 and 40-50. These grades of rubber were successfully prepared at Mawanella Block Rubber Factory and samples were sent to M/s Weber and Schaer. After preliminary investigations of their quality, 200 kg trial batch was requested by M/s Weber and Schaer. By soaking TSR crumbs in Renacit 7 dispersion followed by HNS solution it was able to produce low viscosity scrap rubber at Ceymac Rubber Company Limited, Horana. (L. M. K. Tillakeratne, P. A. D. T. Vimalasiri and G A. de Silva)

Preparation of constant viscosity sheet rubber

Trials were carried out at Kesbewa and Miriswatta G. P. C. C and Igalkanda Estate. Hydroxylamine neutral sulphate (HNS) was used as the viscosity stabilizer and it was found that 0·2% of HNS on rubber is adequate for this purpose. Addition of sodium bisulphite to the latex prior to the addition of HNS and coagulation does not seem to interfere with viscosity stabilization. Mooney viscosity value of the rubber prepared was in most cases about 77 to 80 and the $\triangle P$ obtained by Accelerated Storage Hardening Test (ASHT) was less than 3. Trials were also carried out with HNS and peptiser RRI 7 in order to obtain viscosity stabilized rubber having a Mooney viscosity value around 60. Results indicate that it is possible, to obtain sheet rubber having these viscosity characteristics. The addition of peptiser does not affect the PRI value significantly at the concentrations used. Trials were also carried out with other chemicals to bring about a reduction in Mooney viscosity. (A. Coomarasamy, P. Sedirishamy, D. Nirmala and D. Nalika)

Coagulum milling of crepe rubber to suit CV requirements

Several experiments were carried out at Dartonfield Factory to assess the viscosity behaviour of crepe rubber with the increasing no of passes through grooved and smooth mills. Hydroxylamine neutral sulphate was added to latex at 0·15% to stabilize the viscosity. Raw Mooney viscosity, plasticity, storage hardening, plasticity retention index were measured and the results are given in Table 1.

Table 1. *Effect of number of passes through the smoo th mill on VR*

Latex type	*No. of passes grooved mill*	*smooth mill*	*VR*	P_0	ΔP	*PRI*
(1) Fractionated & bleached (FB) latex (12% fraction) + 0·15% NH_2OH	5	1	73·0	40	5	59
(2) FB latex (12% fraction) +0·15% NH_2OH	5	3	67·0	35	6	41

It was also observed that the passes through smooth mills most effectively lower the viscosity due to the high friction ratio between the two rollers. One main disadvantage is the lower PRI of these rubbers and this may be due to iron contamination during the milling stage. Further investigations are being carried out to improve PRI. (W. S. E. Fernando and M. D. R. J. Goonatillake)

Cyclised rubber

A series of microcellular compounds were prepared using cyclised rubber obtained from papain coagulated rubber by the solid rubber method, commercially available high styrene resin and mixtures of these resins in different proportions, as the reinforcing filler. These reinforcing fillers were incorporated as a 3 1 masterbatch (Resin : Rubber 3:1). The accelerator combination consisting of MBTS at 0·45 phr and TMTD at 0·3 phr was found to be suitable in these compounds. The results obtained showed that it is possible to substitute high styrene resin by up to 55% of cyclised rubber in the reinforcing filler, without undue loss of the physical properties of the final product.

Technical assistance was given to a leading firm on the manufacture of road marking paints and floor paints based on cyclised rubber. (A. Coomarasamy, L. B. K. Silva and D. G. Samaneris)

Preservation of latex

Experiments are being repeated at Dartonfield to manufacture low ammonia preserved latex using sodium diethyl dithiocarbamate (SEDC) and sodium dimethyl, dithiocarbamate (SDMC). SEDC was the more effective preservative. SDMC preserved latex gave a very poor mechanical stability time (MST).

SDMC alone as a preservation in low ammonia, LATZ latex proved ineffective but the addition of COFA (Coconut Oil Fatty Acid) improved the MST. (S. W. Karunaratne and Manel Neelaweera)

Preparation of polyvinyl acetate latices

Suitable recipes for polymerization of vinyl acetate with other co-monomers such as ethyl hexyl acrylate and vinyl ester of versatic acid are being developed. These latices could be blended with NR latex without coagulation problems. (A. Coomarasamy)

Latex/bitumen and latex/cement system in waterproofing applications

Mason's Mixture Limited continued the manufacture and marketing of latex/bitumen mixture for waterproofing concrete roofs, and the necessary advice was provided by us. The cooling unit of the central air conditioning plant at the Nylon 6 factory of Petroleum Corporation was treated using our process for waterproofing.

Assistance was given to various institutions and private organisations at their request to carry out waterproofing flat concrete roofs and water tanks, using the formulations developed for these applications based on latex/cement and latex/bitumen mixes. (M. R. N. Fernando, S. W. Karunaratne, K. A. R. M. Perera and K. C. Croose)

Rice huller rollers

The effect of using skim rubber as a part or whole of the polymer in rice huller roller compounds was studied. The formulation used was selected from the series of compounds previously investigated in our laboratories. The results obtained showed that the best set of properties is obtained from a formulation consisting of a 50/50 blend of RSS 1 and skim rubber. Table 2 shows the proportion of skim rubber to RSS 1 in the formulations studied along with technological properties.

Table 2. *Proportion of skim rubber to RSS in the formulations studied*

Formula	1	2	3	4	5
*RSS 1 (pbw)**	85	0	42·5	60	25
Skim rubber (pbw)	0	85	42·5	25	60
Technological Properties					
Hardness, IRHD	97	97	95	90	94
Resilience, % Rebound	43	35	38	38·3	36
Abrasion Resistance					
Vol. loss/min, cc	0·2121	0·2288	0·1884	0·2017	0·1976
Elongation at Break	350	283	347	339	352
Tensile Strength MN/m²	15·2	11·2	14·0	14·4	13·6

* Parts by weight.

The effect of accelerators in rice huller roller compounds was studied using formula 3 in Table 2. Out of the accelerators TMTD gave satisfactory results compared to TMTM.

A set of rice huller rollers was prepared at Don Somapala Corporation, Kelaniya, and these were tested at a rice mill at Ambalantota and compared with imported Chinese rollers.

The performance of the imported rollers were better and it was necessary to further adjust the formulation. Silane coupling agents were used to improve the hardness in the new compounds, which are being evaluated. (M. R. N. Fernando, S. W. Karunaratne and K. C. Croose)

Custom Compounding

The study was initiated using the following formula:

Rubber	100
ZnO	5
Stearic acid	1
ZDC	0·1
MBTS	0·9
S	2·5

Field latex was used without diluting. Addition of ZnO gave coagulation problems, hence it was excluded. The sample with 0·05 parts of Renacit 7 and 0·9 parts of MBTS gave a very low Mooney but the addition of S inhibited the peptising action as expected.

MBTS alone was not effective at the drying temperature of 100°C.

A retarder was added to overcome the problem of pre/vulcanization during drying. Since a retarder is not effective in a formulation with ZDC, this accelerator was taken out from the formulation. (M. C. S. Perera and D. G. Samaneris)

Mastication and green strength of NR

In this work it was observed that the incorporation of a desiccant such as caloxol WSG retarded the mastication of *Hevea* rubber at temperatures between 30-140°C. The formation of cross links via a process similar to aldol condensation occuring during storage hardening of *Hevea* rubber was thought to be responsible for this process. The presence of caloxol WSG greatly increased the green strength of compounded unvulcanized *Hevea* rubber. (W. S. E. Fernando and M. C. S. Perera)

Metal salts of higher fatty acids as activators for vulcanization

The effect of dispersing stearic acid and metal stearates (in varying proportions) in rubber process oil on vulcanisates containing white fillers was studied.

Formulation used	*Sample 1*	*Sample 2*
Pale crepe IX or I	100·0	100·0
Zinc oxide	5·0	5·0
Dispersion of stearic acid/metal stearate in rubber process oil	4·5	4·5
China clay	40·0	40·0
MBTS	1·25	1·25
TMTD	0·25	0·25
Sulphur	2·5	2·5
Paraffin wax	1·0	1·0
Antioxidant WSP	1·5	–

Cure characteristics were studied using the Monsanto Rheometer. Samples were cured at 140°C at their respective optimum cure time.

Calcium stearate dispersions were incorporated into rubber according to an industrial formulation (Asia Limited).

Sample 1 Control
Sample 2 Cast dispersion
Sample 3 Cast dispersion with phthalic anhydride

Calcium stearate was found to decrease the scorch time and a retarder was added to remedy this. Cure characteristics were studied and samples were cured at 140°C at their respective optimum cure time.

Properties of the vulcanisates such as tensile strength, modulus at 100% and 300%E, stress relaxation, ageing, hardness, abrasion resistance and flex resistance were studied.

Samples which showed the best ageing properties were prepared and oxygen absorption measurements were taken. A study of the metal ion concentration that bloom to the surface was carried out by soaking the sample in a suitable solvent (toluene) and determining the metal content at intervals of 24 h, 48 h, etc. by the atomic absorption method. (A. M. Angammana, A. Coomarasamy and W. S. E. Fernando)

Flame resistant rubberized coir

Flame resistant characteristics of rubberized coir products could be improved by suitable treatment of coir or the rubber latex or both, with flame retardant chemicals. Samples of rubberized coir were prepared by spraying compounded latex containing boric acid, borax, calcium pyro phosphate, alumina, antimony trioxide, locally available fluoro apatite, chlorinated paraffin such as cereclor S 45 and combinations of these chemicals. Samples were also prepared with latex modified with bromo trichloro methane in the presence of free radical redox catalysts. The samples containing antimony trioxide, calcium phyrophosphate and the samples prepared with bromotrichloro methane modified rubber latex were observed to be the most resistant. (A. Coomarasamy, S. Salam, D. Nirmala and D. Nalika)

Granular rubber

Copolymers of acrylic acid, methacrylic acid with acrylamide were synthesized by free radical polymerization for use as encapsulating agents for the preparation of granular natural rubber, suitable recipes for polymerization were developed by studying the kinetics of polymerization using dilatometry. The polymers were characterized by viscosity measurements, IR spectroscopy and by acid value detemination. These polymers and commercially available sodium alginate were used for the preparation of granular rubber samples. The properties of granular rubber samples were evaluated and found to be satisfactory. Encapsulating agents containing antioxidant groupings were prepared by reacting 4-amine diphenylamine either with the acid chloride of the monomer or the polymer containing carboxylic groups. The evaluation of the properties of the granular rubber prepared with the encapsulating agents is in progress. (A. Coomarasamy, K. G. K. de Silva, P. Sedirishamy and D. Nirmala)

Chemical Modification of Natural Rubber

Chlorine containing modified rubbers

There is no convenient method available at present for the estimation of chlorine content in polymers. Standard sodium peroxide method is not very convenient for routine use. It was found that Schoniger oxygen flask, which is used for the estimation of sulphur by M/s Dunlop Limited is suitable for the estimation of chlorine in polymers. Here the sample is ignited in an atmosphere of oxygen contained in the one litre flask. The sample should be tightly wrapped up by platinum gauze to ensure complete combustion. The hydrogen chloride formed on combustion reacts with the barium carbonate suspension contained in the flask to form barium chloride. The barium chloride formed can be quantitively estimated either by titration, or gravimetrically. The results obtained by this method were compared with the results obtained by sodium peroxide method and sodium fusion method (similar to Lassaignes fusion test used in qualitative analysis). The accuracy of the oxygen flask method in the form of mean and standard deviation was found to be comparable to that of the sodium peroxide method. Rubber

hydrochloride prepared from latex and bromotrichloro methane modified rubber were used in the experiments. (A. Coomarasamy, Sithy Salam, and H.P.C.K. Jayawickrame)

Epoxidation of NR latex

Epoxidized rubber samples were prepared from latex by the *in situ* method using hydrogen peroxide/glacial acetic acid as the reagent. Estimation of epoxy content by the hydrogen bromide method revealed that it is possible to obtain samples with 20% of the double bonds converted into epoxy groups using 30% hydrogen peroxide. (Sriyani Abeywickrama and A. Coomarasamy)

Epoxidation of rubber seed oil

Epoxidation of rubber seed oil was done by treating the rubber seed oil directly with pre-formed peracetic mixture which contained about 28% peracetic acid. Epoxidized rubber seed oil thus prepared was incorporated into PVC and its heat stabilizing effect was studied and found to be comparable to that of the commercially available epoxidized soya bean oil. A sample was supplied to a PVC products manufacturing firm for their evaluation. (P. Abeywickrema, A. Coomarasamy and Chitra Perera)

Synthesis of new antioxidants for NR

The work carried out on the synthesis and characterization of antioxidants based on 2,6 di-tert-butyl phenol has been summarized in the last Annual Review. The antioxidants based on cardanol and metacresol with dimethyl amine, piperidine and morpholine were synthesized during this year. The characterization was done using Infra Red, Nuclear Magnetic Resonance and Mass Spectroscopy. The antioxidant synthesized belong to two groups of compounds namely Mannich bases and dithio-carbamates.

The volatility of the compounds was determined, at 100°C in an air circulating oven. The values obtained for all dithio-carbamates and the derivatives of cardanol, are comparable to those of the commercial antioxidants.

The following formulation was used for the preparation of gum compounds.

Rubber	100·0 g
Stearic acid	3·0 g
ZnO	5·0 g
Antioxidant	1·0 g
Accelerator	0·7 g
Sulphur	2·5 g

For comparative purposes gum compounds were also prepared with commercial antioxidants such as 2:2[1] – methy lene - bis 4 (6 - (methyl cyclohexyl phenol-) *para* cresol (Nonox WSP), 2:2[1] methylene bis (4 methyl, 6-tert-butyl phenol) (CAO 5) and styrenated phenol (Nonox SP).

The curing characteristics of the gum compounds were studied using the Monsanto Rheometer. Scorch times, cure times and cure rate indices were calculated. From the results it can be seen that the values for scorch times are generally comparable to those samples containing commercial antioxidants. The values obtained for cure times, especially in the case of antioxidants containing dithiocarbamate groups are shorter and the cure rate indices are higher. The dithiocarbamate group accelerates the rate of cure without reducing the scorch time significantly.

The vulcanisates were prepared at 140°C and the following tests were done to evaluate the antioxidant activity. Accelerated ageing tests were carried out at 85°C for 72 hours and the percentage retention of tensile strength, modulus at 100% and 300% elongation and elongation at break were calculated. The results indicate clearly that most of the compounds synthesized have comparable antioxidant activity to Nonox WSP and are better than that of Nonox SP.

Oxygen absorption measurements at 100°C and stress relaxation at 85°C were performed, for all the samples. The results show that the cardanol derivatives are more active than Nonox SP but somewhat less active than Nonox WSP.

These compounds show considerable promise as antioxidants for NR.

The compounds synthesized from cardanol are particularly interesting from the commercial point of view, as cardanol is a locally available raw material. (Indrani Jayawardena, A. Coomarasamy, and S. W. Karunaratne)

Low Temperature Curing Compounds

Further work on low temperature vulcanizing natural rubber formulations was continued. A series of compounds containing binary and ternary combinations of TMTD, DPG and MOR were prepared and tested. The amount of sulphur and stearic acid in these compounds was also varied. The main intention of this exercise was to study the effect of synergistic combinations on scorch time and to achieve induction periods comparable to that of a typical tyre tread vulcanizing system. The formulations studied and their properties are given in Table 1 and 2. In contrast to the compounds studied earlier the present systems also contained an antioxidant. Modulus at a number of elongations were measured as it is known that the tensile strength measurements of given compounds are often misleading. (M. R. N. Fernando, K. A. R. M. Perera and W. C. M. Perera)

Raw Rubber Specifications

Testing of Block Rubber for TSR Specifications

During this period 22508 TSR samples were tested. The average number of samples tested per working day was about 120. The details of the number of samples tested from various TSR producers are given in Table 3.

Table 3. *Identity and main grades of block rubber produced in Sri Lanka*

Code	*Producer*	*Number of Samples*	*Main grades of SLR produced*
AA	State Rubber Manufacturing Corporation	2585	5L 5,10
AB	Cenat Block Rubber Factory, Paiyagala	2318	5,10,50
AD	Statcon Rubber Co. Limited, Getahetta	3839	5,10,20,50
AE	Sherman Sons Limited	6659	5L,5,5(RSS)20,50
AF	Ceymac Rubber Co. Limited	2943	5L.5(RSS)10,20,50
AG	Orient Rubber Products Limited	441	5
AH	Star Rubber Works Limited	3723	5,10,20,50

Inspection visits

Routine inspections were carried out as usual. All the factories were visited on a regular basis to carry out sampling and to give advice on how to improve block rubber production.

Miscellaneous analysis

Routine testing of miscellaneous rubber samples, latex, chemicals and masterbatches were undertaken by the specifications section. The number of tests carried out were:

Miscellaneous rubber samples	892
Masterbatches	420
Latex testing	21
Chemicals	12

(L. M. K. Tillekaratne, P. A. D. T. Vimalasiri and A. S. Dekumpitiya)

Carbon black in masterbatches

Carbon black content in CB masterbatches and camel back's is now determined by dissolving the rubber portion of the compound in a suitable solvent and then filtering and weighing the amount of free carbon. Since this is a tedious method, a density method was tried for quick accurate results.

Two sets of samples were prepared with varying amounts of C/B and rubber, and constant amounts of other major components. The densities of these standard samples were measured and graphs of density against the percentage of C/B were plotted.

Comparison of the two methods using industrial samples indicated that the two methods are comparable.

It was concluded that the density method can be used for C/B determination, instead of the presently used method, because it is a simple and quick method, and the results are in good agreement. Also, a considerable saving on chemicals and man power can be achieved by using the density method. (S. W, Karunaratne and P. Abeywardena)

Standardisation of RSS sizes

The accepted size of sheet for conventional packing in 100 kg and 111.1 kg bales is 600 mm x 430 mm (approximately 22" x 17").

The preferred bale weight for palletization is 50 kg or ideally 33⅓ kg which is the standard bale size for technically specified block rubber. In order to press into 33⅓kg bales of standard dimension, 675 mm x 330 mm, the size of the present sheet (600 mm x 430 mm) is awkward and it would be far easier to handle a sheet of size 675 mm x 330 mm.

Several experiments using four different pan sizes as given in Table 4 were conducted at a GPC.

Table 4. *Pan sizes*

Sample No	*Pan size (cm)*
A	25·0 x 52·5
B	27·5 x 47·5
C	28·75 x 55·0
D	30·0 x 50·0

The results obtained are given in Table 5. Statistically, it can be concluded that by using similar weights of rubber in the four (4) different pans, the best sheet length comes from pan C which has a length of 55·0 cm and the best breadth comes from the pan B which is 27·5 cm wide. A pan size corresponding to these dimensions gave reasonably close results. (S. W. Karunaratne and M. D. R. J. Goonatillake)

RSS bale marking inks

Hitherto our sheet rubber which was exported to China as 100 kg bales carried only one colour (Black) for all grades. Consequently the identification of different grades was found to be difficult. As a remedy for this, China authorities have suggested that RSS grades 1, 2 and 3 should be marked in 3 different colours. The colours suggested were:

RSS No. 1 – Red
RSS No. 2 – Blue
RSS No. 3 – Black

The Department of Commodity Purchase handed us the task of making suitable inks for this purpose. Initially some trials were carried out using a rubber paint prepared by incorporating the pigment into the rubber and dissolving the pigmented rubber in waste turpentine. The paint was satisfactory but the drying quality was poor. Further trials were carried out using locally available material. These inks were tested in our laboratories as well as the Commodity Purchase Stores and these were found to be satisfactory. Cost per bale works out to less than 6 cts. Colour fastness and rubbing qulitites of the paint during transit was found to be satisfactory. (S. W. Karunaratne, R. Goonetillake and P. P. Jayasinghe)

Table 5. *Effect of pan size on the size of the sheets*

	Mean				*Variance*			
	A	B	C	D	A	B	C	D
Weight (g)	513·09	525·75	525.00	529·40	6438·14	5218·29	6258·43	6346·00
Length (cm)	77·85	74·49	70·27	72·65	176·86	262·26	27·65	26·71
Breadth (cm)	35·09	34·50	37·52	38·65	5·63	4·04	18·61	31·69

Smoke house with adjustable capacities

It was observed that some of the smoke houses having larger capacities, have to be run at their full capacity even on low cropping days. As a consequence of this the firewood consumption is higher than the average. Therefore, a necessity was felt to construct a smoke house having adjustable capacities. In accordance with the above suggestions a trial smoke house having two adjustable capacities is being constructed at Lower Vykumbura Estate, Passara. (M. D. R. J. Gunatillake)

Bleaching agents for crepe

The Crepe Rubber Development Unit participated in several planters, conferences and discussed the problems connected with the bleaching agents Rupepa and RRI 7 (Nexobleach).

A complaint was received from Halpe Group regarding discolouration. A trial was carried out and it was observed that the discolouration is in rubber made in one division out of the two in this plantation.

A trial done at Hapugastenna Estate indicated that there is a clonal influence in discolouration of bleached crepe using RRI 7 (Nexobleach). This will be checked by carrying out further trials during a dry spell.

Our observations on the two main bleaching agents available in the market, namely Rupepa and RRI 7 is that RRI 7 is a better bleaching agent than Rupepa when no fraction is removed in crepe manufacture.

Batch to batch variation in the quality of RRI 7 marketed as Nexobleach was observed and efforts are being made to reduce this variability. The odd sample showed a high level of sediment and this was partially responsible for the discolouration. (M. C. S. Perera, R. Goonatillake and S. W. Karunaratne)

Colour coding scheme

In the absence of any information from the consumers regarding the acceptance of the colour coding scheme it was felt that no useful purpose would be achieved by trying to persuade the producers to do the labelling. It was also observed that many plantations did not take much interest in carrying out the labelling. (M. C. S. Perera)

Water content of yellow fraction coagulum

Some experiments were carried out at Panawatta Estate, Yatiyantota to find out the water content of yellow fraction coagulum. The following conclusions were made:

(1) The dry rubber content of the yellow fraction coagulum (immediately after removal from bulk latex) has been found to be in the range of 30%–35% by weight.

(2) The dry rubber content increases to 35%–45% by weight during the first 24 h of storage due to evaporation of surface moisture.

(3) After 48 h the dry rubber content rises to 50%–60% by weight and there is very little change on further storage of the whole coagulum.

(4) When the coagulum is milled into thin laces the drc rises up to 70%–75%. (M. D. R. J. Goonatillake)

Coagulum Milling

Raw Mooney viscosity measurements of lace crepe revealed, that laces used in the production of sole crepe and blanket crepe of the same origin, exhibit substantial differences in their viscosities. This was thought to be due to extra milling of the sole crepe laces (Table 6).

Table 6. *Raw Mooney viscosity of sole crepe and blanket crepe laces*

Laces/Bleaching Agents	V_R	*Po*	*PRI*
Sole Crepe/Rupepa	80	41	71
Sole Crepe/Nexobleach	79	40	82
Blanket crepe/Rupepa crepe	85	44	45
Blanket crepe/Nexobleach	85	44	46

Experiments were conducted using hydroxylamine neutral sulphate to assess the viscosity changes in rubber on coagulum milling. (W. S. E. Fernando and R. Goonatillake)

Accelerated hardening of sole crepe

These experiments were laid out to investigate the use of difunctional carboxyl reagents to introduce some cross links to raw rubber. It was envisaged that this treatment will enhance the hardness and dimensional stability of sole crepe without adversely affecting the raw rubber properties. The results obtained with phthalic dihydrazide (PHD) are given in Table 7. (W. S. E. Fernando and R. Goonatillake)

Table 7. *Effect of difunctional agents on the physical pro perties of the rubber*

Sample	V_R	*Po*	*PRI*	*P*
Control	76	51	64	28
0·5 parts PHD	106	76	51	8

Technical properties of sole crepe

A study was undertaken to provide the consumers with some technical properties of sole crepe produced in Sri Lanka. Sole crepe produced from various plantations was collected and tests such as Mooney viscosity, plasticity retention index, 50% hardness and ply adhesion were carried out. It was observed that the minimum technological properties required for a good quality product are:

Mooney viscosity	70
Plasticity	40
PRI	50
50% hardness	4 kg/cm^2
Ply adhesion	5 kg

All the details of the above tests have been reported in a paper which was submitted for publication in the Rubber Bulletin. (M. D. R. J. Gunatillake, P, P. Jayasinghe and S. W. Karunaratne)

Advisory services to producers

Several factories were visited and were given necessary advice to either improve the quality of their rubber or modernize their factories. (R. Goonatillake and S. W. Karunaratne)

Solar drying of crepe rubber

Natural convection experiments were carried out on the experimental collector and a maximum collector outlet temperature of 50·5°C was observed. Efficiency was calculated to be 24% and this was found to agree closely with a theoretical production. A blower was subsequently installed at the collector inlet for forced convection experiments. Maximum collector outlet temperature was about 46°C and efficiency increases. The collector was then connected to the 1/20 th scale drying tower. Maximum temperatures within the drying tower obtained up to date are around 39°C with 34°C of the thermal capacity of the tower brickwork. These experiments are proceeding. (N. C. C. Walpita and Ranjan Gunatillake)

Control of effluents in crepe factories and industries

Malaysian work on the subject was reviewed and it was concluded that experiments should be carried out at Dartonfield on the "oxidation ditch" method. The tank system at the Gloweave Rubber Factory was investigated. A scheme was set up whereby effluent from factories and industries would be tested at the Water Resources Board, Ratmalana, for chemical and biological activity, before and after treatment. This allows efficiency of the actual industrial treatment process to be monitored. (M. C. S. Perera and N. C. C. Walpita)

Effluent disposal

On a request made by Udapolla Group, a proposal was made after a visit to the estate, to construct a ponding system to treat the effluent from the factory. It was emphasized that the wash water should be separated from unadulterated serum water in order to reduce the capacity of the ponding area. Udapolla Group is hopeful of getting foreign assistance to undertake this project under the Deraniyagala village development scheme.

Samples of water were removed from near the outlet to the stream and about 100 yds away, down stream and the BOD values were determined.

These values are far in excess of the limit of 30 ppm recommended by the Labour Department. Hence it was felt necessary to treat the water before channeling into the stream. (S. W. Karunaratne and M. C. S. Perera)

Biochemistry

Phospholipids

Phospholipid content of polybag rubber was determined and it was found to be higher compared to normally processed rubber. Sodium fluoride inhibited the phospholipase activity in *Hevea* latex, The distribution of phospholipids in various phases of latex was studied. Of the fractions investigated, the bottom fraction of enzyme - inhibited latex was found to have the highest phospholipid content. (S. Kasinathan and P. A. J. Yapa)

Protein pattern during latex flow

Changes in protein pattern during latex flow, in A-serum of *Hevea* were investigated by polyacrylamide disc electrophoresis. Protein content of all three clones examined in this study namely RRIC 45, RRIC 100 and PB 86 decreased towards the end of latex flow and the degree of reduction of protein content in these 3 clones was 32·8%, 13·1% and 27·1% respectively. Altogether 19, 17 and 23 protein bands were detected in A-serum of RRIC 45, RRIC 100 and PB 86, respectively, on polyacrylamide gels which were stained with Coomassie Brilliant Blue.

In clone RRIC 45, the initial 19 protein bands were reduced to 13 towards the end of flow. Similarly in RRIC 100 and PB 86 the number of bands was reduced from 17 to 16 and from 23 to 20, respectively. In addition, the majority of the other bands were also found to be reduced in intensity, contributing again to a low protein content at the end of latex flow.

The plugging of latex vessels leading to cessation of latex flow has often been associated in the osmotic changes releasing acidic B serum rich in $Ca^{++}$and Mg^{++} ions from damaged lutoids. Neither the factors responsible for a general decrease in protein content during latex flow nor the exact physiological significance of such a decrease are known, although it is indicative of a general reduction of metabolic activities in the laticiferous tissue. (S. P. Prematillake and P. A. J. Yapa)

Fungal growth on leaf extracts

A preliminary study was carried out to examine the effect of β-sitesterol on the mycelial growth of *Collettorichum* sp. No noticeable effect was observed. β-sitesterol was extracted from the leaf tissue of two clones namely RRIC 114 and RRIC 130. Compounds were separated by TLC. (G. Munasinghe, C. K. Jayasinghe and P. A. J. Yapa)

Leaf and bark phenols

Leaf phenolics in clones RRIC 114 and RRIC 130 were invesitgated Chromatographic analysis of leaf extracts of these two clones showed the presence of both kaemferol and quercetin. Arrangements are being made to carry out a quantitative analysis. These two compounds were not present in the bark extracts of brown bast trees. (D. A. S. M. Arsecularatne and P. A. J. Yapa)

Miscellaneous

A further 2 kg sample of quebrachitol was prepared and sent to West Germany for evaluation during the year. (P. A. J. Yapa and S. I. Senanayake)

The work on ATP-ase activity in latex serum was continued during the year. Synergistic effects of various cations were studied. Further work is in progress. (C. P. Wickremasinghe and P. A. J. Yapa)

A new study on seed proteins of *Hevea* was initiated during the year. Preliminary work on the separation of seed proteins by electrophoresis was carried out. (S. I. Senanayake, C. P. Wickremasinge and P. A. J. Yapa)

The studies on enzyme deproteinization were continued. An investigation was initiated to study the storage hardening of deproteinized natural rubber prepared by treatment of latex with different proteolytic enzymes. This trial will be run over a period of 2 years. (P. A. J. Yapa, S I. Senanayake and M. D. C. Seneviratne)

Proteolytic action of papain, pineapple juice, purified bromelain, superase and TPN on *Hevea* proteins was investigated. (D. S. Attanayake and P. A. J. Yapa)

REVIEW OF THE STATISTICS SECTION

By

V. ABEYWARDENA

SUMMARY

Statistical assistance was provided to the Research Departments of the Institute. Meteorological work was also carried out uninterrupted. The Assistant Statistician continued his work on a dissertation to be presented to the Colombo University, as a partial fulfilment for the requirements of the Degree of Master of Science in Applied Statistics.

DETAILED REVIEW

Staff

Mr W. N. Wickramasinghe, Assistant Statistician was on duty until 12 August after which he left on study leave to join Iowa State University, USA, to read for the Degree of Master of Science.

Technical Officers Messrs L. T. Peiris, R. A. . Abayapala and Miss J. D. Nandanie were on duty throughout the year. Mr V. Abeywardena, the Consultant Biometrician, continued to visit the institute regularly.

Meetings

Mr R. A. P. Abayapala completed a two week tráining course on repair and maintenance of meteorological instruments at the Department of Meteorology.

Technical Officer Mr R. A. P. Abayapala participated in a seminar on agrometeorology conducted by Mr G. W. Robertson at the Department of Meteorology Colombo, from the 21 September to 1 October, 1981.

Research Studies

The Assistant Statistician continued a study on the influence of weathrr factors on the yield of rubber for a dissertation to be presented to the University of Colombo

as a partial fulfilment for the requirement of the Degree of Master of Science in AppliedStatistics.

For this study monthly yield records of the clone PB 86 in a fixed area at Dartonfield Estate, Agalawatta, over a period of 10 years and weather records available at Dartonfield Meteorological Station over this period have been used. The study was to find a model to explain the total variation in the yield per tapping using the methods for Time Series analyses and the techniques of regression.

Statistical work

Assistance to other research departments in the design of experiments and analysis of experimental data constituted the bulk of the work of the section.

The data analysis for the annual reports of the other research departments, was completed during the first month of the current year. Data from about Ninety experiments were analysed during the year. The section had to do additional statistical work for the post-graduate research students who are attached to various Research Departments.

Meteorology

The routine meteorological data collections and regular supplies of these summaries to various departments outside the Institute, were carried out uninterrupted. These included records from Dartonfield Meteorology Station and also from Nakiadeniya Estate.

The graphs of rainfall, temperature and sunshine duration at Dartonfield are shown in Fig. 1.

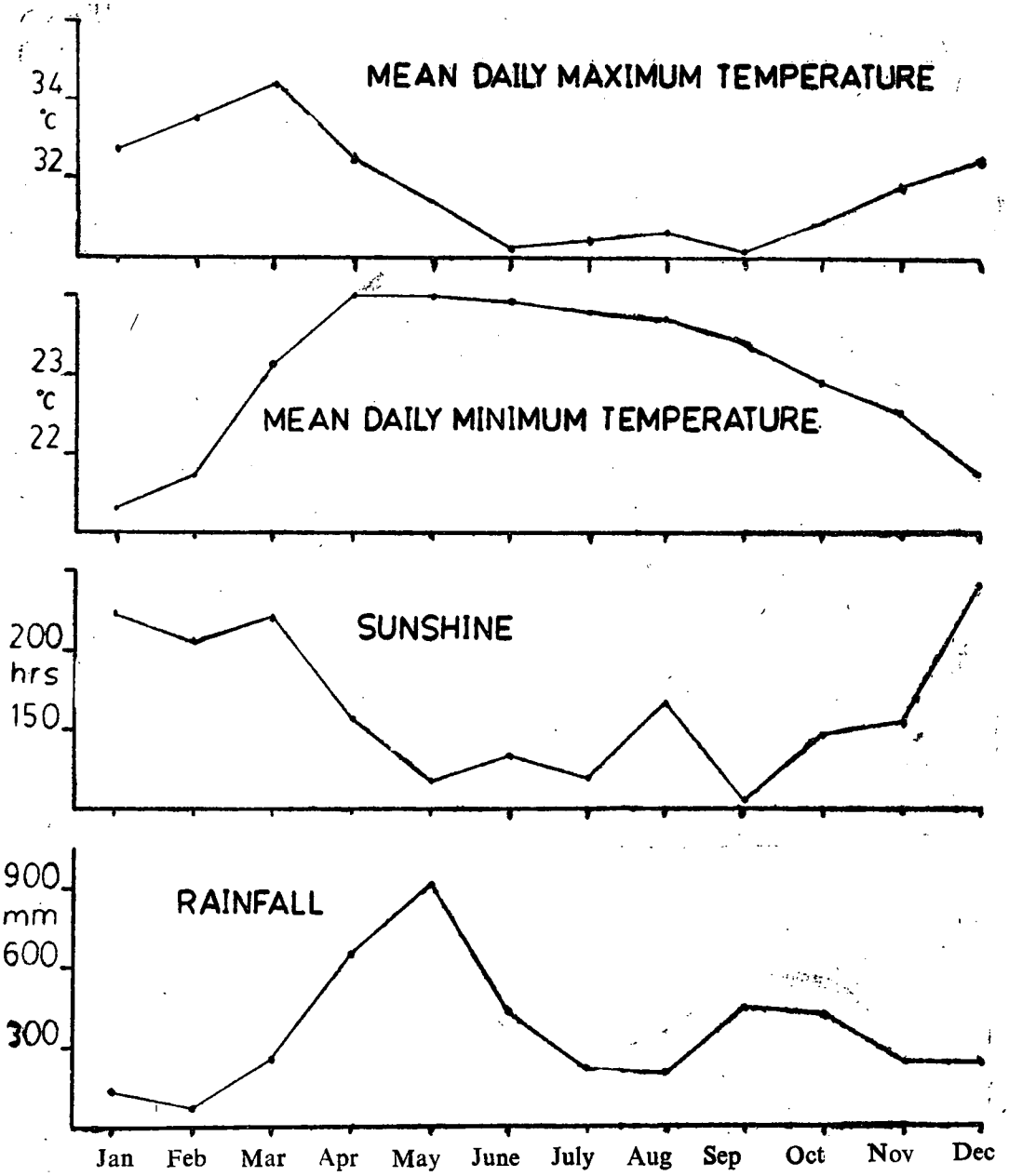


Fig. 1 Rainfall, duration of sunshine and temperature at D'field

REVIEW OF THE ADVISORY SERVICES AND AGRICULTURAL ECONOMICS SECTION

By

R. P. M. de ZOYSA

SUMMARY

All required assistance and advice were given to smallholders and to Estates. New rubber planting areas have been visited for free lining for soil conservation work and planting holes and to advise owners in planting their lands.

A considerable time of the field staff was also devoted for subsidy replanting work. The Smallholder Rubber Rehabilitation Project (SRRP) continues to progress satisfactorily. Replanting achievements have surpassed targets established at appraisal by 50%. Sufficient planting material was available in 1981, to even surpass targets; the difference between total replanting requirements and supplies from estates was supplied by the Rubber Control Department nurseries and private nurseries. The arrangements for fertilizer distribution has been operating well. The construction of the Training Centre is complete. Refresher courses for both Rubber Extension Officers (REOO) and Rubber Extension Assistants (REAA) have been scheduled to begin in March 1982. About 35 Group Processing Centres have now applied for registration. The publicity Unit visited 54 villages, and 8000 leaflets were printed and distributed explaining the replanting programme and Subsidy Scheme.

DETAILED REVIEW

Staff

Mr A. B. Dissanayake, Head of the Department, Mr R. P. M. de Zoysa, the Deputy Head, Messrs A. Dahanayake and A. J. L. de Silva, Regional Advisory Officers in Kegalle and Kalutara, respectively, were on duty throughout the year. Mr A. Widanapathirana, Regional Advisory Officer, Ratnapura, resumed duties after successfully completing his post-graduate studies at the Post Graduate Institute of Agriculture, University of Peradeniya.

Messrs A. C. Swaris and P. Samarasinghe assumed duties at Colombo Office as Assistant Accountant and Supplies Officer on 5th October, 1981 and 25th May 1981, respectively.

Routine transfers to be effected from January 1982, were arranged for all Rubber Extension Officers who had served for 4 years in a station. Requests for transfers from Rubber Extension Officers serving in the Project districts were also considered.

An interview for the selection of Chief Processing Officer was held during the last quarter of the year. Mr N. Samarappuli, was recruited as Training Officer, and assumed duties on 2 March 1981. Twelve Rubber Extension Officers were selected during the 3rd quarter of 1981, and are undergoing training under Senior Rubber Extension Officers; 13 Rubber Extension Assistants selected during the 3rd quarter of 1981 were sent to work with the Rubber Extension Officers in the project areas. During the 4th quarter of 1981 interviews were held for the selection of 36 Rubber Extension Assistants, and appointments would be made in early 1982.

Messrs G. Ranwalage, E. C. D. Senanayake and A. H. M K. Jayasinghe, REOs and Messrs S. W. S. Samaraweera and T. A. K. G. Udayakumara, DREOs, resigned from service during the year.

Meetings

A. B. Dissanayake undertook a study tour of the Rubber Rehabilitation Projects in Malaysia, Indonesia and Thailand. He also attended the second ANRPC/ESCAP meeting on "Determination of the maximum production capacity of NR including analysis of factors inhibiting the adoption of a dynamic production policy", at Hatyai, Thailand, in September. The three Regional Officers too, had an opportunity of visiting Malaysia, touring rubber replanting projects and gained valuable experience from this study.

A. B. Dissanayake attended the following meetings:

The Steering Committee on the Smallholder Rubber Rehabilitation Project.

Rubber Policy Review Committee meetings held at the Ministry of Plantation Industries

SLAAS Seminar at the Post Graduate Institute of Agriculture at Peradeniya.

He also addressed a seminar organised by the National Institute of Plantation Management, for planters in the Southern Province on "The Economics of Production of Different Types of Rubber".

R. P. M. de Zoysa, attended monthly meetings of the field staff, 22 annual general meetings of Group Processing Centres (GPCC), 12 group meetings and 2 publicity meetings.

A. Dahanayake, attended 11 District Agricultural Committee meetings during the year.

A. Widanapathirana attended the SLAAS Seminar at the Post Graduate Institute of Agriculture at Peradeniya in August. Rubber Extension Officers held 90 Smallholder discussions, 13 Gramodaya Mandala meetings were held during this period.

Publications

The following Advisory Leaflets were prepared:

Passion Fruit cultivation as an intercrop in rubber. Coffee cultivation as an intercrop in rubber. Replanting Rubber under the Subsidy Scheme. Grading of RSS.

New Planting

All required assistance and advice were given to new planting permit holders. All new rubber planting applications received by the Rubber Controller and referred to this Department, were in turn referred to the respective Rubber Extension Officers for a preliminary report after a visit to such lands. Further 3276 final inspections and special reports too have been furnished.

Smallholder Rubber Rehabilitatian Project

This project was envisaged as the replanting rate had declined during the past ten years resulting in an over aged national stand of rubber with low production. A total of 18,800 ha will be replanted according to the schedule in Table 1.

Table 1. *Replanting schedule in the smallholder rubber rehabilitation project.*

Project Year	*Area Replanted (ha)*	*Proposed District Share %*		
		Kalutara	*Ratnapura*	*Kegalle*
1	–	–	–	–
2	1,600	50	25	25
3	2,800	42	28	28
4	4,000	50	25	25
5	4,800	46	25	24
6	5,600	36	28	36
	18,800	44	26	30

Participation in the project is open to any smallholder having title to registered rubber lands which is either over 20 years old or particularly low yielding because of disease, damage or inherent genetic potential. Under this project it is expected that about 27,000 smallholders would replant 18,000 ha with high yielding rubber. Technical advice and other inputs like high yielding planting materials and fertilizer will be distributed by the Field Officers of the Department at convenient points to suit smallholders. In addition inspection of holdings for authorization of the replanting payments is the sole responsibility of the Department.

Intercropping

As intercrops in rubber have little or no adverse effect on long term rubber production, the Department has now undertaken a publicity campaign to encourage planting intercrops (bananas, passion fruit and pineapple) recommended by the Rubber Research Institute. Leaflets on the cultivation of these crops were distributed.

The details of intercropping in smallholdings (project area only) for 1981, classified according to various types are given in Table 2.

Table 2. *Extent of various intercrops in three districts*

Intercrop	*District*			
	Kalutara (ha)	Ratnapura (ha)	Kegalle (ha)	Total (ha)
Banana	5·08	36·12	101·60	142·80
Banana/vegetable	–	2·90	·41	3·31
Banana/pineapple	·55	·30	–	·85
Banana/coffee	–	.61	–	·61
Banana/pepper	–	·82	–	·82
Banana/passion Fruit	10·24	–	–	10·24
Vegetable	·30	1·13	–	1·43
Pepper	–	·61	–	·61
Coffee	–	·82	–	·82
Passion Fruit	84·72	·20	·51	85·43
Total	100·89	43·51	102·52	246·92

Group Processing Centres

As in the previous years the Group Processing Centres offered a potentially useful means for improving smallholder RSS manufacture.

Every possible effort has been made and the necessary advice and assistance given to smallholders by field staff to improve the quality and quantity of sheet rubber. A total of 1760 visits to Group Processing Centres and 400 visits to demonstration and ordinary smokehouses were made.

During the period a total of 1,649,372 kg of rubber were processed into RSS or sold as latex. Throughout the year 11 centres sold latex to rubber goods manufacturers and latex crepe factories while another 16 Group Processing Centres sold latex and commenced sheet rubber production in the latter part of the year.

The Group Processing Centres with the highest throughput processed 48,769 kg for the year while the best Centre produced 99·4% RSS Grade 1.

Table 3. *Production Data for various grades of RSS*

Grade	*Production*		
	kg	%	
RSS No. 1	518,800	55·0)	87·3
RSS No. 2	304,347	32·3)	
RSS No. 3	79,865	8·5	
Others	40,067	4.2	
Total	943,079	100	
The total production of 75 centres		943,079 kg	
RSS manufactured by the 16 GPCC after the stoppage of selling latex		382,648 kg	
Latex sold by 11 GPCC		323,645 kg	
Grand Total		1,649,372 kg	

The progress on the construction of Group Processing Centres is as follows:

In production	102
Ready for operation	01
Total	108

Loan repayments made for the year are as follows:

G. P. C. Building Loans	Rs. 44,757·32
Coagulating Pans Loans	,, 645·00
Total	,, 45,402·32

During this period general meetings in Group Processing Centres were held and an Officer of the Co-operative Department attended most of these meetings and explained the by-laws. Thirty four Group Processing Centres in the project area applied for registration and a total of 20 Group Processing Centres are now registered.

Routine Work

Correspondence

Inward 2870 (Applications for new planting unregistered rubber lands and new permits).

Outward 5190 (Preliminary reports, final and special reports).

From Rubber Extension officers to Smallholders 5695.

Visits

The following visits were made:

First visit	613
Subsequent visits	2541
Preliminary reports	3896
Final and special inspection	3276

Lining

Free lining is done by the Rubber Extension Officers for soil conservation and planting holes at the request of the owners as shown below:

	No. of Permits	*Ha*
New Planting		
This year's permit areas :		
Soil conservation	357	203·89
Planting holes	317	195·44
Last year's permit areas:		
Soil conservation	249	142·00
Planting holes	247	143·17
Replanting:		
Previous year's permit areas:		
Soil Conservation	2802	1494·63
Planting holes	2933	1586·35
Marking of trees for tapping	74	1752 trees
This year's permits issued	6146	
Visits to this year's permit areas	11268	
Visits to previous year's permit areas	14024	
Visits for special reports	364	

Special visits for inspection for Rubber Control Department

Preliminary reports	3896
Final and special inspection (new planting)	3276
Special inspection (replanting)	364
Recommendation of Subsidy payments by DREOO and REOO	12746
Planting material checks at the Commodity Purchase Depots	19
Distribution of planting material (non project area)	12
Plants inspected	4305
Nurseries inspected and reports sent	93
Plants distributed (project area)	8,77,957
Fertilizer distributed (project area)	73,415 kg

Advice to Estates

A total of 106 visits to small and medium estates were made during the year. The visits included advice on soil conservation, tapping and disease control.

Agro Economic Studies

Collection of data on the cost of cultivation of intercrops is in progress.

Demonstrations

The following demonstrations were given by the field staff during the year.

Sheet making	575
Tapping	669
Disease Control	456
Miscellaneous	711

Training Centre

Construction work in the training centre at Nivitigalakele was completed and is now fully equipped. Teaching courses prepared by consultants are ready and training is expected to commence during the first quarter 1982.

Training Classes

Of the 21 classes organised 12 classes were completed and 676 smallholders were trained in these classes.

Film Shows

During the year under review 54 film shows were conducted in the ranges.

Exhibitions

During the first quarter, the Department took part in the Mahapola Exhibition held at Moneragala. The Department maintained an exhibition stall from 5 April to 15 April at an exhibition held at Kirindiwela Maha Vidyalaya in the Dompe Electorate. During the last week in June exhibits were lent to Gamudawa 1981 held at Tissamaharamaya.

Visitors

16 officers of the office of the Rubber Replanting Aid Fund (ORRAF) and the Rubber Research Centre, Hatyai, Thailand, arrived in two batches during the 2nd and 3rd quarter of the year. They were conducted on a study tour to show the methods of transferring innovations, techniques for improvement of smallholder rubber, identify training and development needs, observing group actvities of farmers and group processing and marketing of smallholder RSS. Each batch spent 8 days on these studies.

An ANRPC expert team visited smallholding intercropping areas and Group Processing Centres in Gampaha and Kegalla Divisions. The expert team arrived in Sri Lanka to study improvements in processing and marketing of smallholder rubber.

REVIEW OF THE ESTATE DEPARTMENT

By

R. G. SIRIWARDANE

SUMMARY

The extent of the estate belonging to the Research Institute at Dartonfield & Gallewatta Divisions in Agalawatta and Nivitigalakele in Matugama known as Dartonfield Group is 355 ha. The planted area is 286·03 ha, of which 187·24 ha were in bearing during the year. 1·70 ha from the 1962 field at Nivitigalakele Division were taken over by the Rubber Rehabilitation Project in March 1981 for the construction of buildings for a Training Centre. A block of 2·02 ha called Harankahapotawatta situated on the boundary of Dartonfield Division was acquired and handed over to the Institute during the year by the Government Agent, Kalutara. The buildings and 0·81 ha of land from this property would be handed over to the Education Department to house the Estate School and the Teacher's quarters, once all the Estate Schools are taken over by the Government.

The rainfall recorded in 1981 was higher than that in 1980. Tapping operations were disrupted causing dalays to the Estate which had forward contractual commitments. Nevertheless, with the exception of a few scattered showers, fair weather, favourable for harvesting of crop, was experienced during the year.

Wintering was early this year. No symptoms of *Oidium* leaf disease was noticeable except on the later wintering clones, which suffered slight leaf fall such as the 1971, PB 28/59 areas.

The incidence of *Phytophthora* leaf disease was negligible this year. A few scattered bark rot trees in the PB 86 areas of Gallewatta Division were treated. *Rigidoporus* affected trees were treated with Collar Protectant fungicide.

Budwood of clones of the RRIC 100 series and PB 86 continued to be in demand and issues to all Estates and Smallholders were made accordingly.

All agricultural operations were carried out in mature and immature areas and nurseries of the Group.

DETAILED REVIEW

Staff

The writer resigned from the post of Estate Superintendent on 18 March, 1981, and Mr. A. C. Swaris, Assistant Accountant, over-lookcd the Estate. Mr. R. G. Siriwardene assumed duties on 15 April, 1981 as Estate Superintendent on a contract basis, and with effect from 1 July, 1981 he was appointed to the post.

The post of Chief Clerk remained vacant throughout the year.

The Senior Assistant Clerk, Mr. U. D. S. Perera was on sick leave from February, 1981 onwards.

Mr. A. A. Ariyaratne the Check Roll Clerk/Typist was promoted to act for the Senior Assistant Clerk.

Miss M. Kalyani and Miss M. Thambathi were absorbed into the monthly paid cadre in November, 1981 as Estate School Teacher and Creche Attendant, respectively of Dartonfield Division.

The Dartonfield Group cadre stood at 19 at the close of the year, made up as follows :

Senior Staff	1
Assistant Staff	12
Minor Staff	6
	19

Agricultural Adviser

The Agricultural Adviser, Mr. R. C. Peries, of Elston Estate, Puwakpitiya, paid two visits to the property during the year under review. Reports on these visits were submitted to the Rubber Research Board.

Hectareage

A summary of the hectareage is given in Table 1.

Table 1. *Land distribution in Dartonfield Group*

	Dartonfield	Gallewatta	Nivitigalakele	Total
Mature Area	28·31	115·50	43·43	187·24
Immature	15·21	66·65	10·08	91·94
Nurseries	2·22	·50	4·13	6·85
	45·74	182·65	57·64	286·03
Paddy Fields	–	·75	–	·75
Abandoned Area	7·18	–	5·58	12·76
Swamps Road	–	–	1·21	2·21
Buildings/Roads	2·67	6·50	·32	9·49
Streams/Reservations	·03	–	–	·03
Jungle	–	–	·71	·71
Buildings/Sites etc.	16·23	–	7·79	24·02
Grand Total	71·85	189·90	73·25	335 00

Weather

Rainfall figures (mm) for 1981 and 1980 are given in Table 2.

Table 2. *Rainfall distribution for 1980 & 1981 in Dartonfield Group*

	Dartonfield		*Gallewatta*		*Nivitigalakele*	
	1981	1890	1981	1980	1981	1980
January	128·8	79·9	232·9	80·5	133·5	26·2
February	64 0	–	79·8	21·6	48·5	61·6
March	253·9	147·6	311·4	100·6	67·0	46·5
April	646·6	393·0	481·3	389·9	376·8	326·7
May	904·9	383·8	827·8	408·6	958·4	269·8
June	422·7	345·0	503·2	340·8	376·0	330·5
July	206·7	287·9	201·9	324·3	213·2	286·2
August	191·2	243·7	172·7	233·0	157·4	189·2
September	441·1	314·3	388·6	311·7	324·5	301·8
October	419·6	365·4	450·3	416·3	579·2	577·2
November	240·2	434·1	312·7	476·5	285·4	440·2
December	230·5	203·4	191·5	187·9	262·0	148·0
	4153·2	3198·1	4154·1	3291·7	3781·9	3003·9
Total wet days	215	214	196	195	133	122

The beginning of South-West monsoon was very wet, May being the wettest month of the year under review.

Crop

The harvested crop of 206,986 kg this year exceeded the previous season by 6550 kg and stood at 100·68% of the season's estimated crop exceeding the estimate by 1396 kg. The crop harvested this season is the highest since 1974. The yield data for the last 5 years are given in Table 3.

Table 3. *Yield records from 1977–1981 (Kg/ha)*

	Year				
	1981	1980	1979	1978	1977
Dartonfield	818	858	1058	766	727
Gallewatta	1233	1129	901	869	959
Nivitigalakele	953	944	803	915	887
Total	1105	967	836	860	695
Estimated	1064	983	970	887	725
Tapping (ha)	187	207	216	216	240

Tapping

Seventy (70) days tapping was lost due to unfavourable weather conditions and recovery tapping was done on forty four (44) days during the year. Tapping was carried out throughout the wintering period.

Tapping cuts were marked with appropriate guide-lines for bark consumption according to the systems of tapping adopted.

Stimulation with Ethrel was carried out by the Plant Science Department in the 1961 field of Gallewatta Division.

All the Tapping Panels were treated with Brunolinum Plantarium and Red powder.

Manufacture

A summary of manufacture records during the year is given in Table 4.

Table 4. *Details of manufactured crop in Dartonfield*

Latex Grade	*Total (kg)*	*Crop (%)*
Pale Crepe No. 1	167945	92
Pale Crepe No. 2	1600	1
Pale Crepe No. 3	12777	7
	182322	100
Scrap Crepe No. 1	9452	51
Scrap Crepe No. 2	5742	31
Scrap Crepe No. 3	3396	18
	18590	100
Smoke Sheet No. 1	15750	99
Smoke Sheet No. 2	–	–
Smoke Sheet No. 3	207	1
	15957	100
Total crop manufactured (inclusive of 9883 kg of bought latex)	216869	

42 m Tons of Thin Crepe was contracted for and supplied during the year.

1850 kg of C. V. Crepe Rubber was manufactured and supplied on a special request made by Messrs C. W. Mackie & Co., Ltd.

The manufacture of Sole Crepe commenced at Dartonfield Factory during 4th quarter of the year and a small lot of this rubber was sent to Brokers. The Brokers' comments were favourable. The Estate intends to manufacture at least 25% of Sole Crepe in 1982.

40370 kg of outside rubber belonging to the Smallholders was manufactured at Dartonfield Factory.

To encourage the Smallholders and to give them a better price for their latex, with effect from 1st of December 1981 Dartonfield Group commenced buying latex from the Smallholders of the neighbouring areas. The total bought latex manufactured at the end of the year was 9883 kg. All bought latex was paid on the basis of *sale price minus manufacturing costs* only. The Rubber Research Board expects all estates to adopt this system of payment, in order to give the best prices to smallholders.

Factory Machinery

Mill Nos. 5 and 6 were re-installed after a complete overhaul by Messrs Colombo Commercial Co. Ltd. All the other machinery were in fair order during the season.

Agricultural operations

Routine weeding, manuring and all other agricultural operations were carried out. The immature areas were in good condition and were maintained up to the required standards of sound agricultural practice. Growth was very satisfactory and the cover crops were well maintained.

Roads

All motorable roads within the Group were maintained in good order throughout the year.

Pests and Diseases

Oidium heveae: Wintering was early this season; *Oidium* was not noticeable in the early wintered areas. The late winterers specially the PB 28/59 areas suffered a very slight leaf fall. However, sulphur dusting was not carried out this season, on the basis of advice of the Plant Pathology Department.

Colletotrichum gloeosporioides: The incidence of *colletotrichum* was negligible.

Phytophthora meadii: Leaffall was negligible. A few trees detected at Gallewatta Division in the PB 86 1960, 1961 and 1964 areas were treated.

Rigidoporous lignosus: A few scattered trees affected by *Rigidoporous lignosus* were detected specially in the 1980 and 1977 Replantings and were treated with Collar Protectant.

Wind Damage

The South-West monsoon caused extensive wind damage in the hilly areas of outlying Divisions this year. The loss of trees due to wind damage on Dartonfield, Gallewatta and Nivitigalakele were 10, 40 and 130 respectively. The 1974 field of RRIC Mixed Clones at Nivitigalakele Division suffered the most; on one day 108 trees were blown down by the wind.

Replanting

1981 Replanting - 10·63 ha - Clones RRIC 100, 102, 103 - Gallewatta Division: The planting of this area was done during the North-East monsoon and was completed.

1982 Replanting - 10·88 ha - Clones RRIC 100, 103 - Dartonfield Division: Preliminary works were completed and the field is ready for replanting in May/June 1982.

Nurseries

All nurseries were well maintained during the season. Nurseries were established in Nivitigalakele and Gallewatta Divisions for 1982/83 replanting.

Field and Factory Experiments

The Research Departments were given the necessary assistance in carrying out their field and technological experiments.

Accounts

The final accounts for the year 1981 are being carried out. The anticipated revenue profit, excluding replanting expenditure, for the season would be about Rs. 510,000/-.

Estimates

Estimates of Capital and Revenue expenditure for 1982 in respect of Dartonfield Group, were prepared and submitted by the writer to the Rubber Research Board for approval.

Labour and Health

The health of the entire estate population was satisfactory during the year. The number of patients treated at the Medical Centre was 6295.

Births: 21 children were born during the year.

Deaths: There were 4 deaths on the Group this year.

Family Planning and Family Health:

Number of Vasectomies	13
IUCD insertions	26
Depo Provera injections	403

Immunization against Polio and vaccination of BCG and Triple were carried out at the Poly Clinics conducted by the Assistant Medical Practitioner with the assistance of the Medical Officer of Health of the District in the Medical Centre of Dartonfield Group.

The CARE, Sri Lanka Branch, continued to provide "Thriposha" free of charge under the medically selective programme for infants, ante-natal and lactating mothers.

All non-working resident children over 1 year of age and below thirteen years continued to be issued with ¼ lb. of bread per day per head. In addition, fortnightly cash payments were made in lieu of half cream milk to resident non-lactating mothers with infants under 1 year of age.

Line room accommodation was satisfactory. Repairs to line rooms and lavatories were attended to, where necessary.

Wages were paid during the year in accordance with the Wages Board Ordinance in force. Festival Advances were paid as required. Incentive Bonus and the Annual Holiday Pay Wages were paid to the labour in accordance with the Ordinance.

General

Two modern Creches were constructed at Dartonfield and Gallewatta Divisions with UNICEF aid. The selected Creche Attendants were trained at the Sarvodaya Training Centre, Hatton. The UNICEF provided large quantities of vaccines and valuable equipment to the RRI Medical Centre, which helped immensely in conducting the Poly Clinics. The assistance given by the UNICEF in this regard is greatly appreciated.

Despite very poor trading conditions, and the increase in cost of chemicals, fertilizers etc., the Estate was able to make a profit of Rs. 2/30 per kilo during the season 1981.

The Crop harvested and the Yield/ha achieved is the highest since 1974.

REVIEW OF THE LIBRARY AND PUBLICATIONS SECTION

By

VIJITHA JAYARATNE

Staff

Miss L. I. T. Ramanaden, Library Assistant and Assistant Publication Officer, attached to the Colombo Office Library, Mrs Vijitha S. Jayaratne, Library Assistant and Assistant Publication Officer, Mr D. C. Thambawita, Library Clerk and Mrs D. T. Danthanarayana, Clerk/Typist at Head Office/Library were on duty throughout the year 1981.

During the year 1981 Miss L. I. T. Ramanaden and Mrs V. S Jayaratne, Library Assistants and Assistant Publications Officers, successfully completed their final examinations in Library Science. They were also able to attend the 3 weeks National Workshop conducted by the UNDP/NSC which enabled them to improve their knowledge in every aspect of Library Science including documentation and dissemination of information which would be an immense help to carry on the work of a Research Library.

Acquisitions

Book purchases and subscriptions to journals and other publications were reduced during the year 1981 due to the daily increasing prices of books and periodicals. Therefore, only 31 books were added to the existing library collection of 3695 books bringing the total number to 3726. Of these 14 were purchased locally and abroad and 17 were received as gifts and donations. The Colombo Office Library was fortunate to get an ODA grant to purchase books for the next year.

Two hundred and twenty four titles of current periodicals are being received both at Head Office and at Colombo Office Library of the Institute including fifteen abstracting and indexing periodicals, which are much in demand.

	Local	*Overseas*
On subscription	–	97
On exchange/gratis	32	115

This year too a large sum of money was spent mainly to acquire periodicals as it is the only way in which we could help the Research Officers to obtain the latest research done throughout the world.

Inter library loans

With the help of the existing inter-library loan scheme the Head Office Library was able to co-operate with the other research libraries and obtain six journals and books from various other libraries for the use of our research staff and we were also able to help other libraries by lending 16 journals and books for the use of their research staff. As the prices of periodicals have risen tremendously, this scheme has helped us in obtaining the relevant research papers from periodicals, which we are unable to purchase.

Information service

The role of communication and dissemination of information to meet the needs of the various sectors of the industry was further strengthened by the work of the RRISL Library during the year 1981.

The advisory publications have already earned wide recognition for the dissemination of information, of particular interest to the smallholders. Therefore, several new advisory circulars were printed in a revised format in a more attractive way both in terms of its looks and contents. An advisory circular on white root disease in Sinhala was published accordingly with the help of Mr C. K. Jayasinghe, Assistant Plant Pathologist, and a circular on fertilizer too, in both Sinhala and English has been given for printing. A special issue of the Sinhala publication 'Rubber Puwath' was published on replanting with many research papers relevant to this subject, for the use of smallholders as special emphasis was shown by the Government too on this subject. The other remaining publications published in English which give more valuable information for all research officers throughout the world on the research done by the RRISL too were sent for printing, but could not issue them on schedule due to the delay by the printers.

The RRISL Library continued its service to the research staff by attending to communication and dissemination of information and other functions, on behalf of the Institute. We have been able to help them by continuously keeping them informed of the latest advances in various current research, done throughout the world by indexing of the research articles relevant to the research staff.

Liaison with other libraries

We have continued assisting in the Union Catalogue of Scientific and Technical Publications (UNICAST) by sending additional 54 catalogue cards during the year 1981.

The work of the Network of Agricultural Libraries initiated by the Sri Lanka Scientific and Technical Information Centre (SLSTIC) continued during the year 1981

too, and as a member of this Agriculture Sub-system, the RRSIL library too participated by attending all AGRINET meetings held, and obliging to help to carry out the work of the sub-system, as it helps all research libraries in various aspects. At the last meeting held AGRINET proposed to commence shortly a Selective Dissemination of Content Page Service, by photocopying of content pages of selected agricultural journals. This service identifies the journals required by agricultural scientists attached to various libraries and arrange photocopies of content pages of those journals to be sent to the relevant libraries. A survey was carried out by the SLSTIC among the Agricultural Scientists, to know the relevant periodicals these scientists would like to obtain and to draw up a scheme for exchange of photocopies The RRISL research staff too participated in this survey. With the help of this system our research officers too will be able to get the current research information that they cannot get from their own library as all relevant research periodicals cannot be purchased by one single library.

A programme was organised by the National Science Council during the 1981 SLAAS sessions to promote the use of Scientific and Technical Information. Displaying of abstracting and indexing journals was one of their objectives and we co-operated with them by sending two of the latest issues of the Helminthological Abstracts – Series B.

REVIEW OF THE KURUWITA SUB-STATION

By

R. C. PERIES

SUMMARY

The work at the Sub-Station was overlooked by the Visiting Superintendent. A freak storm resulted in a loss of 575 trees. The estimated crop for the year fell short by 7272 kg. Latex was supplied to the State Rubber Manufacturing Corporation.

DETAILED REVIEW

Staff

Mr S. G. Fernando continued as Assistant Superintendent. Mr G. D. A. Weerasuriya and Mr T. D. Kularatne continued as K. P. and Assistant K. P., respectively.

Hectarage Statement

The distribution of land at Kuruwita Sub-Station is given in Table 1.

Table 1. *Hectarage Statement*

1961	Replanting	—	33·59
1962	,,	—	15·68
1963	,,	—	9·10
1964	,,	—	7·28
1965	,,	—	7·89
1966	,,	—	4·05
1967	,,	—	4·05
1968	,,	—	4·05
1969	,,	—	4·05
Extent in Tapping		—	89·74
Nurseries		—	·86
Paddy		—	2·23
Roads, Buildings etc.			7·01
Total extent		—	99·84

Weather

Rainfall distribution for 1981 and 1980 are given in Table 2.

Table 2. *Rainfall and wet days for 1980 and 1981*

Year	*Rainfall* (mm)	*Wet days*
1981	4596·07	191
1980	3990·73	203

The rainfall during the year under review was fairly well distributed, except during the cropping months of September and November, when an unusually high rainfall was recorded.

Crop

The estimated and harvested crop are given in Table 3.

Table 3. *Details of Crop Figures*

Estimated (kg)	*Harvested* (kg)	*Shortfall* (kg)
90,000	82,728	7,272

Due to tapping now being done on renewed bark and with a loss of 575 trees due to the freak storm in April, the crop secured fell short of the estimate by 7272 kg.

Manufacture

Latex continued to be supplied to the State Rubber Manufacturing Corporation Factory, Kuruwita, and the scrap rubber sold to Statcon Block Rubber Factory, Getahetta and Lanka Star Rubber Works Factory at Parakaduwa.

Cultivation

The manure applications were carried out as per the Season's Estimate.

General

The preliminary works have been taken in hand to plant a new Clearing in 1982 and the work has progressed very satisfactorily.

The Net Sale Average is governed by the prices paid by the State Rubber Manufacturing Corporation Factory that purchases the latex crop from the Sub-Station and it is a matter for regret that a very poor price is received on the present basis evolved by the SRMC.

I wish to place on record my appreciation of the co-operation and assistance received from the Director, Staff of Rubber Research Institute, the Assistant Superintendent and the staff of the Sub-Station, in the discharge of my duties.