THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

1989

ANNUAL REVIEW

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW 1989

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Dr M. K. S. A. Samaraweera, Head, Soils & Plant Nutrition Department, RRI.
Mr C. K. Jayasinghe, Assistant Plant Pathologist, RRI
Mr L. K. Meegahawatta, Head, Development Division, ASD
Mr V. M. Katugaha, Estate Superintendent, Dartonfield Group, RRI
Mr C. Rodrigo, Agricultural Advisor, JEDB Central Board
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Mr S. N. Gunaratne, Director, JEDB, Cluster J7, Vincit Estate
Mr U. Jayasekera, Director General, JEDB Cluster J9, Hopton Group
Mr A. M. Perera, Manager, JEDB, Bibile Group
Mr D. E. C. Wijesinghe, Manager, SLSPC, Padukka Estate
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Mr J. Weragama, Cluster Director, SLSPC, Parakaduwa
Mr N. G. Dias Abeysinghe, Director General, SLSPC
Mr H. P. S. Dassanayake, Director/General Manager, SLSPC
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Mr S. W. Karunaratne, Deputy Director, (Research) (Convenor)
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Dr L. M. K. Tillekeratne, Head of Specifications & Analysis Department
Dr P. A. J. Yapa, Head of Biochemistry Department (upto 24.02.1989)
Dr A. Coomarasamy, Head of Polymer Chemistry Department (upto 24.02.1989)
Mr A. Dahanayake, Head, Processing Division, ASD
Mr D. E. C. Wijesinghe, Factory Advisor, SLSPC
Mr L. Perera, Factory Advisor, JEDB
Mr Jim Amarasinghe, Marketing Specialist, JEDB
Mr Desmond Fernando, Marketing Specialist, JEDB
Mr Lee Madawala, Marketing Specialist, SLSPC
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Mr Austin Perera, Commissioner of Commodity Purchase Dept.
Dr N. R. de Silva, Director – General, Sri Lanka Standards Institution

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Mr Merril Kariyawasam, Chairman, RRB (from 16.03.1989) – 04.09.1989)
Prof I. Balasooriya, Actg. Chairman, RRB (from 25.09.1989 – 31.12.1989)
Mr T. P. G. N. Leelaratne, Rubber Controller (upto 18.08.1989)
Mr R. A. P. Goonetilleke, Secretary, State Ministry of Plantation Industries (from 04.05.1989 – 31.12.1989)
Mr A. Rajapakse, Deputy Director (Budget Division), Ministry of Finance (from 04.05.1989 – 31.12.1989)
Mr Sepala Ilangakoon, Secretary General, Planters' Association of Ceylon (from 04.05.1989 – 31.12.1989)
Mr M. M. A. Naina Marikar, Planter (from 04.05.1989 – 31.12.1989)
Dr A. de S. Liyanage, Director, RRISL (In attendance)
Mr K. Ginige (Secretary)

Provident Fund Committee

Mr Rajah Salgado – Chairman, Provident Fund Committee (upto 01.02.1989)
Mr Merril Kariyawasam – Chairman, Provident Fund Committee (from 31.05.89 to 04.09.89)
Prof I. Balasooriya – Actg. Chairman, Provident Fund Committee (from 25.09.89 to 31.12.89)
Dr A. de S. Liyanage – Director, RRISL
Mr K. Ginige – Secretary, Provident Fund Committee
Mr W. C. Dayaratne – Elected Committee Member
Mr A. L. Ratnayake – Elected Committee Member

Extension Committee

Mr G. A. S. Ganepola, Chairman, RRB (upto 14.03.1989)
Mr Merril Kariyawasam, Chairman, RRB (31.05.89 – 04.09.89)
Prof I. Balasooriya, Actg. Chairman, RRB (17.11.89 – 31.12.89)
Mr T. P. G. N. Leelaratne, Rubber Controller (upto 18.08.89)
Mr Naina Marikar, Member of the Rubber Research Board
Mr S. Ilangakoon, Member of the Rubber Research Board
Mr D. E. F. Jayasuriya (Smallhloder's representative) (upto 14.03.89)
Dr A. de S. Liyanage, Director, RRI
Mr L. K. Meegahawatta, Head, Development Division, ASD
Mr A. Dahanayake, Head, Processing Division, ASD
Dr (Mrs) A. C. I. Samaranayake, Head, Plant Science Department, RRI
Mr S. W. Karunaratne, Deputy Director (Research) RRI
Dr N. Yogaratnam, Assistant Director, RRI
Dr N. E. M. Jayasekera, Head Genetics & Plant Breeding Department, RRI
Dr A. Coomarasamy, Head of Polymer Chemistry Department, RRI (upto 24.02.1989)
Dr P. A. J. Yapa, Head Biochemistry Department, RRI (upto 30.06.1989)
Dr L. M. K. Tillekeratne, Head of Specifications & Analysis Department, RRI
Dr M. C. S. Perera, Head of Raw Rubber Development Department (upto 11.01.89)
Mr A. J. L. de Silva, Regional Advisory Officer (Colombo District)
Mr P. Samaranayake, Regional Advisory Officer (Kalutara District)
Mr. M. C. Samarasekera, Regional Advisory Officer (Galle & Matara Districts)
Mr D. D. Dassanayake, Regional Advisory Officer (Kegalle District)
Mr A. H. Kularatne, Regional Advisory Officer (Ratnapura District)

Secretary to the Board

Mr K. Ginige

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Mr Manilal Fernando,
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Colombo 3.

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Colombo 1.

Bank of Ceylon,
Agalawatta.

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Advisory Services Department
Rubber Chemistry Department,
Polymer Chemistry Department,
Specifications & Analysis Department,
Raw Rubber Development Department,
Rubber Technology Department and
Electronic Instruments Repair Unit,
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THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

(As at 31st December 1989)

Chairman	–	Mr G. A. S. Ganepola, BA(Cey.), Diploma in Development Administration (U.K. & S. L. A. S.) (upto 14.03.1989)
Chairman	–	Mr Merril Kariyawasam (from 16.03.1989 to 04.09.1989)
Acting Chairman	–	Prof I. Balasooriya, BSc(Cey.), PhD. (Liverpool) (from 25.09.1989 to 31.12.1989)
Director	–	Dr A. de S. Liyanage, BSc Agric (Cey.), PhD (Lond.)
Deputy Director (Research)	–	Mr S. W. Karunaratne, BSc (Cey.), MSc (Aston), ARIC, ANCRT, FPRI, FIC
Deputy Director (Administration)	–	Mr K. Ginige, BA (Cey.)
Assistant Director	–	Dr N. Yogaratnam, BSc Agric (Alhabad), PhD (Lond.)
Secretary to the Chairman	–	Mrs L. J. C. Perera
Clerk/Typist	–	Miss S. N. Munasinghe

RESEARCH DEPARTMENTS

Plant Science

Head of Department	–	Mrs A. C. I. Samaranayake, BSc (Cey.), PhD (Lond.)
Botanist	–	R. C. W. M. R. A. Nugawela, BSc (Cey.), MSc (Lond.) PhD (Essex)
Assistant Botanists	–	*Mrs G. P. W. P. P. Seneviratne, BSc (Cey.) *Miss M. S. Ranasinghe, BSc (Cey.)
Research Assistant (Intercropping)	–	V. H. L. Rodrigo, BSc Agric (Cey.)

Experimental Officers	–	Mr L. S. S. Pathiratne, M. I. Biol., M. Phil (Cey.) R. B. Gunaratne
Senior Technical Officer	–	Mr L. S. Kariyawasam
Technical Officers	–	Mrs C. W. Ranasinghe, BA (Cey.) Mrs G. A. S. Wijesekera Miss A. R. Kusum Mr K. G. A. B. Amaratunge Mr R. P. Karunasena Mr U. S. Weerakoon Mr S. L. G. Ranjith Mr R. S. Wijesundera
Experimental Assistant	–	Mr S. Wilbert
Clerk/Typist	–	Miss H. D. D. E. Jayasekera

Genetics & Plant Breeding

Head of Department	–	Dr N. E. M. Jayasekera, BSc Agric (Cey.), PhD (Birm)
Assistant Geneticists & Plant Breeders	–	Mrs S. C. Dharmaratne, BSc (Cey.), PhD (Scot.) *Mr D. P. S. T. G. Attanayake, BSc Agric (Cey.)
Experimental Officer	–	Mr K. B. A. Karunasekera
Senior Experimental Assistant	–	Mr B. M. S. G. Peiris
Senior Technical Officer	–	Mr K. W. Rupatunga
Technical Officer	–	Mr R. A. S. K. Ranatunga Mr I. D. M. J. Sarath Kumara
Experimental Assistant	–	Mr A. K. M. S. Senaratne
Clerk/Typist	–	Mrs K. D. R. Tissera

Plant Pathology

Head of Department	–	Dr A. de S. Liyanage, BSc Agric(Cey.), PhD (Lond.)
Plant Pathologist	–	Dr (Mrs) N. I. S. Liyanage, BSc Agric (Cey.), MSc (Cey.), PhD (Lond.), DIC (Lond.)

Assistant Plant Pathologists	–	Mr C. K. Jayasinghe, BSc (Cey.), MSc (Cey). *Mr A. H. R. Jayaratne, BSc (Cey.), MSc (Cey.)
Experimental Officer	–	Mr L. W. Amaratunge
Senior Technical Officers	–	Mr W. A. D. D. S. Wettasinghe Mr E. B. Fernando
Technical Officers	–	Mrs P. C. Wettasinghe Mr S. S. Warnapura Mr E. A. T. Senadeera
Clerk/Typist	–	Mrs W. S. P. Amarasekera

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Agronomist	–	Mrs M. L. A. Samarappuli, BSc Agric (Cey.), MS (Calf.)
Assistant Soils Chemist	–	*Mr D. M. A. P. Dissanayake, BSc Agric (Cey.)
Experimental Officers	–	Mr W. C. Dayaratne Mr A. M. A. Perera Mr F. P. W. Silva Mr H. P. S. P. Perera, BSc (Cey.)
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Technical Officer	–	Miss S. D. C. K. Maheepala Mrs M. K. Mahanama Mr S. N. Silva Mr P. Karunadasa Mr A. H. U. Mitrasena Mr A. N. Yakandawala Mr T. B. Dissanayake Mr B. A. Nandalal
Specification Assistant (Special Grade)	–	Mr T. M. Ahamadeen
English Stenographer	–	Mrs K. A. D. L. Rupasinghe Perera

Biochemistry, Polymer Chemistry, Specifications and Analysis, Rubber Technology and Development Raw Rubber Development and Electronic Repair Unit

Head of Biochemistry Department	–	Dr P. A. J. Yapa, BSc (Cey.), PhD (Lond.), M. I. Chem (Cey.) (up to 30.06.1989)
Head of Polymer Chemistry Department	–	Dr A. Coomarasamy, BSc (Cey.), PhD (Aston) (up to 24.02.1989)
Head of Specifications & Analysis Department	–	Dr L. M. K. Tillekeratne, BSc (Cey.), MSc (Aston), PhD (Aston), F. I. Chem. C.
Head of Raw Rubber Development Department	–	Dr M. C. S. Perera, BSc (Cey.), MSc (Cey.), PhD (Australia) (up to 11.01.1989)
Rubber Chemists	–	Dr Mrs K. G. K. de Silva, BSc (Cey.), MSc (Cey.), PhD (Aston) Miss N. M. V. Kalyani, BSc (Cey.), PhD (Lond.) Dr E. D. I. H. Perera, BSc (Cey.), MSc (Reading), PhD (Reading)
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Assistant Biochemist	–	Mr M. T. Warnakula, BSc (Cey.)
Assistant Specifications Officer	–	Mr L. Karunanayake, BSc (Cey.)
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Biometrician	–	Mr W. N. Wickremasinghe, BSc (Cey.), Dip. Stat. (Cey.), MSc (Iowa State)
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Technical Officers	–	Miss J. D. Nandanie Mr L. P. P. Vitharana

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Experimental Officer (T. A. to the Director)	–	Mr K. E. Jayasooriya, MSc (USSR)

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Internal Audit Assistants	–	Mr W. Kularatne Mr S. W. S. G. Gunawardene Mr D. E. C. Warnakula

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Electrical Foreman	–	Mr W. D. Ratnasinghe
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Charge Hand (Buildings)	–	Mr H. A. Somasiri
Charge Hand (Electrical)	–	Mr J. D. Sirisena

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Accounting Assistant	–	Mr K. G. A. K. Dharmawardena
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Clerk	–	Mr G. A. Kannangara
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Store Keeper	–	Mr D. C. P. Pothmitiyage
Assistatnt Store Keeper	–	Mr P. L. A. W. Cooray
Cashier	–	Mr D. C. A. D. B. de Silva
Accounts Clerk	–	Mr K. C. Fernando

Estate Department

Estate Superintendent	–	Mr V. M. Katugaha
Chief Clerk	–	Mr S. A. L. Chandrawansa
Acting Senior Asst. Clerk	–	Mr K. K. P. Gunawardena
Junior Assistant Clerks	–	Mr K. D. Sumanasena Mrs C. Dissanayake Mr A. K. A. Wickramasinghe
Rubber Factory Officer	–	Mr D. S. K. Ranaweera
Rubber Factory Supervisor	–	Mr W. D. D. Senanayake

Field Officers	–	Mr N. L. D. Piyadasa Mr A. K. D. Hemapala Mr H. M. J. Premalal Mr S. K. S. de Silva (attending to clerical work)
Assistant Field Officer	–	Mr J. A. Wimalasena
Field Supervisors	–	Mr S. R. Vadivel Mr T. Somaratne Mr N. L. D. Reggie

Kuruwita Sub-station

Visiting Superintendent	–	Mr R. C. Peries
Assistant Estate Superintendent	–	Mr S. A. R. Samarasekera

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

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

DIRECTOR'S REVIEW

By

L. M. K. TILLEKERATNE *

In 1989, world total rubber consumption rose to 15.69 million tonnes, which is an increase of 3.7% compared to the previous year. In this total figure the increase in NR consumption was by 5.3 million tonnes which is a 3.6% increase. SR consumption during this period increased at a slightly higher rate by 3.7% to reach 10.39 million tonnes; keeping the percentage share of synthetic rubber consumption unchanged around 66.2%. In the same year, NR prices declined from the exceptionally high levels attained in 1988 owing to the abnormal demand for latex, in the context of the escalating AIDS and other blood related infections scare. There was a short fall of 190,000 MT of NR over consumption, which was 530,000 MT; in 1989. This would indicate an imbalance in favour of a healthy price, which failed to materialise. This shortfall recorded entirely in Malaysia, was counter-balanced by the increased production in other NR producing nations where producers who were attracted by the high price paid in 1988 begun harvesting more rubber. However the prosperous "boom" expected for the centrifuged latex prices started dropping rapidly in February 1989 shattering the dreams of producers to the levels in 1987. Other factors contributed to the decline in the NR price during 1989 were, the selling of the INRO buffer stocks on the market, excess supply of concentrated latex and the latex based products, political turmoil and the wheather related factors. According to the analysts, the main cause for the weak price forecast was the over production of concentrated latex in Malaysia and in other neighbouring South East Asian Countries. Even the gloves demand in the USA and in other European Countries came down drastically thereby creating an excess supply which ultimately resulted in a price fall fro m US $ 8/100 PCS to US $ 2.5/100 pcs. Build up of stocks of passenger car tyres in USA and the over production of truck tyres in India may continue to have an impact on the demand for NR. This situation worsened with the inflation and rising wages in Taiwan and also the policy in S. Korea of exporting of rubber products. The present depressed state of NR price cycle, if continued further could generate a positive respnose in production growth. Reaction of Malaysian and Thailand producers towards the depressed rubber prices could slow down the NR production increase in 1990, thereby increasing in demand for NR.

* Prepared by L. M. K. TILLEKERATNE for and on behalf of A. de S. LIYANAGE, the ex Director

Further prospects of NR depends largely on the world tyre industries. However, the car sales in the W. Europe are likely to drop in 1990 and hence the demand for tyres as well. Slight growth of the car industry in the other regions may not be sufficient to compensate for this declining demand in the Western Europe. Development of a new Isoprene/Polybutadiene/styrene based high performance polymers would influence the demand for synthetic rubber based tyres. Because they have the advantage in helping to reduce heat build up and fuel consumption. However, it is believed that in the radial-ply passanger car industry, NR will retain its position and hence its market share at the turn of this century, consuming nearly 20 million metric tons. The International Natural Rubber Organisation (INRO) too will influence the rubber markets in years to come. It is clear that the release of 15 – 20,000 MT buffer stocks of rubber in 1989 at the "May buy" level had influenced the rubber prices.

In Sri Lanka, the annual rubber production had shown a steady decline since 1973, Production figure of 155,000 MT in 1973, declined to only 110,000 MT in 1989 which as a 10.5% drop in production compared to 1988. Exports have even been worse in 1989, which was 86,000 MT compared to 99,000 MT exported in the previous year. This is mainly due to the uncertain situation that prevailed in the country in the latter half of the year.

RRI now intensifies its efforts to increase production in years to come by introducing high yielding clones such as RRIC 100, 102 and 121 which can give yields upto 3000 kg/ha/yr, instead of clone PB 86 which produces only 1000 kg/ha/yr. Improved agricultural practices, advanced tapping methods and the use of rain guards to recover more tapping days are also underway to improve this situation.

Experiments are underway to improve fertilizer efficiency by using coir dust and other forms of agricultural wastes to compensate for the 100% increase in fertilizer prices. Multi cropping with tea, and inter cropping with pineapple & banana are encouraged among small holders so that they could earn an income during the inmature period of rubber. Every effort has been made by the RRI to increase, productivity and finished products manufacture in the country. Estate sector factories are now geared to produce centrifuged latex in large scale, out of their estate latex to cater multinational gloves manufacturers, while converting small holders latex which is normally going for the manufacture of low grade sheet rubber into quality latex crepe & sole crepe. This will not only improve the foreign exchange earning to the country, but also minimise quality claims received mainly for the exports of low grade sheets. Setting up of finished products factories have increased the local rubber consumption to 20,976 MT from 19,861 MT in the previous year. But with the stepping up of production of Ansells factory in their next two phases, and also with the setting up of many new factories, the local consumption figure is expected to rise up rapidly in the future.

Chemical and processing aspects

Mechanical Stabilisers for latex

A castor oil based soap, capable of improving the mechanical stability time of latex, better than the traditionally used lauric acid soap was developed. This development will enable to prevent the out flow of foreign exchange to import lauric acid for the fast growing concentrated latex industry. Castor oil is a local raw material which has not much of a demand at the moment.

Rainguard Sealent

A rubber/bitumen based sealent for the skirt type polythene rainguard has been developed. This sealent does not crack on girthing of the tree. It is neigher attacked by insects nor by hot weather, and it tends to vulcanise slowly in the hot sun thereby improving its stretchability. The total cost of one of these rainguards is only about Rs. 2 and the cost of the rainguard could be recovered in few days tapping on a rainy day. Rubber production in the wet districts like Ratnapura & Kalutara is expected to increase in the near future, as a result of the discovery.

Microwave oven based test methods

Another contribution made this year was the development of microwave oven based test methods for determing the volatile matter content of raw rubber and also for the determination of dry rubber content and total solid contents of latex. These new techniques are not only cheaper to use, but also less time consuming thereby increasing the laboratory output. Even International testing organisations have already started using these techniques for testing of raw rubber and latex.

Can Sealent

Polymer Chemistry Department has been able to develop a NR based can sealant to replace the imported synthetic can sealant consumed in large quantities every year. Experiments carried out on industrial scale in a can manufacturing firm have shown that the NR based sealant developed by the RRI is solvent and water resistant and also has better sealant properties compared to the imported sealant. The Polymer Chemistry Department has obtained a local patent for this discovery. The cost of the locally manufactured sealant is only 1/3 the cost of the imported sealant.

A trial carried out with this MG grafted latex blended with the polyvinyl chloride paste to coat cotton gloves have shown promising results. Now different blends of this MG grafted latex with other synthetic elastomers are being tried out to get the oil resistant properties.

Carbon black masterbatches

In order to eliminate difficulties encountered in mixing of carbon black with dry rubber, and also to cut down on power consumption NR of lower Mooney viscosity obtained by generating singlet oxygen in the latex stage before processing into dry rubber has been tried out.

It has been found that there is a considerable retention of carbon black in low molecular weight rubber obtained when compared to the normal dry rubber. Mooney viscosity values of the carbon black masterbatches prepared from undepolymerised NR latex are higher than the carbon black masterbatch prepared from depolymerised NR latex. This may be due to the cross linking formation with alkylic hydroperoxide and the storage hardening. Trials have been carried out with success to prevent this hardening effect.

It has been found in this study that the centriguged latex after deploymerisation is the best suitable latex for the manufacture of carbon black masterbatches.

Depolymerised NR latex

Our scientists have been able to produce depolymerised NR latex by using non toxic chemicals such as H_2O_2 and NaOCl. The rate of this reaction is determined by the amounts of chemicals used, temperature and the pH of the latex. Optimum temperature and pH for best results have already been found out and it has been found that the level of depolymerisation could be controlled by the amount of reagents employed. Poor property of this depolymerised latex is the poor stability on long standing. Experiments carried out to improve stability of this depolymerised latex have also given successful results. Trials are under way to prepare low viscosity dry rubber by blending depolymerised latex with normal field latex.

Precoagulation of Latex of Matale Region

Matalé region is facing a problem of latex precoagulation due to the high hardness of water in the area. This problem however, cannot be overcome by softening water, using modern techniques. Now it is believed that this problem is due to the result of a combined effect of characteristics of latex and of water. Studies are under way to investigate this fully. Trials have been carried out in this region to find out the possibility of making high Mooney viscosity RSS, by varying the dilution of latex and the drying conditions. Mooney viscosities between 80 and 85 were achieved but a batch to batch variation has been observed. Most of the research work done had to be abandoned due to the uncertain situation which prevailed in the area during this year.

Composition of Properties of Ebonite made from different types of NR.

Hard ebonite compounds are used in lining of various metallic containers and pipelines used in chemical industries. The most limiting factor in the use of ebonite in this application is its softening temperature. A study has been carried out to identify grades of raw rubber which give higher softening temperature. In order to check the hardening point of ebonite, an apparatus has been successfully turned out locally.

Quality Improvement of Scrap Crepe

In order to eliminate defects such as high dirt content, high VM content, high Po and PRI and the lack of consistancy of scrap crepe available in the Country, a full study was carried out in collaboration with C. W. Mackie & Co. Ltd. Based on the results of their experiments an Advisory Circular giving guidelines for processing of better quality scrap rubber has been prepared and circulated among the remillers.

Effluent disposal

Experiments carried out have shown that soakage pit system is not satisfactory for the treatment of effluent from the centrifuged latex factories. This is due to the clogging effect of the soil by the tiny rubber particles in the skim.

However, the ponding system has shown satisfactory results and this has been recommended for the centrifuged latex factories, while work on further improvement of the process is under way.

Drying and Energy

Evaluation of forced convection drying system has been completed. Cost of drying by this new technique is comparable to the cost of the conventional drying system. The report on this has been submitted with recommendations for further improvement of the efficiency of this system.

A comprehensive report has also been submitted after evaluation of the vacuum dryer for crepe laces. Cost wise the vacuum drying has been found to be double compared to the conventional drying. Now work is being carried out to see the effect of vertical partitioni ng of drying towers on the efficiency, to save on power and fuel specially when the crop is less in estates. In addition to this energy surveyes are being conducted in many estates. According to the results obtained by the NERD centre, nearly Rs. 50,000 could be saved per annum in estate producing about 2 tonnes of crepe a day.

Processability of NR Latex Concentrate

Influence of compounding ingredients upon the processing behaviour of compounded latex vary with the characteristics of the raw latex. A study was carried out to investigate the correlation between the characteristics of uncompounded latex and its processibility. It has been found in this study that certain properties of NR latex such as VFA and KOH number greatly control the processing behaviour. It has also been observed that the factors such as period of maturation and method of manufacture of latex concentrate also play a significant role in determining its processing behaviour.

Experiments carried out to study the influence of non-rubber constituents upon thickening behaviour of latex have revealed that proteins and lipids naturally present in the latex play a significant role in determining the extent of thickening in the presence of the compunding ingredient ZnO.

Special type latex to be used in Radiation Vulcanisation

In order to bring the cost of radiation vulcanisation of latex, sensitisers are used. Although the monomer n-butylacrylate (n-BA) is the most suitable sensitiser to be used in radiation vulcanisation of NR latex, use of n-BA has been difficult, because of its ability to destabilise latex. In an attempt made to develop a latex which could withsatnd the destabilisation caused by the n-BA, it has been possible to produce a latex of a special type which can remain stable in the presence of the monomer n-BA. Now research is being conducted to study the variation of colloidal properties and technological properties of the irradiated latex in the presence of n-BA.

In the experiments carried out to evaluate radiation pre-vulcanised NR latex it had been found that the properties such as tensile strength and modulus etc. are dependent on :

1. Type of latex.
2. Dose of radiation given.
3. Thickness of the tensile test piece.
4. Leaching solvent.
5. Ageing temperature.

It has also been observed that the film forming properties of the blends of irradiated latex with unirradiated latex are much superior to those of the individual components of the blend.

Evaluation of Locally available minerals and clays.

It has been able to show that calcium carbonate, locally available as corals can be used in dipped rubber products industries as the coagulant solution. A collaborative project with a newly set up dipped product industry is under way to study the commercial feasibility of the project.

An evaluaion of local Dolomite to be used in coating and other latex based industries have been carried out at the request of local industrialists. The main snag in this process is the non availability of a metal crusher to crush these stones. Experiments are being conducted to evaluate the possibility of using other minerals and clays also in the rubber industry.

Biological aspects

Breeding and testing

Two clones viz RRIC 121 recommended for large scale planting recently, and RRIC 110 recommended for planting upt 20 ha. have yielded in small scale trials about 3000 kg per hectare. In the multilateral exchange clone trials established in Malaysia, clone RRIC 100 has recorded the highest yield with an average of 1740 kg per hectare per year in the first 6 years of tapping.

It has now been possible to select 4 promising clones from hand polinated population of which 74 – 193 has yielded 74.09 gm/tree/tapping compared only to 40.53 gm/tree/tapping by clone RRIC 121 planted in the same small scale trial (85% increase in yield).

Recently, we have been able to introduce high yielding foreign clones from RRIM, Indonesia and Prang Besar Research Station (PB) for testing under an Accelarated Testing Programme (ATP).

Germplasm collection

Rubber breeding in the past was based on a very small population. Thus, the heritable variation expected would be very narrow, specially after 80 years of directional selection. The International Rubber Research and Development Board, therefore, funded a mission to South America to collect new genetic material for further breeding programme. From these collections, over 65000 accessions have now been imported and grown in Sri Lanka for genetic improvement.

Molecular genetics

Studies on plant molecular genetics have now been initiated on Hevea plants. This technique is likely to help in the early identification of promising materials with qualities such as high vigour and yield and disease resistance.

Nursery practices and planting techniques

By the introduction of techniques such as "young budding" it appears possible to achieve, high success in field establishment, reduction in cost of planting and reduction in the immature period in the field.

Budwood multiplication nurseries were inspected regularly to certify the authenticity of clones planted so that the purity of plant material used is maintained. Also, plant material for budwood multiplication nurseries are being supplied as budded stumps to all nurseries in the country and over 25,000 plants have been issued.

Tissue Culture

Plantlets obtained from seedling shoot tip culture were acclamatized and transferred to unsterilized soil in pots, success was around fourty percent. Shoot tip explants derived from sprouts induced to grow at the base of the scion stem in 10 year old trees of clone RRIC 103 also could be successfully established in culture.

Exploitation

High intensity tapping with double three system has significanly reduced the girthing of trees, compared to 1/2s and 1/4 cut tapping in all clones.

As the gutter type of rainguards developed earlier have now been found to be too costly, the use of polythene (apron type) rainguard which would be economical to use under local conditions is being evaluated.

Use of Physiological parameters for early selection

As the methods available in the past for early selection of high yielding progeny were not reliable, physiological parameters viz gas exchange capacities and water use efficiency have been used and found that the dry matter production ability is higher in the high yielding genotypes and that they are also more efficient in the use of water. It is therefore possible now to predict the yield potential of mature plants at a very early stage of 2 months, thus reducing the time, money and effort involved in breeding and selection of new clones.

Intercropping/multicropping

With the objective of providing an income in particular to the smallholders during the long immature period, crops such as banana, passion fruit and pineapple are now recommended as intercrops during the immature period.

Experiments on multicropping, Rubber with Tea, have also given promising results.

Response to fertilizers

Smallholding with irregular application of fertilizers during the immature and early mature phase, showed yield increase upto 47% with conventional fertilizer mixtures and 87% with fertilizers on the basis of soil and foliar survey scheme.

Mulching

Mulching had been found to be very effective in not only avoiding evapotranspiration losses, but also in enhancing growth of rubber trees, providing more nutrients and preventing run off and soil erosion losses. Therefore, it may be a good practice to mulch the soil atleast around the base of the rubber tree, immediately after planting atleast until the legume covers are fully established.

Disease control

All the clones that have been bred by the Gnetics and Plant Breeding Depatment and the foreign clones are being screened for all the diseases present in Sri Lanka. As a result of this screening programme clones which are resistant/tolerant/susceptible have been identified for each economically important disease.

Clone RRIM 600 was temporarily suspended from the list of recommended clones with effect from 1991 as it is reported to be highly susceptible in Malaysia to CLF and Fusicoccum leaf blight, a new rubber disease.

A new fungicide for Phytophthora panel disease (bark rot) was recommended. A furmigant, Formalin, was found to be effective in controlling collar rot of *Hevea.*

Adaptive Research Programme

Experiments were started on 82 small holdings where different clones, planting practices (bare root, poly bagged, green budded and young buddings) and intercrops are tested.

STAFF

Overseas visits

Dr W. M. G. Seneviratne, Assistant Rubber Chemist resumed duties on 23 October, after successfully completing the PhD degree at the University of Susses, U. K.

Dr (Mrs) S. A. P. P. Seneviratne, Assistant Rubber Chemist resumed duties on 2 November after successfully completing the PhD degree at the University of Sussex, U. K.

Dr (Mrs) S. C. Dharmaratne, Assistant Geneticist and Plant Breeder resumed duties on 30 October after successfully completing the PhD degree at the Scottish Crop Research Institute, U. K.

Mr A. H. R. Jayaratne, Assistant Plant Pathologist left for U. K. on 12 March on an ARP Fellowship to read for his PhD degree at the University of Sheffield, U. K.

Mr D. M. A. P. Dissanayake, Assistant Soils Chemist left for U. K. on 15 February on an ARP Fellowship to read for his MPhil degree at the University of Aberdeen, U. K.

Miss M. S. Ranasinghe, Assistant Botanist proceeded to the University of New England, Australia to read for her PhD degree on the 13 April.

Mr H. Talgaswatta, Assistant Agricultural Economist left for New Zealand on 12 February for a training in Agricultural Economics.

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

Dr A. de S. Liyanage, Director, visited Malaysia from 26 June to 01 July to attend IRRDB Annual Meeting and visited Thailand from 6 July to 15 July to attend IRSG Meeting.

Mr. S. W. Karunaratne, Deputy Director (Research) attended the Inception Seminar on the Development of Rubber based manufacturing industries in the ANRPC Member countries at Genting Hilands, Malaysia from 23 to 27 January. He attended a Conference of the International Rubber Research and Development Board held in Malaysia from 26 June to 1 July and attended an International Symposium on Radiation vulcanization of natural rubbe r latex held in Japan from 26 to 28 July. Mr Karunaratne also visited Bangkok (Thailand) and Dhake (Bangaladesh) to give a series of lectures on Radiation vulcanization from 13 to 22 December.

Dr A. Nugawela, Botanist resumed duties on 6 October after successfully completing the PhD degree at the University of Essex, U. K.

Dr N. Yogaratnam, Assisatant Director, visited Thailand and Malaysia on an Adaptive Research Programme from 26 August to 11 September.

Dr M. K. S. A. Samaraweera, Head of Soils and Plant Nutrition Department participated in Commonwealth Science Council Agro-Forestry Programme 'Amelioration of soils by trees' meeting held in Nairobi, Kenya from 20 to 24 November.

Dr (Mrs) K. G. K. de Silva attended the 4th International Symposium held in Canada from 8 to 10 May.

Dr L. M. K. Tillekeratne, Head of Specifications and Analysis Department attended Polytech '89 held in Bangkok, Thailand held from 5 July to 9 July. Dr Tillekeratne also attended a meeting of the Technical committee on Rubber and rubber products (ISO/TC/45), held in Kuala Lumpur, Malaysia from 9 to 16 November. He also participated in the Workshop on liquid Natural Rubber held in Abidjan, Ivory Coast from 4 to 8 December.

Dr E. D. I. H. Perera, Rubber Chemist attended the 2nd phase of Integrated Market Development Programme to promote speciality grades of NR held in the Netherlands and West Germany from 14 to 29 January.

Mr C. K. Jayasinghe, Assistant Plant Pathologist attended the Rubber growers' Conference 1989 held in Malaysia from 21 to 23 August.

Mrs H. S. Weeraman, Senior Technical Officer left for U. K. on 24 July on a U. K. Technical Co-operation Training Programme.

Local Training :

Mr L. P. P. Vitharana, Technical Officer followed a course on Meteorology from 24 April to 29 April at the Department of Meteorology.

Miss J. D. Nandani, Technical Officer, followed a course on Meteorology from 24 April to 29 April at the Department of Meteorology, and she also followed a course on use of SAS for a period of 2 months with effect from 1 December at the CINTEC Training Centre.

Mr L. G. P. Lelwala, Instrument Technician attended a Workshop on Use, maintenance and repair of analytical instruments from 11 August to 28 August at the CISIR.

Mrs K. P. R. Gunasekera followed an Introductory Course on Computer appreciation from 16 – 20 October at the National Institute of Business Management.

No pay leave

Mr R. A. P. Abeypala, Senior Technical Officer was granted an extension of no pay leave up to 15 April.

Mrs V. S. Jayaratne, Librarian & Publications Officer was on no pay (abroad) for a period of two years effective from 12 March.

Mr S. W. Karunaratne, Deputy Directory (Research) was appointed Acting Director from 4 July to 19 July when Dr A. de S. Liyanage, Director was away to attend the IRRDB Annual Meeting and IRSG Meeting.

Dr M. K. S. A. Samaraweera, was appointed to the Post of Head of Soils and Plant Nutrition Department with effect from 1 January.

Dr L. M. K. Tillekeratne was appointed to the Post of Head of Specifications and Analysis Department with effect from 1 January.

Dr P. A. J. Yapa was appointed to the Post of Head of Biochemistry Department with effect from 1 January and he resigned with effect from 1 July.

Dr A. Coomarasamy was appointed to the Post of Head of Polymer Chemistry Department with effect from 1 January and he resigned with effect from 25 February.

Dr M. C. S. Perera was appointed to the Post of Head of Raw Rubber Development Department with effect from 1 January and he resigned with effect from 12 January.

Dr E. D. I. H. Perera was promoted to Research Officer Grade I with effect from 24 April and re-designated as Rubber Chemist.

Mrs M. L. A. Samarappuli was promoted to Research Officer Grade I with effect from 30 March and re-designated as Agronomist.

Visitors to the Institute inluded :

Dr P. Lawrence, University of Birmingham, U. K.

Mrs Lawrence, U. K.

Mr L. Lindeboom. Rubber Consultant, The Netherland

Mr D. Meadows, Washington

Mrs D. Meadows, Washington

Dr J. P. Appleton, British Geologist, Nottingham, U. K.

Dr J. M. Anderson, University of Exeter, U. K.

Mr Chokachai Anekachai, Rubber Research Centre Hatgai, Thailand

Mr Pichit Sopcmoke, Rubber Research Centre, Thailand

Mr Camaran Saenoruksawang, RRI Centre, Thailand

Mr Bones, Washington

Mr M. Wilinera, France

REVIEW OF THE DEPUTY DIRECTOR (RESEARCH)

BY

S. W. KARUNARATNE

Deputy Director (Research) served as Acting Director during the period 7th to 17th July.

Deputy Director (Research) was the recipient of a Merit Award given by the Plastics and Rubber Institute for distinguished services to the Polymer Industry.

Deputy Director (Research) was invited by the International Atomic Energy Authority to give a series of seminars on latex technology and radiation vulcanization in Bangkok and Dhaka. He was engaged in this overseas mission during the period 13th December to 23rd December.

ANRPC study

The Deputy Director (Research) was elected as the Group Leader of a team of experts from Sri Lanka, to promote rubber based industries in the ANRPC member countries. A team of experts from each ANRPC member country was selected to assist in the project which was financed mainly by the Asia Development Bank (ADB). A marketing specialist and a specialist technologist were recruited by the ADB as consultants to the project.

The inception seminar held in January in Kuala Lumpur devised the standard format for country reports and decided upon the schedule for completing the activities. The field mission to examine the rubber based industry in the producing countries was also drawn up.

The country study involved visits to several rubber based industries and the positive response of the industralists, who assisted by giving all the relevent information to the study team, is greatly appreciated.

The outcome of the ANRPC study is a concise report on the activities of the rubber based industries in the region and suggestions for its development. Institution building and consolidation for providing testing facilities and technical assistance to the rubber industrialists is highlighted in the report. All ANRPC countries engaged in rubber manufacturing would benefit from greater activity in the field of standards, such as information on standards in the export markets, certification of standards to meet requirements of export markets and development of new standards. The ANRPC should act as a meeting place for the institution concerned with promoting down stream activities. There is also scope for interchange of training facilities. The need to prepare a directory of rubber manufacturers in the ANRPC countries is also mentioned in the report and consideration should be given to a low – cost public relations activity aimed at informing rubber manufacturers and buyers of rubber goods in other countries of the advantages of relocating in, sub contracting from or purchasing from the ANRPC countries.

Technology and end uses group – IRRDB

Deputy Director (Research) was nominated to represent the RRI at the technology and end uses group of the IRRDB which met for the first time in Penang, Malaysia in June 1989.

The Group shall concentrate its activities on all aspects of NR processing technology and end uses and matters impinging on these areas. Such as

(a) Work aimed to increase the consumption of NR in engineering applications with special reference to developing countries.

(b) Work aimed to maximise consumption of NR in tyres in developing countries.

(c) Work aimed to enlarge/develop/modify parameters in TSR specifications and on relevant test methods.

(d) Latex specifications, processes and products.

The following technology oriented projects will be considered for external funding.

They are in order of preference ;

(a) Influence of processing variables on rubber properties.

(b) Natural rubber in hydraulic seals.

(c) Laboratory for toxicological testing.

Projects

Effluent Treatment

All equipment and chemicals for the estimation of BOD in effluent was organised and two technical officers were trained in the analytical techniques.

The construction of an effluent treatment tank in Dartonfield was completed along with the laying of the pipe line and drainage pits for the isolation of the main effluent from dilution water.

Once the vacuum aerator is fixed trails will be started to evaluate the treatment system and to ascertain the effectiveness of the system in the control of BOD levels. Both the Raw Rubber Development Department and the Biochemistry Department will be associated in these studies.

The Institute has agreed with the Central Enviromental Authority to have facilities for the testing of effluent from rubber factories and to give technical assistance to several projects which will come into stream during the year 1990. (S. W. Karunaratne and M. T. Warnakula)

Radiation Vulcanization of Natural Rubber Latex (RVNRL)

The National Research Group (NRG) on RVNRL had several meetings to discuss the research programme on RVNRL. NRG is represented by the RRI, CISIR, IDB, and the AEA. The research work was mainly concentrated on the prevention of destabilization of both HA and LA centrifuged latex in the presence of n – butyl acrylate as the sensitizer.

A project proposal was submitted to the AEA for the development of technology of RVNRL and the use of such latex in rubber products manufacture. The proposal includes training and scientific visits for officers working in the project and the provision of a 500 Kilo curie capacity gamma irradiator and dipping equipment.

MSc Projects

Two MSc students from the Sri Jayawardenapura University worked on the following projects supervised by the Deputy Director (Research) and Dr N. M. V. Kalyani.

(a) The use of n – butyl acrylate as a sensitizer in RVNRL.

(b) The use of different grades of brown crepes in the retreading of tyres.

Deputy Director's Publications

The following publications were prepared by the Deputy Director (Research).

Karunaratne, S. W. (1989). Standardisation of radiation vulcanized Natural Rubber Latex. Paper presented at the International Conference on Radiation Vulcanization held in Takasaki, Japan.

Karunaratne, S. W. (1989). Use of radiation vulcanized natural rubber latex in small and medium scale industries. Paper presented at the International Conference on radiation vulcanization held in Takasaki, Japan.

Karunaratne, S. W. (1989). The present status and future prospects of radiation vulcanization of natural rubber latex. Paper presented at the seminar held in Colombo on radiation vulcanization organised jointly by the RRI and Atomic Energy Authority.

Karunaratne, S. W. (1989). The role of RRISL in assisting the Rubber Industry. Paper presented at the 1st meeting of the technology and end uses group of the IRRDB in Penang, Malaysia.

Karunaratne, S. W. (1989). Environmental problems in centrifuged latex manufacture. Paper presented at the seminar on centrifuged latex organised by the RRI.

Karunaratne, S. W. (1989). The future of the natural rubber industry. Paper presented at the National Executive Management seminar on radiation vulcanization organised by the Atomic Energy Authority.

Karunaratne, S. W. (1989). Research and developed programme in radiation vulcanization of natural rubber latex in Sri Lanka. Paper presented at the National Executive Management seminar on radiation vulcanization organised by the Atomic Energy Authority.

Reports

Karunaratne, S. W. (1989). Report on the visit to Malaysia to attend the group leaders meeting in connection with the ANRPC study on the development of rubber based industries in the ANRPC member countries.

Karunaratne, S. W. (1989). Report on the visit to Malaysia to attend the 1st meeting of the technology and end uses organised by the IRRDB.

Karunaratne, S. W. (1989). Report on the visit to Japan to attend the National Research Group leaders meeting on radiation vulcanization of natural rubber latex.

Karunaratne, S. W. (1989). Report on the status of the Rubber industry in Sri Lanka in connection with the ANRPC study on the development of rubber based industries in the ANRPC member countries.

Deputy Director (Research) served on the following bodies during the year.

Member of the Chemicals Divisional Committee of the Sri Lanka Standards Institution.

Member and leader of the National Research Group on Radiation Vulcanization.

Member of the Board of the Sri Lanka co-operative Industries Union.

Member of the central and regional scientific committee of the Rubber Research Board.

REVIEW OF THE PLANT SCIENCE DEPARTMENT

BY

CHANDRA SAMARANAYAKE

SUMMARY

Plantlets obtained from seedling shoot tip culture were acclamatized and transferred to unsterilized soil in pots, success was around fourty percent. Shoot tip explants derived from sprouts induced to grow at the base of the scion stem in 10 year old trees of clone RRIC 103 also could be successfully established in culture.

A selection index perfectly correlated with yield potential could be calculated using the net assimilation capacity of a whorl and the water use efficiency, deterimined at leaf level.

High intensity tapping, with double three system has significantly reduced the girthing of trees, compared to 1/2 s and 1/4 s cut tapping in all clones.

Banana was found to be the most profitable crop to be grown during the immature phase of rubber, from the demonstration plots, maintained in the Kalutara District. More than 20,000 budded plants of different clones were issued to private and state sector nurseries for the establishment of budwood multiplication nurseries.

DETAILED REVIEW

Staff

The Head of Department Dr (Mrs) A. C. I. Samaranayake, Mr V. H. L. Rodrigo, Research Assistant, Intercropping, Messrs L. S. S. Pathiratne, R. B. Gunaratne, Experimental Officers, Mr L. S. Kariyawasam, Senior Technical Officer, Messrs K. A. G. B Amaratunge, U. S. Weerakoon, R. P. Karunasena, S. L. G. Ranjith, R. S. Wijesundera, Mrs. C. W. Ranasinghe, Mrs G. A. S. Wijesekera, Miss R. K. Aluthhewage, Technical Officers, Mr S. Wilbert, Experimental Assistant and Miss D. E. Jayasekera, Clerk/Typist were on duty through out the year.

Dr A. Nugawela, Botanist returned on 6th October, after successfully obtaining a PhD in Plant Physiology from the University of Essex, England.

Mrs G. P. W. P. P. Seneviratne, Assistant Botanist, continued her post-graduate training at the University of Bath, England.

Miss M. S. Ranasinghe proceeded to Australia in May for her post-graduate training at the University of New England, Armidale.

Mr U. K. D. Lewis, Experimental Assistant retired on 15th December after serving the Institute for 33 years.

Research Students

Miss P. H. A. P. Chandrakanthi, Temporary Research Student continued her studies on shoot tip culture of *Hevea.*

Six students were trained under the National Apprenticeship Board Training Programme.

Visits

Advisory visits to estates and smallholders could not be made as requested by the growers during the year due to the disturbances in the country. Experimental visits also could not be made regularly.

Meetings and Conferences

Head of the Department addressed the following meetings.

Seminar for executives of the JEDB and SLSPC organised by the NIPM. Scientific Committee Meeting (Agricultural),
Rubber Task force of the JEDB.

Discussions were held with the Regional Boards of the SLSPC and JEDB on their future replanting programme along with Head of Genetics and plant Breeding Department and the Assistant Agricultural economist.

Training Programmes

Department staff were involved with the following training programmes.

Refresher course for processing assistants of the Advisory Service Department.

Training programme for the Assistant Superintendents of the SLSPC, Ratnapura.

Training of budders of private nurseries on green budding.

Training of private nursery owners and field staff of estates on preparation of young buddings.

Field days for planters of the JEDB Avissawella and SLSPC Ratnapura.

Publications

Long, S. P., Bother – Nordenkampf, H. R. Coft., S. L., Farage, P. K., Lechner, E. and Nugawela, A. (1989). Analysis of spatial variation in CO_2 uptake within the intact leaf and its significance in interpreting the effects of environmental stress on photosynthesis. Phil. Trans. R. Soc. Lond. B 323, 385–395.

Nugawela, A. (1989). Gas Exchange Characters of *Hevea* Genotypes and their use in selection for crop yield, Ph. D. Thesis University of Essex, England.

Reports

Samaranayake, Chandra (1987). Ann. Rev. of the Plant Science Department.

Gunetilleke, Irangannie and Samaranayake Chandra (1989) shoot tip culture as a method. of micropropagation of *Heava Jl. Rubb. Res. Inst. Sri Lanka (in press)*

Laboratory Investigations

Tissue Culture

Seedling shoot tips

Studies were continued on seedling shoot tip culture to improve axillary shoot proliferation and induction of rooting. Thidiazuron in very low concentrations was found to improve axillary bud proliferation. Proliferated axillary shoots were separated and induced to root on a low cytokinin medium. The plantlets were then transferred to unsterilized soil in pots.

Clonal shoot tips

Shoot tip explants removed from shoots, induced to sprout near the base of 10 year old trees of RRIC 103, were successfully established in culture, the cultures showed proliferation of axillary buds and these proliferated buds were separated and subcultured. However the progress of these cultures could not be monitored as most of the cultures were lost as routine maintenance could not be carried out due to the disturbances in the country, during the latter part of the year. (P. Chandrakanthi, Chandra Samaranayake and Sunitha Wijesekera)

Gas Exchange Studies

Diurnal variations

CO_2 assimilation rates (A) and stomatal conductances (gs) determined under control and field conditions were higher earlier in the day than later for similar hight levels. *Hevea brasiliensis* clones seem to differ in the pattern in which (A) declines with time of day. Decline is less marked in clone RRIC 100 when compared with clones PB 86 and RRIM 600. (A. Nugawela and R. K. Aluthhewage)

Responses to light fluctuations

Hevea brasiliensis leaves in which photosynthesis is fully induced at 600 / ^{u} mol m^{-2} s^{-1}, when exposed to low light for periods longer than 5 min. resulted in a loss in the induction stage of the leaves. The loss of induction state is proportional to the duration in low light. Leaves in low light i.e. 100 / ^{u} mol m^{-2} s^{-1}, for 60 min. needed around 10–15 min. high light for photosynthesis to be fully induced again. Clonal differences in the ability to maintain the state of induction during low light is evident. (A. Nugawela and R. K. Aluthhewage)

Genotypic differences in low light

Gas exchange characters of the juvenile plants of 10 *Hevea brasiliensis* genotypes with contrasting yield potentials were determined. There are significant genotypic differences in the CO_2 assimilation rates (A), dark repiration rates (Rd) and Leaf are (La). However, the differences are not perfectly correlated with the differences in yield potential of mature stock. The net CO_2 assimilation capacity of a whorl, i.e. (A–Rd). La in a juvenile plant and the daily gross photosynthetic integral of a mature plant, determined by using the leaf gas exchange characters of juvenile plants, tends to be correlated with the yield potential of mature plants. A selection index perfectly correlated with yield potential could be calculated using the net CO_2 assimilation capacity of a whorl and the water use efficency, determined at leaf level. (A. Nugawela and R. K. Aluthhewage)

Genotype differences in mature plants

Canopy photosynthetic characteristics of two genotypes with contrasting yield potentials, i.e. RRIC 100 and PB 86, were studied using mature stands of the same age and in the same location It is apparent that the canopy photosynthetic rate tend to be high in the high yielding genotype. Further, there is evidence to show that the relatively higher CO_2 assimilation capacity and leaf area and lower respiration rates associated with juvenile plants of the high yielding clone are maintained in to maturity. (A. Nugawela R. K. Aluthhewage and R. P. Karunasena)

Tapping

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

The purpose of this experiment was to ascertain the most suitable tapping systems for different clones. Five tapping systems were tested during the first three years and then from 1987 the following systems were adopted by introducing.

(1) An extra 1/2 S cut on panel Bo – 2 in treatment 3. So that tapping was changed to 2 x 1/2 S d/3 system.

(2) Puncture tapping was discontinued and a 1/4 S cut was opened and tapped on d/2 frequency with a monthly application of Ethrel.

Tapping treatment tested from 1987 are as follows;

Treatment 1 – 1/2S d/3

Treatment 2 – 1/2S d/2

Treatment 3 – 2 x 1/2S d/3

Treatment 4 – 1/4S d/2 + E

Treatment 5 – PT d/2

Tapping was interrupted from time to time due to the disturbances in the country and test tapping data could not be recorded regularly during the year.

Girth measurements recorded in December, 1989 are summarised in Table 1. There was a significant effect of tapping systems on girthing of the tree (Table 2). The high intensity tapping with 2 x 1/2S d/3 system has reduced the girthing of trees significantly compared with other tapping systems. (Chandra Samaranayake, L. S. S. Pathiratne and C. W. Ranasinghe)

Table 1. Mean girth of different clones (CT/77/3)

Clone	Girth (cm)
RRIC 100	66.835
RRIC 101	61.140
RRIC 102	65.245
RRIC 105	61.155
RRIC 108	61.805
RRIC 109	64.660
RRIC 110	68.660
HP 2427	69.190
RRIC 117	64.370
RRIC 113	71.770
RRIC 112	62.565
RRIM 600	64.850
PB 86	64.990

L.S.D. = 2.274
(P = 0.05)

Table 2. *Effect of tapping systems on girthing (CD/77/3)*

	Tapping Systems	Mean Girth (cm)
1.	1/2S d/3	66.186
2.	1/2S d/2	65.167
3.	2X1/2S d/3	63.398
4.	1/4S d/2 + E	65.376
5.	PT d/2	65.719

L.S.D. = 1.410 (P = 0.05)

PB 86 replantation, Urumiwela (T/84/3)

This experiment was started in 1984 to investigate the effect of opening tapping cuts at different heights and tapping high panels upwards before the normal base panels. (Details Ann. Rev. 1984) Tapping upwards was discontinued at the end of 1987 and a new cut was opened on BO–2 and tapped downwards.

There has been no significant difference in yield due to the opening of cuts at different heights. Although sufficient yield data for a statistically analysis could not be recorded in 1989 due to the disturbance in the country, the data collected indicate the same trend that was seen in 1988. (Chandra Samaranayake, and U.K.D. Lewis)

PB 86, replantation, Urumiwela (T/84/2)

This experiment has been in progress since 1984 and compared several initial girths for commencement of tapping on conventional (CT) and puncture tapping (PT) systems for their efect on yield and subsequent growth in girth. At the end of 1986, PT was discontinued and all treatments were tapped on 1/2S d/2. Tapping was interrupted from time to time and test tapping data could not be recorded regularly in 1989. (Chandra Samaranayake and S. Wilbert)

High intensity tapping, Frocester (IS/84/1), (IS/84/2), Nakiadeniya (IS/84/3), (IS/84/4) and Ambadeniya (IS/84/6)

The objective of these experiments is to investigate suitable systems of high intensity tapping during the last few years of exploitation to obtain maximum possible yields. Yield data could not be collected regularly according to the programme in 1989. (A. Nugawela and S. Wilbert)

K levels on tapping systems and clones – Eladuwa (F/76/5)

Effect of three levels of K and three tapping systems on the performance of clones PB 86, RRIC 100 and 101 is studied in this experiment. The yield data recorded in 1988 did not indicate a significant effect of K levels on either clones or tapping systems. However there was a significant interraction of clones and tapping systems. Only a few test tapping readings could be recorded in 1989 and no interferences can be made as the data cannot be statistically analysed.

This experiment is carried out in collaboration with the Soils & Plant Nutrition Department. (Chandra Samaranayake, S. Wilbert and R. P. Karunasena)

PB 86, 1979 replantation, Eladuwa (T/81/1)

This experiment was started in 1981 to compare puncture tapping (PT) with conventional tapping (CT) under commercial conditions. After two years, PT was discontinued and CT was started on all puncture tapped trees and were tapped on the 1/2S d/2 system. Five PT trees and five CT trees from each of the girth classes were selected and test tapped to study the effect of PT on future yield and growth of trees.

Initially there was a significantly higher yield from previously puncture tapped trees when tapped on conventional 1/2S d/2 system. From 1986, there has been no significant difference in yield between previously puncture tapped trees on conventional cut tapping. Yield data could not be recorded regularly in 1989. Trees of T_1 were excluded from the experiment in 1988 as they developed panel dryness. More trees have developed panel dryness in other treatments also in 1989. (Chandra Samaranayake and R. P. Karunasena)

Low frequency tapping

RRIC 100 1981 replantation, Gallewatta (LIT/88/1)

The objective of this experiment is to study the performance of clone RRIC 100 on low frequency tapping systems with yield stimulants. The following tapping treatments are being tested, on a randomised block design.

T_1 – 1/2S d/2 Control

T_2 – 1/2S d/3 + 2.5 Ethrel

T_3 – 1/2S d/4 + 2.5 Ethrel

T_4 – 1/2S d/3 + 2.5 Ethrel

Application of Ethrel was carried out according to schedule but test tapping data could not be recorded regularly in 1989. (Chandra Samaranayake and S. Wilbert)

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

The objective of this experiment is to study the performance of clone RRIC 102 on low frequency tapping systems with yield stimulants. The following tapping systems are being tested on a randomised block design

T_1 – 1/2S d/2 Control

T_2 – 1/2S d/3 Control

T_3 – 1/2S d/3 + Ethrel

T_4 – 1/2S d/4 + Ethrel

T_5 – 1/4S d/2 + Ethrel

Ethrel could not be applied at regular intervals and test tapping data could not be recorded in 1989. (Chandra Samaranayake and K. A. G. B. Amaratunge)

Propagation

Stock–scion relationships

Stock–scion experiments, Moralioya (St. Sc./81/7)

Test tapping could not be carried out as planned during the year. (Chandra Samaranayake, and R. P. Karunasena)

Crown budding

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

Yield data could not be collected regularly in 1989, girth data recorded in December, 1989 are summarised in Table 3. (Chandra Samaranayake & K. A. G. B. Ameratunge)

Young budding

Performance of young buddings – Gallewatta (YB/89/1)

Young buddings of clone RRIC 100 prepared during the first part of the year were planted in the field in June along with bare root brown budded stumps and bare root green budded stumps on a randomized block design with 8 replicates.

The purpose of the experiment is to compare the performance of young buddings with conventional planting techniques.

Table 3. *Girth of trunks (cm) 1989 (CB/77/1)*

	GROWNS						
	RRIC 101	RRIC 45	RRIC 48	RRIM 600	PB 86	2473	RRIC 102
RRIC 101	59.36				61.4	63.9	63.8
RRIC 45		60.5			60.4	60.8	62.2
RRIC 48			63.52		60.4	63.2	58.5
RRIM 600				60.3	59.5	61.5	61.8

Performance of young buddings – Gallewatta (YB/89/2)

Young buddings of clone RRIC 121 at a more advanced stage of growth than those in (YB/89/1) were planted in the field in November along with brown budded stumps and green budded stumps on a randomized block design. (Chandra Samaranayake, Muditha Ranasinghe and K. A. G. B. Amaratunge)

Extension trials on young buddings

The objective of this experiment was to evaluate the performance of young buddings under commercial conditions in different planting districts and to popularise this technique in estates.

18 estates in different planting districts were selected and at least 1000 seedlings were planted in polybags in each of these estates. The field staff was given a training on the technique. The estates could not carry out this programme properly due to the disturbances and this would be repeated in 1990 with a larger number of estates included in the programme. (Chandra Samaranayake, R. B. Gunaratne and K. A. G. B. Amaratunge)

Intercropping

Intercropping of coffee and pepper – Padukka (IC/87/1)

This experiment was started in a State Plantation in the Kalutara District, to study the feasibility of growing coffee and pepper among rubber in the low country wet zone. Details of the experiment are given in Ann. Rev. 1987.

Coffee plants came to bearing, in the third year however the yields could not be recorded due to the loss of crop due to theft.

Pepper plants which were affected due to the severe drought were replaced.

Spacing of pepper in the rubber inter-row, Dartonfield (IC/88/1)

Nine different spacings of pepper along the rubber inter-row were tested in this experiment to select the most suitable density of planting pepper as an intercrop. Details of experiment are given in Ann. Rev. 1988. Experiment was maintained during the year.

Smallholder demonstration plots

Three demonstration plots established in the Kalutara District for popularising banana, passion fruit and pineapple as intercrops in smallholdings during the immature period of the rubber, were maintained. Details of the plots are as follows;

Plot No.	DREO Division	Year planted	Intercrop	Extent
1	Bandaragama	1986 S.W.	Banana	0.4 ha.
2	–do–	1986 N.E	Banana	0.2 ha.
3. (a)	Dodangoda	1987 N.E.	Banana	0.4 ha.
(b)	–do–	1987 N.E.	Passionfruit	0.4 ha.
(c)	–do–	1987 N.E.	Pineapple	0.4 ha.

	Expenditure			*Income*		
Plot No.	Yr. 1 Rs.	Yr. 2 Rs.	Yr. 3 Rs.	Yr. 1 Rs.	Yr. 2 Rs.	Yr. 3 Rs.
1.	2822.00	2165.00	2010.00	845.00	5276.00	6769.00
2.	1784.00	1295.00	810.00	522.15	7361.00	3811.00
3. (a)	3891.50	1802.50		2429.00	11524.25	–
(b)	4830.50	1072.00		687.00	2379.00	–
(c)	10950.00	4790.00			8829.00	–

Pepper was introduced in between banana plants in demonstration plots No. 1 and 2. As the smallholder of plot No. 1 did not maintain the demonstration plot satisfactorily it was discontinued as a demonstration plot.

Removal of too many banana suckers in the plot No. 2 by the owner caused a sharp drop in the number of bunches produced during the year. Fertilizer could not be applied according to schedule due to the disturbances in the area and there has been a drop in yield of all three crops.

There was a better market for passion fruit and this is reflected in the higher income from passion fruit. (V. H. L. Rodrigo, L. S. Kariyawasam and U. K. D. Lewis)

Adaptive research programme

Proposed intercropping sites in the adaptive research programme were visited to plan the field lay out.

The following intercrops have been planted in smallholdings planted with clones PB 86, RRIC 100 and 121 planted at spacings 27' x 8' (8.2 x 2.44m), 18' x 12' (5.48 x 3.66m), 22' x 9' (6.7 x 2.7m).

Crop planted
Banana
Pineapple
Passion fruit
Cinnamon
Vegetable
Coffee
Pepper

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

Extension

Nursery Inspection

Nursery inspection programme could not be carried out as planned due to the disturbances in the country and lack of vehicles for travel.

Supply of nucleus planting material for budwood multiplication nurseries

Following plant materials were issued to State Plantations and Private Nurseries.

Clone	No. of budded stumps	
	State Plantations	Private nurseries
RRIC 100	650	2923
RRIC 102	1160	1972
RRIC 110	1075	–
RRIC 130	575	–
RRIC 121	2150	–
RRIM 600	2050	–
PB 28/59	1050	–
PB 86	–	1458
	7800	6353

No. of plants supplied from Kuruwita Substation = 7037

Total = 21190

REVIEW OF THE PLANT PATHOLOGY DEPARTMENT

BY

A. de S. LIYANAGE

SUMMARY

The joint operation on eradication of *Corynespora* leaf fall disease (CLF) conducted by the Rubber Research Institute, Advisory Services Department and the Rubber Control Department was terminated at the end of May 1989, as a decision was made to terminate the relief payment scheme. However, necessary advise on control of *Corynespora* leaf fall disease was provided to smallholders and the estate sector, on their requests. Upto 1st of March 1990, around 5000 requests were made by the smallholders. These smallholdings have been inspected and around 3500 recommendations were issued to owners of 3500 holdings to uproot an extent of around 2000 ha.

Clone RRIM 600 was temperorily suspended from the list of recommended clones with effect from 1991 as it was reported to be highly susceptible in Malaysia to CLF and *Fusicoccum* leaf blight, a new rubber disease.

Incidence of the *Oidium* leaf fall was mild and a fair amount of *Phytophthora* leaf fall was observed in Kalutara and Ratnapura Districts during the south west monsoon season.

A new fungicide for *Phytophthora* panel disease (Bark Rot) was recommended. A Fumigant, Formalin was found to be effective in controlling Collar rot of *Hevea*.

DETAILED REVIEW

Staff

The Director, Dr A. de S. Liyanage who was overlooking the activities of the Department, Dr (Mrs) N. I. S. Liyanage, Plant Pathologist; Mr C. K. Jayasinghe, Asst. Plant Pathologist; Mr W. Amaratunga, Experimental Officer; Senior Technical Officers / Messrs D. S. Wettasinghe, B. Fernando; Technical Officers Messrs S. S. Warnapura, E. A. T. Senadheera, Mrs P. C. Wettasinghe and Clerk/Typist Mrs P. Amarasekera were on duty throughout the year. Mr R. Jayaratna, Asst. Plant Pathologist left for U. K. on 12th March 1989 for post-graduate studies.

Mr C. K. Jayasinghe, Asst. Plant Pathologist attended the Plant Growers' Conference in Malacca, Malaysia from 21st to 23rd August and presented a paper entitled "Losses due to Corynespora leaf fall disease and its eradication".

Mr C. K. Jayasinghe and Dr (Mrs) N. I. S. Liyanage participated in the meeting of the Association of the Natural Rubber Producing Countries (ANRPC) held in Colombo on the 2nd September to 6th September.

Research Students

Miss C. Meegoda, Temporary Research student, funded by the NARESA discontinued the research project on disease without mechanisms on 31st June due to personal reasons.

Miss W. P. K. Silva and Mr H. G. Jayatissa, Post-graduate research students from the University of Colombo, completed the 6 months project successfully supervised by Dr Mrs. N. I. S. Liyanage.

Under the National Apprenticeship Board Scheme four students from Hardy Technical College, Ampara were trained. Mr V. Perera, Research student funded by NARESA completed the research work for his post-graduate degree.

Visits

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

Experimental	=	86
Advisory	=	157
Miscellaneous	=	85
Total	=	328

Meetings

Mr C. K. Jayasinghe addressed a seminar on "Towards increasing productivity" organized by the NIPM for Chairmen, Directors and Agricultural Advisors of the SLSPC and JEDB.

Dr (Mrs) N. I. S. Liyanage attended the meetings of the Pesticide Formulary Committee.

Training

Dr (Mrs) N. I. S. Liyanage and Mr C. K. Jayasinghe conducted lectures for refresher courses on rubber diseases for the Extentsion Staff.

Publications

Jayasinghe, C. K; Liyanage, A. de S. and Warnapura, S. S. (1988) Outbreaks and new records. Collar rot of rubber seedlings caused by *Sclerotium rolfsii,* FAO Plant. Prot. Bull. *36* : 189.

Liyanage, A. de S. Jayasinghe, C. K. and Liyanage, N. I. S. (1989). Losses due to Corynespora leaf fall disease and its eradication. Proc. Rubber Growers Conference, Malaysia (In press).

General

The proposed programme of research and extension work could not be carried out as expected due to the disturbed conditions that prevailed in the country during the year.

RRI/ASD/RCD joint operation on eradication of *Corynespora* leaf fall disease which has been carried out since 1987 was terminated at the end of May 1989 as a decision was taken to terminate the relief payment scheme. However, necessary advice was given on the control of *Corynespora* leaf fall disease to smallholders as well as to the state sector estates, on their request.

The incidence of the *Oidium* leaf fall disease was mild in most areas as dry weather prevailed during the period of refoliation. But at higher elevations the disease was severe. A fair amount of *Phytophthora* leaf fall was observed in May and June in Kalutara and Ratnapura Districts.

The clone RRIM 600 was reported to be highly susceptible to *Corynespora* leaf fall disease in two localities in Malaysia by the Rubber Reserach Institute of Malaysia. Further a new leaf disease, *Fusicoccum* leaf blight has been reported from Malaysia and clone RRIM 600 was observed to be highly susceptible. As a precautionary measure RRIM 600 was temporarily suspended from our recommended list of clones, with effect from 1991.

Laboratory Investigations

Corynespora cassiicola (SC/89/1)

Isolates

In the first quarter, a heavily sporulating isolate was obtained from infected leaves of clone RRIC 132. Isolates collected previously had poor sporulation. This indicated the possibility of having isolates of varying virulence in Sri Lanka.

During the year several isolates of *C. cassiicola* were collected from different rubber clones for further studies.

Pathogenicity

A population of rubber plants obtained by cross pollination between clones RRIC 100, 101, 102 & 103 belonging to 16 families was tested for susceptibility to *Corynespora* infections using a culture filtrate of the fungus. The same population was assessed for *Corynespora* infection in terms of visual symptom ratings under field conditions. The results indicated that there was a positive correlation between the lesion size obtained in the laboratory and that of the disease rating under field conditions. Generally, families which had highly susceptible clone RRIC 103 as the parent or one of the parents showed an increase susceptibility whereas families with a parentage of clone RRIC 100 (tolerant clone) showed a tolerant reaction (N. I. S. Liyanage and W. P. K. Silva)

Biological Control (BC/89/1)

(i) Selection of antagonistic fungi :–

Previous research work has proved that *Trichoderma* species commonly present in rubber soils are antagonistic towards *Rigidoporus lignosus,* the causal organism of white Root disease (WRD).

Trichoderma harzianum was isolated and grown on macerated straw, clay (Pottery clay), clay + rice bran. *Trichoderma* grew profusely on clay + rice bran mixture.

Trichoderma was also grown on various synthetic liquid media such as Potato Dextrose Extract (PDE), Czapacdox Broth (CDB) and Malt Extract (ME). The fungus grew profusely and rapidly as all three media but on CDB produced a large number of chlamydospores whereas on ME and CDB more sporangia were produced.

A pot trial was initiated in which *Trichoderma* grown on Clay + rice bran mixture (200g) was introduced into pots containing seived soil. Root pieces (100 g) infected with *Rigidoporus lignosus* was introduced to each pot. Seedlings of rubber were transplanted in one set. A similar set was prepared without incorporating the antagonistic fungus, in the soil.

Mortality rate determined 2 1/2 months after initiating the trial showed that 2 plants have died due to WRD in pots containing infected root pieces without the antagonistic fungus.

In another trial infected root pieces were burried in soil with and without antagonistic *Trichoderma* fungi. *Trichoderma* was introduced into the soil by incorporating cubes of clay + rice bran on which the antagonistic fungus was grown. Observations noted 2 months after initiation of the trial indicated that the inoculum of *Rigidoporum liguosus* was not inactivated due to the presence of the antagonistic fungus.

Production of alginate pellets :

Trials were conducted to make dry pellets of antagonistic fungus which could be kept in viable form for a longer duration.

Aliginate pellets containing the fungus *Trichoderma* was prepared by using Sodium alginate, conidia and chlamydospores. Conidia and chlamydospores were prepared initially by growing *Trichoderma* on Potato dextrose agar. CDB medium is more suitable for growing the fungus for pellet formation as more chlamydospores are produced in this medium. (N. I. S. Liyanage and E. A. T. Senadheera)

Studies on the phylloplane microflora of Hevea brasiliensis (SC/89/1)

It is generally believed that actively growing and moribund leaves carry a vast number of micro-organisms as the surface flora. This project was under taken to find the saprophytic and pathogenic microflora present on the *Hevea* leaf surfaces.

The leaves were collected randomly from different sites. From the top, middle and basal parts of each leaflet three discs of 1 cm diameter were cut out with a cork borer and the discs suspended in 100 ml sterilized water in three separate flasks. The flasks were mechanically shaken for 15 minutes on a Waring Blender and suspensions were diluted to get 1 : 1 and 1 : 100 dilution. 0.5 ml of these suspensions were plated on PDA containing 0.003% Rose Bengal. Fungal colonies were transferred to PDA seprately for identification purposes. (C. K. Jayasinghe and S. S. Warnapura)

Field Investigations

Studies on Collar Rot of Hevea seedlings (CC/89/1)

An attempt was made to find suitable fungicides to control Collar Rot of rubber seedlings caused by *Sclerotium rolfsii*. Seven chemicals namely Anthracol (0.2% ai) Benlate (0.2% ai) Captan (0.2% ai), Cobox (0.2% ai), Dithane M 45 (0.2% ai), Formalin (0.5% ai) and Thiram (0.2% ai) were evaluated by Poisoned Food Technique on PDA. The result of this experiment showed that Benlate, Captan, Dithane M 45, Thiram and Formalin are the best chemicals as they checked the growth of the pathogen successfully on the agar medium.

However, field trials conducted in pots showed that only Formalin (0.5% ai) is effective in controlling the pathogen under natural conditions. Then a series of experiments was conducted using lower concentrations of Formalin as 0.5% ai was phytotoxic. It was found that 0.12% ai Formalin can check the growth of pathogen completely without causing any harmful effect to the young rubber seedlings. Furthermore, it was observed that Formalin enhances the growth of antagonistic flora in the soil whereas other fungicides checked the growth of antogonistic flora. Experiment is in progress. (C. K. Jayasinghe, A. de S. Liyanage and S. S. Warnapura)

White root disease :

Fungicide (Collar protectant) recommended for control of white root disease is presently not marketed in Sri Lanka due to it's carcinogenic properties. As a result two new fungicides Bayleton 25 wp (triadimefan) and Bayfidan (triadimenol) 250 EC are being tested with a view to finding a substitute for collar protectant. This study is still in progress. (N. I. S. Liyanage, D. S. Wettasinghe, E. A. T. Senadheera)

Phytophthora meadii

Three formulations of a phthalimide group of fungicide given below, were tested against *Phytophthora* infection. Folpet R, Folpet 40 TK, Folpet 40 TKH. Trials were conducted both *in-vivo* and *in-vitro*. All these formulations proved to be effective in controlling the disease under field conditions. Studies showed that Phthalimide group of fungicides (Folpet) could be used effectively in addition to the recommended fungicides Brunolinum and Sandofan, for controlling *Phytophthora* panel disease of rubber. Further it is cheaper than the product Sandofan. (N. I. S. Liyanage and H. G. Jayatissa)

Screening of clones for diseases (SC/89/1)

The following clones were assessed for *Corynespora, Colletotrichum* and *Oidium* infection, under local conditions.

PB 217, PB 235, PB 255, PB 260, PR 255, PR 261, RRIM 712, RRII 105, BPM 24, PR 305, PR 307, PR 306, PR 309, HEIKEN, 44 – 9, 88 – 13, RRIM 803, GT 1. Assessments were made on 1 – 2 whorl polybag plants, at Nivitigalakele Sub–station. Since the ideal season for assessing *Oidium* infection has already passed, an assessment of spotting of mature leaves or defoliation that has occurred at the beginning of the year due to *Oidium* infection was taken into account.

Clones PB 255 and PB 260 showed susceptibility to *Corynespora* infection while PB 235 appeared to be susceptible to *Oidium* infection. SEATC 88 – 13, GT 1, PB 217 appeared to be less susceptible to all 3 leaf diseases. These clones have to be assessed further for leaf disease infection. (N. I. S. Liyanage, D. S. Wettasinghe and E. A. T. Senadheera)

Clones which are under test in the Genetics and Plant Breeding Dept. are being included in the Plant Pathology nurseries established in 12 locations. Polybag plants of these clones were established during this quarter and these will be screened for leaf diseases in the future. (N. I. S. Liyanage and D. S. Wettasinghe)

RRI/ASD/RCD Joint operation on eradication of CLF disease

The above programme was terminated at the end of May as the relief payment scheme was withdrawn from 1st May 1989. It was decided to consider CLF disease as another common disease of *Hevea* and advise the affected smallholders through Advisory Services Dept. just as we do for other diseases. Therefore, all requests received after 1st May 1989 from smallholders were forwarded to the respective Divisional Rubber Extension Officers for necessary action (C. K. Jayasinghe, A. de S. Liyanage, D. S. Wettasinghe, B. Fernando, S. S. Warnapura and E. A. T. Senadheera)

Incidence of CLF disease in smallholding sector at the end of May 1989

Rubber growing Area	No. of holdings affected	Area to be replaced with tolerant clones
Colombo/Gampaha	801	389
Kalutara	1379	722
Galle	130	120
Ratnapura	618	427
Kegalle	508	307
Total	3436	1965

CLF disease survey in State Plantations

Eventhough this survey has been completed in all rubber growing districts in 1986 – 1987, several new requests have been made during this year (A. de S. Liyanage, C. K. Jayasinghe, A. C. I. Samaranayaka, E. A. T. Senadheera, A. Weerakoon and B. Gunaratne)

The effect of planting distance on productivity and nitrogen fixation of P. phaseoloides

Eventhough the periodical assessements could not be made as expected due to disturbed situation prevailed around the experimental site during this year, arrangements have been already made to obtain the results during early January 1990 (C. K. Jayasinghe and D. S. Wettasinghe)

REVIEW OF THE SOILS AND PLANT NUTRITION DEPARTMENT

BY

M. K. S. A. SAMARAWEERA

SUMMARY

The work of the Department is concerned mainly with investigation on methods of overcoming soil related constraints to increasing the productivity in rubber lands. Several experiments are being conducted to investigate a range of soil factors, namely, physical, chemical and biological which influence the performance of the rubber tree. The overall objective of the programme is to come out with several practices to improve the fertilizer use efficiency, soil exploitation and soil management, which are acceptable to all grades of rubber growers.

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

The work involves agronomic evaluation of fertilizer requirements of the rubber tree, the study of plant – soil relationships, carbon and mineral nutrition and water relationship of the rubber tree and weed control. Field, pot and laboratory investigations are in progress.

However the progress during the period under review was rather slow, and the popular activity the "Soil and Foliar Survey" programme for recommending fertilizer to mature rubber was not carried out. This was mainly due to the unsettled conditions prevailed and nonavailability of vehicles.

Several advantages, of having a mulches round the tree were seen. Among them are the increased growth and latex yield, better rooting pattern and improved soil conditions. The rubber trees continued to show a positive response to fertilizer. The yield increases in small holdings were spectacular, and up to a 87% increase over the control, without fertilizer, was observed.

Staff

Dr M. K. S. A. Samaraweera was appointed the Head of the Department with effect from 1st of January 1989. The Assistant Agronomist Mrs M. L. A. Samarappuli was promoted to the Senior Staff Grade I with the designation Agronomist on the 30th March 1989. The Head of the Department and the Agronomist were on duty through-out the year. One of the Assistant Soils Chemist, Mr D. M. A. P. Dissanayake left the country on the 10th February 1989 for post graduate studies at the University of Aberdeen. Mr. S. M. Weerasuriya, the other Assistant Soils Chemist resigned from the Institute services on the 19th August 1989.

The Experimental Officers Messrs W. C. Dayaratne, A. M. A. Perera, F. P. W. Silva and H. D. S. P. Perera the Senior Technical Officer Mr J. G. De Mel, the Technical Officers Messrs S. N. Silva, P. Karunadasa, U. Mithrasena, A. N. Ykandawala, Miss C. K. Maheepala and Mrs Manel Mahanama, the Specification Assistant T. M. Ahamadeen and the English Stenographer Mrs Lakshmi Perera were on duty. Mr T. B. Dissanayake, Technical Officer was transfered from the Biometry section to the Department on 9th May 1989 and Mrs Ranjani Bogahawatta, Technical Officer, was transfered from the Department to Polymer Cheimistry Department on 1st June 1989.

Temporary Workers

Three Research Assistants Messrs K. G. S. Jayawardene, S. M. M. Iqbal and R. M. U. Senarath and one Technical Assistant, Miss Chandani Jayalath worked in the Department through out the year in NARESA funded projects. Miss Vanoja Jayasekara, Technical Assistant in a NARESA funded project left the Institute on 12 October 1989 to take up a permanent position in the Department of Animal Health and Production.

Visits

Dr M. K. S. A. Samaraweera attended the Common wealth Science Council Agroforestry Programme, Amelioration of Soil by Trees, Review Meeting, held at the International Council for Research in Agroforestry (ICRAF), Nairobi, Kenya, 20 – 24 November 1989 and presented a paper entitled "Amelioration of an Ultisol by Rubber *(Hevea)* Trees". His visit was sponsored by CIDA and NARESA.

Advisory Visits

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

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

Working groups and committees

The Head of the Department served in the following:

Co-ordinating committee on fertilizer supplies of the Ministry of Agriculture Food and co-operatives.

Technical committee on Biological Control of Aquatic weeds of the Natural Resources Energy and Science Authority of Sri Lanka (NARESA).

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

Agricultural Committee of the Atomic Energy Authority of Sri Lanka.

Technical Committee on fertilizer of the Sri Lanka Standards Institution.

Member, sub committee on Applied Chemical Sciences, appointed to commemorate the Golden Jubilee of the Institute of Chemistry, Sri Lanka in 1991.

Visitors

Dr D. J. Appleton of the British Geological Survey visited the Department in his capacity as the Consultant (African Carbonate and Agrogeology Project) for the Overseas Development Administration to discuss details of the experiments conducted with Rock Phosphates.

Dr J. M. Anderson of the Department of Biological Science was in the Department working with Dr Samaraweera and Professer I. A. U. N. Gunatilleke (Department of Botany, University of Peradeniya) in the project on "Nutrient Cycling in Rubber Plantations and Low Land Forest of Sri Lanka."

Professer R. B. Soper of the University of Manitoba was here in the capacity as Research Monitor, to evaluate the CIDA funded projects.

Publications

IQBAL, S. M. M. (1989) Effect of K and Mg fertilizer on growth, yield and mineral composition of *Hevea Brasiliensis* (Proc. Institute of Biology Sri Lanka)

JAYAWARDENA, K. J. S. & SENARATH, R. M. U. Nutrient cycling in rubber plantations and lowland forests (Proceedings of the seminar organised for Young Scientists by the Institute of Biology of Sri Lanka)

SAMARAPPULI, L. (1989) Some aspects of moisture stress on *Hevea brasiliensis* (Proceedings of the seminar organised for Young Scientists by the Institute of Biology of Sri Lanka)

SAMARAWEERA, M. K. S. A. & ATKINS, C. A. Fate of photosynthetically derived carbon in young rubber plants. (Submitted for publication)

SAMARAWEERA, M. K. S. A. (1989) "Fertilizer use efficiency in rubber plantations" Proceedings of the seminar on "Fertilizer and their efficient utilization", organised by the Institute of Chemistry, Sri Lanka (In press)

SAMARAWEERA, M. K. S. A. (1989) Study of potassium and magnesium deficiency in young rubber". Proceedings of the seminar organised by the Natural Resource, Energy & Science Authority of Sri Lanka. (In press)

SAMARAWEERA, M. K. S. A. (1989) Amelioration of an Ultisol by rubber *(Hevea)* tree, Proceedings of the Commonwealth Science Council, Agroforestry Programme Review Meeting. (In press)

SAMARAWEERA, M. K. S. A. (1989) Use of Isotopes and Radiation Techniques in Plant Nutritional Research, Proceedings of the Seminar on "Use of Isotopes and Radiation Techniques in Agriculture" Atomic Energy Authority of Sri Lanka. (In press)

SAMARAWEERA, M. K. S. A. (1989) Use of Eppawala Rock as a Source of phorlhorm for Rubber Plantations. Tropical Agriculturist. (In preparation)

SAMARAWEERA, M. K. S. A. (1989) Instrumental Methods of Analysis in Agricultural Research Newsletter (No 1) of the Sri Lanka Association of Technicians in Analytical Instruments.

WEERASURIYA, S. M. & YOGARATNAM, N. (1989) Effect of potassium and magnesium on growth of young *Hevea brasiliensis*. J. Rubb. Res. Ins. of Sri Lanka. (In press)

WEERASURIYA, S. M. & YOGARATNAM, N. (1989) Effects of potassium and magnesium on leaf and bark nutrient contents of young *Hevea brasiliensis.* (In preparation)

YOGARATNAM, N. (1989) Trends in fertilizer use in Rubber and the likely impact of the proposed measures on fertilizer use and productive. Paper presented at the seminar on current issues in the Agricultural Sector, ARTI., December 1989.

Books

Dr M. K. S. A. Samaraweera is one of the principal contributors to the book entitled, "Tropical Soil Biology and Fertility" A Hand book of Methods (1989) (Anderson and Ingream J. S. I. eds), C. A. B. International U. K.

Lectures

Following lectures were delivered by the Departmental staff :

1. Dr M. K. S. A. Samaraweera. "A Chemist Among Rubber Tree" at the research colloqium of the Institute of Fundamental Studies.

Laboratory Investigations

Carbon and mineral nutrition

Several aspects of the carbon and mineral nutrition, physiology and biochemistry of the rubber tree were examined employing field grown trees at Eladuwa State Plantation, Payagala.

Phloem sap samples from the rubber trees were freeze dried and sent to the University of Western Australia for detailed chemical analysis of the constituents. Latex samples collected at different times of the day by piercing the bark to different *deptho* are being analysed for sugars (mainly sucrose) and nutrients (mainly K) in them. The aim of the study is to determine the translocation path of assimilates and nutrients to laticifers.

(M. K. S. A. Samaraweera, W. C. Dayarathne, A. M. A. Perera and Miss Chitra Mahipala, in collaboration with Professor C. A. Atkins of the University of Western Australia and Professor J. A. Milburn of the University of New England, Armidale.)

Field Experiments

Response to K

In experiment, F/76/5, in progress at Eladuwa State Plantation, the effect of 3 levels of K and 3 tapping systems on the performence of clones PB 86, RRIC 100 and RRIC 101 is being studied. It was not possible to make regular assessment during this period. (N. Yogaratnam and G. de Mel)

Response to NK

Effects of N and K on growth and yield were compared on Clones PB 86, RRIC 100, RRIC 101 and RRIC 102 in experiment F/76/4 at Sorana State Plantation, Horana. It was not possible to make regular assessments during this period.

K/Mg Nutrition

In experiment, F/84/1, methods of improving soil fertility and fertilizer use efficiency in rubber plantations by using a combination of organic and chemical fertilizers are being studied at five sites with 7 blocks in a split plot confounded design. The main plot treatments are :

T_1 – Control without organic matter fertlizer, prior to planting
T_2 – K and Mg before planting
T_3 – Rice straw thrice a year
T_4 – Coir dust thrice a year

The sub treatments are four K levels and four Mg levels (ie. 16 combinations)

Thus, there are 16 plots at each block and we have no intention of studying the K – Mg interaction with 16 – 20 trees per plot. Each is seperated from the other by guard rows. The experimental sites are at Eladuwa Estate – Payagala, (2 block), Divitura Estate – Elpitiya (2 blocks), Atale Estate – Kegalle, (1 block) and Pitiyakanda Estate Mawatagama (1 block). (The trees of the experimental block at Padukka Estate were uprooted because of the *Corynespora* leaf disease).

Because of the political unrest that prevailed the progress during the period under review was rather slow. Organic matter and fertilizer were applied, and measurements of the growth of the trees were carried out. Samples of latex were collected. Chemical analysis of the samples (leaves and soil) collected during the 2nd half of 1988 were completed. Exudates were collected from the experimental trees at the Eladuwa State Plantation and sent to the University of Western Australia for chemical analysis. (M. K. S. A. Samaraweera, W. C. Dayaratne, A. M. A. Perera, S. N. Silva, Miss Chitra Maheepala, T. M. Ahamadeen and Miss Chandani Jayalath)

The experiment (F/84/1) started in 1984, at Eladuwa S. P. Payagala to study the effects of 3 levels of K and Mg fertilizers on clone PB 86, is in progress. The results showed a significant increase in plant girth and leaf K content at the first level of K. Leaf Ca and Mg contents showed a significant decreases with application of K at the first level. (S. M. M. Iqbal, N. Yogaratnam and U. Mithrasena)

A field experiment was started (F/88/1) using immature rubber plants growing in a 1987 replanting at Clyde S. P., Kalutara. This experiment on Boralu soils, studies the effects of 5 levels of K and 2 sources of Mg fertilizers on growth and Mineral Composition of immature *Hevea*. Leaf and soil samples were colleced and measurements of girth were done at 4 monthly intervals. (S. M. M. Iqbal, N. Yogaratnam and U. Mithrasena)

Two pot experiments were stareted in 1988 at Dartonfield Estate, Agalawatta. In the first pot experiment three levels of K were compared on 5 soil series Viz. Agalawatta, oralu, rambe, Homagama, and Ratnapura, using clone RRIC 100 series. In the second experiment the effects of five levels of K on five clones Viz. PB 86, RRIC 102, RRIC 110 and RRIC 121 were studied.

These two pot experiments were uprooted in August and October 1989, respectively. Leaf, soil and latex sampling were done to assess their nutrient consentrations. Diameter and height measurment, whorl count, bark thickness, Microtapping, net photosynthetic rates and transpiration rates were also assessed before uprooting. Fresh and dry weights of seperated plant parts such as leaves, petioles, stems and roots were measured and bark analysis was done for their nutrient consentrations. (S. M. M. Iqbal and N. Yogaratnam)

Response to N P K Mg

Experiment, F/76/8 investigating into the effect of 3 levels of N, P, K and Mg on the performance of clone RRIC 45 in Agalawatta soils was in progress at Raigama State Plantation, Ingiriya. It was not possible to make regular assessment during this period. (N. Yogaratnam and F. P. W. P. Silva)

Response to N P K Mg in smallholdings (F/84/2)

Use of fertilizer in smallholdings is being investigated in an experiment on Godigamuwa Estate in Kalutara using clone PB 86 from a 1976 replanting. Fertilizer treatment consists of no fertilizer control, standard fertilizer mixture and fertilizer on the basis of soil and leaf analysis. Yield data (Table 1) obtained in the sixth year of the experiment shows significant yield increase to application of conventional fertilizer mixture by 47% and an increase of 87% with fertilizers on the basis of leaf anaylsis. As similar results were obtained in 1986, 1987 and 1988 also, it appears that significant yield increases could be in smallholdings with a history of irregular application of fertilizer during the mature period. (N. Yogaratnam and F. P. W. Silva)

Table 1. *Effect of fertilizer on yield of PB 86*

Treatment	Yield (Kg/ha)	% increase over control
No fertilizer (control)	852	100
Conventional fertilizer mixture	1252	147
Soil and foliar survey scheme	1592	187

Fertilizer requirement of young budding

Three experiments were started to study the effects of fertilizers on the performance of *Heavea* planted in polybags to be used for young budding as an improved planting technique.

In experiment 1, following treatments were allocated to single plant plots in a randomized block design with 25 replicates for each treatment.

T_1 – Current recommendation for young budding
T_2 – Sulphate of Ammonia based N P K Mg mixture + watering
T_3 – Double the sulphate of Ammonia based misture + watering
T_4 – Sulphate of Ammonia based mixture without watering
T_5 – Urea based 12 : 14 : 14 N P K mixture + watering
T_6 – Double the urea based mixture + kieserite + watering
T_7 – Urea based mixture without watering
T_8 – Mixture of urea, concentrated super phosphate, potassium sulphate and commercial epsom salt in liquid form.
T_9 – Urea commercial epsom salt, rock phosphate and muriate of potash as soil application.
T_{10} – Control (Nil fertilizer)

In experiment 2, following treatments were allocated to single plant plots in a fully randomized design with 20 replicates to study the time of application of fertilizer.

T_1 – Control (Nil fertilizer)
T_2 – Current recommendation – weekly
T_3 – Current recommendation – 2 weekly
T_4 – Current recommendation – 3 weekly
T_5 – Current recommendation – 4 weekly

In experiment 3, FOREST FOLIAR SPRAY was used as a foliar spray in addition to the current recommendation. Treatment were allocated to single tree plots in a fully randomized design with 15 replicates.

T_1 – Control (Nil fertilizer)
T_2 – Current recommendation – (liquid form)
T_3 – Current recommendation + (FFS) (Forest Foliar Spray)
T_4 – Current recommendation + Double FFS
T_5 – Double Current recommendation (liquid form)
T_6 – Double Current recommendation + FFS
T_7 – Double Current recommendation + Double SFFS

(N. Yogaratnam, F. P. W. Silva and A. Yakanndawala)

Soil-plant-water relations

Effect of cover management practices on moisture stress and mineral composition, growth and latex production of *Hevea* trees were studied in experiment SM/82/5. The treatments are clean weeding natural covers, mixed legumes and dead mulch cover. The latex yield of the trees receiving mulches was higher than those with other treatments. Like last year the growth of the trees showed similar trend. (Table) Data obtained showed an increase in latex that were in comparison with the plants in other three management practices. Growth of the trees also showed a similar trend. (Table 1)

It is possible to obtain significant girth and yield increase by mulching (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena in colloboration with N. Yogaratnam)

Table 1. *Effect of different soil managment practices on girth and mean yield in terms of grams per tree tapping (g/t/t)*

Treatment	Girth (cm)	Mean Yield (g/t/t)
Bare	47.58	18.41
Naturals	44.64	18.86
Legumes	46.49	20.10
Dead mulch	53.61 ***	23.82

In experiment SM/83/1 the effects of some soil managment and fertilizer practices on mineral composition growth and ability to withstand moisture stress by immature rubber were studied. The results are similar to last year.

The growth measurement made indicated that the trees with mulch around the plant had higher girth than trees without mulch. (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena, in collaboration with N. Yogaratnam)

Table 2. *Effect of mulch on girth of rubber trees*

Treatment	Girth
Without mulch	38.08
With mulch	38.98 *

Three experiments SM/88/1, SM/88/2, SM/88/3 are being conducted in three different agro-ecological regions to study the influence of ground covers and potassium on some soil characteristics and their effects on moisture stress, mineral composition and growth of immature rubber. The moisture content of the soil and leaf water potential of the plants were measured. It is too early to make any conclution from these studies. (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena in collaboration with N. Yogarathnam)

In experiment SM/88/4 effects of different levels of soil moisture and potassium on the performance of *Hevea* plants are being studied. Plant growth, leaf water potential, relative water content and transpiration rate were measured. It is too early to make any conclusion from this experiment. (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena in collaboration with N. Yogaratnam)

Studis on the effects of the moisture content of the soil on different *Hevea* clones and establishment practices were continued in two pot experiments SM/88/5 and SM/88/6. (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena in colaboration with N. Yogaratnam)

The experiment SM/88/7 started to study the effect of different mulches on mineral composition, growth and ability to withstand moisture stress by immature rubber was continued. (L. Samarappuli, M. Mahanama, P. Karunadasa, U. Mithrasena in collaboration with N. Yogaratnam)

Response to K in relation ground covers

EXPERIMENT NO C/77/08 - LOWMONT-CLYDE S.P.

Effect of K on leguminous covers and on the N status, growth and yield of clone PB 86 is studied in this experiment. The girth and yield data indicated that the application of K to covers and rubber at first level would give significant increases, but no further increase could be expected at the second level. (S. M. M. Iqbal, N. Yogaratnam and U. Mithrasena)

Organic manures

The programme of the Department on organic manures is aimed at alleviation of soil related constraints for increasing the productivity in rubber lands. The major emphasis is on the use of cattle manure, excess crop residues such as rice straw and coir dust to improve the soil fertility and fertilizer use efficiency and nutrient cycling.

The experiments on the use of organic manures on immature Hevea plantations at Elston Estate, Puwakpitiya (OM/86/1) Paiyagala state Plantation, Paiyagala (OM/86/2) and Hewagama Estate, Padukka (OM/88/1) were continued. (N. Yogaratnam and F. P. W. Silva)

Nutrient cycling in rubber plantation

The work on the project aimed at developing a predictive understanding of the functioning of biological processes and their contribution to soil fertility was continued with a view to improving soil fertility and fertilizer use efficiency in rubber plantations by man ipulating soil biological processes.

The project is funded by the National Environmental Research Council of the United Kingdom under the Tropical Soil Biology and Fertility (TSBF) programme. The TSBF programme focuses its attention on the poor quality of the agricultural soils in the tropics. It has a collaborative programme of research at ten centres to provide a means for the maintenance and improvement of the soil fertility through appropriate managment practices. The centres are well scattered, five in South America, three in Africa, one in Asia (while in Sri Lanka) and one in Australia and the present activities of the Sri Lankan project include the following.

Socio economic survey

Site characterization : Comparison of natural ecosystem, Sinharaja Forest, with a derived or managed ecosystem.; 1984 replanting at Eladuwa State Plantation. This is done by measuring the climate, vegetation, chemical, physical properties and biological activities of the soil under each ecosystem (level 1 studies) as detailed in the TSBF hand book.

Rational testing of hypotheses :

The nature of the experiments performed depends on the research priorities, and institutional constraints (level 11 studies)

The following hypotheses relating to the effect of organic matter on soil fertility are being tested, in a 1984 replanting at Eladuwa State Planatation :

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

Incrasing the proportion of the low quality litter inputs at the onset of rain extends the time period of nutrient availability to plants.

The availability of fertilizers to plants can be delayed by microbial immobilization on low quality litter, hence decreasing the risk of losses by leaching.

Increased soil organic matter results in an increased time of nutrient availability to plants even in the presence of high quality litter or fertilizer.

Studies on vegetation, litter fall, litter decomposition, micro fauna, root studies (devising, distribution an biomass) were continued.

Experimental Design

The experiments of testing of hypotheses are being conducted in the 1984 replanting at Eladuwa State Plantation. Paiyagala in the Kalutara district. The land is with a slight slope and the separation between trees is 4 – 4.5 m.

Individual tree size latex yield and nutrient composition of the leaves and latex, the changes in defoliation – refoliation patterns are also being studied. There are four treatments and three replicates. Hence a total of twelve plots (details given below)

Treatments	Trees	Control (no trees)
No application (O)	+	+
Fertilizer (F)	+	+
Coir (low quality litter) (C)	+	+

A plot contains nine (9) rubber trees in three contours. Each plot is separated by the adjoining plot by using a guardrow of trees and treatments are laid out in a randomize block.

Details of work done during the year :

Soil samples were collected at 2 depths, 0 – 15 cm and 15 – 50 cm, from the area round the trees where the fertilizer is being applied and this was done separately at the upper and lower levels of the plots. Thus there were four (4) samples per plot. These samples were processed for analysis. Fertilizer application and other treatments were made according to the schedule. The changes with time in the leaf nutritional composition were studied by analysing the leaves collected at regular intervals.

Litter decomposition studies were carried out regularly by monitoring the fate of known amount of litter inside standard bags which were placed in the ground. Box like, (30cm x 30cm x 2.5cm) polyvinyl bags with 7mm mesh, provided by the TSBF programme were used, for this purpose. In May, 60 bags each containing 20g of dried rubber leaves and 40 bags, each containing 20g of dried Pueraria litter were placed at random in the plots. Five (5) bags of each type were removed randomly at a given sampling, their contents were washed to remove the soil and clay particles and dry weights of remaining litter were recorded.

The soil profile in an area of 2 m2 (2m, radially away from the base of the tree x 1m depth) was mapped and distribution of the root system was recorded. Synthesis of results is incomplete, but differences among treatments are evident with mulches promoting surface root development and fertilizer alone promoting growth of feeder roots at greater depths.

Root biomass and microbial biomass in the first 15cm of the soil under different treatment were studied as detailed in the TSBF method hand book.

Soil solutions were sampled at different intervals after fertilizer application using ceramic cup lysimeters, installed at two depths (20, 50 cm) and the nutrient content of the soil solution are being determined to study the leaching patterns.

Experiments were initiated to study the denitrification and N mineralization in rubber plantations.

Dry weights of the litter collected into the four traps of 0.25m2 (two canopy and two ground) placed in each plot were to be recorded regularly, until the defoliation is over, in Feb. 1990. However this was not possible due to unsettled conditions. (M. K. S. A. Samaraweera, I. A. U. N. Gunatilleke (Department of Botany, University of Peradeniya), A. de S. Liyanage, K. G. S. Jayawardane, R. M. U. Senarath, Miss V. Jayasekara, in collabaration with J. M Anderson, Department of Biological Science, University of Exeter, U. K.)

Extension trials on fertilizer

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

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

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

Chemical analysis

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

Soil and Foliar Survey

The programme was not carried out due to unsettled conditions and non availability of vehicles.

REVIEW OF THE GENETIC AND PLANT BREEDING DEPARTMENT

BY

N. E. M. JAYASEKERA

SUMMARY

Test tapping, girth measurements and other field work were disrupted due to the unrest prevailed in the country. Lack of transport and funds and disruption of normal estate work were the other constraints that adversly affected the field work. RRIC 121 continued to give high yields in field trials and therefore was promoted to Group I, in the clone recommondation for public sector estates subjected to the condition that it should be planted below 300 meters in areas where the annual rainfall is less than 3750mm. RRIM 600 was removed, as a temperory measure, after considering reports received from Malaysia indicating that RRIM 600 is becoming more and more susceptible to *Corynospora* leaf disease and highly susceptible to a new disease, *Fusicoccum.*

DETAILED REVIEW

Staff

The Head of Department, Dr N. E. M. Jayasekera, Mr K. B. Karunasekera, Experimental Officer, K. W. Rupatunge Senior Technical Officer, Mr B. M. S. G. Peiris, Senior Experimental Assistant, Mr A. K. M. S. Senaratna, Experimental Assistant, Messrs I. D. M. J. Sarath Kumara and R. A. S. K. Ranatunga, Technical Officers, were on duty throughout the year.

Mrs S. C. Dharmaratna, Assistant Genetcist and Plant Breeder completed her PhD thesis on "Studies on self-incompatibility in *Brassica napus* and returned to Island in October 1989.

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

Visitors

Dr M. J. Lawrence, a Senior Lecturer, at the Department of Genetics, University of Birmingham, visited the Department on 27th February 1989.

Meetings

The Head of the Department attended the following meetings.

i. The Central Scientific Committee meeting

ii. ANRPC meeting

iii. Task force meeting organized by the Janatha Estate Development Board (JEDB)

Conferences and Seminars

The Head of Department attended the following seminars and conferences

i. Seminar organised by the Institute of Plantation Management on "Towards increasing rubber production". At this seminar the Head of Department adressed the seminar on "recommended *Hevea* planting material."

ii. Young scientists seminar organised by the Institute of Biology of Sri Lanka.

iii. Seminar on use of radio isotopes in Agriculture

Dr. (Mrs.) S. C. Dharmaratna gave a talk on "Production of synthetic *Brassica napus* using ovary culture" at the young scientists seminar.

The Head of Department conducted lectures on "recommended *Hevea* planting material" in the following field day programmes and training courses.

i. Field day held at Dartonfield for Superintendents of JEDB No. 1, Avissawella.

ii. Training courses for Assistant Superintendents of Sri Lanka State Plantation Corporation (SLSPC) Board V. Ratnapura.

iii. Field day for Superintendents of SLSPC Board V held at Kuruwita sub-station.

Clone recommondations for JEDB and SLSPC estates

The Head of the Department, The Head Plant Science Department and Assistant Agricultural Economist visited all JEDB and SLSPC regional Boards and discussed, with Superintendents, the 1990 replanting programme. Clones were recommended for each estate taking into consideration the following factors.

(i) Extent to be replanted

(ii) Annual rain fall

(iii) Elevation above mean sea level

(iv) Clones already planted on the estate

(v) Amount of budwood available on the estate.

Important feature of the recommondations was that PB86 was not recommended for 1990 replanting programme.

Miscellaneous

Senior Experimental Assistant, Mr. B. M. S. G., Peiris assisted the Plant Science Department in the indentification of budwood nurseries of SLSPC estates in Ratnapura District and also helped in the distribution of budded stumps for the expansion of budwood nurseries.

Reports from the Rubber Research Institute of Malaysia indicated that RRIM 600 is becoming more and more susceptable to *Corynospora* leaf disease and highly susceptible to a new disease called *Fusicoccum*. After considering these reports it was decided to remove RRIM 600 from the list of recommended clones for planting in wet areas as a temporary measure, till more information is received from RRIM.

Publications

Dharmaratne, S. C. (1989). Studies on self-incompatibility in Brassica Napus. Ph. D. thesis submitted to the University of St. Andrews Scotland.

Reports

Jayasekera, N. E. M. (1989). Annual Review of the Genetics and Plant Breeding Department.

Field Experiments

Breeding, selection and clone evaluation.

Hand pollination programme for 1989

Hand pollination programme for 1989 was abandoned as the contractor could not supply bamboos in time, due to the civil unrest prevailed in the country.

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

A girth measurement was recorded in the two small scale trials established at Moralioya Estate and Yatadola State Plantation (S. P.). In these two trials a part of 1974 H.P. selections are evaluated. Only two new selections, 74 – 166 and 74 – 188, At Moralioya and Yatadola respectively had higher mean girth than the best control clone. New selection 74 – 166 registered a mean girth of 74.6 cm while the mean girth of 74 – 188 was 75.9. Out of control clones planted in these trials. RRIC 121 had the highest mean girth at both locations registering mean values of 65.6 cm and 77.9 cm at Yatadola and Moralioya respectively.

Only five test tappings at Yatadola and three at Moralioya were possible due to civil disturbances during 1989 and due to lack of transport facilities. Mean yield in terms of grames per tree per tapping (g/t/t) are presented in Table 1. (N. E. M. Jayasekera, K. B. Karunasekera, K. W. Rupatunga and I. D. M. J. Sarath Kumara).

Table 1. *Mean yield of the best control clone and promising new selections at Yatadola (BST/HPS/74/2) and Moralioya (BST/HPS/74/2).*

Moralioya		Yatadola	
Clone No.	Mean Yield (g/t/t)	Clone No.	Mean Yield (g/t/t)
RRRIC 121 (control)	47.6	74 – 173	36.8
74 – 202	46.4	RRIC 121 (control)	35.1
74 – 17	31.1	74 – 210	28.1
71 – 173	26.5	74 – 212	26.3
74 – 6	25.0	74 – 188	26.2

In the small scale trial (BST/HPS/74/3) planted at Kuruwita sub-station eleven new selections made from 1974 H.P seedlings were tested. In this trial RRIC 121 registered the highest mean girth. Highest mean yield was recorded by the new selection 74 – 193. It yielded 74.09 g/t/t while RRIC 121, the best control clone yielded only 40.53. Mean girth and mean yield of control clones and some promising selections are given in Table 2. The mean yield of this trial is based on 5 test–tappings. (N. E. M. Jayasekera, K. W. Rupatunga, B. M. S. G. Peiris and R. A. S. K. Ranatunga)

Table 2. *Mean yield and mean girth of control clones and promising selections in Kuruwita small scale trial (BST/HPS/74/3)*

Clone/selection	Mean girth (cm)	Mean yield (g/t/t)
74 – 193	55.51	74.09
74 – 135	63.23	57.11
74 – 205	58.91	55.60
74 – 180	59.83	55.45
74 – 41	65.55	54.94
74 – 162	57.69	42.68
74 – 199	53.61	40.24
74 – 12	61.29	39.03
RRIC 121	64.82	40.53
RRIC 100	51.83	37.20
RRIM 600	47.95	33.91
PB 86	46.38	25.00

A girth measurement was recorded in two small scale trials planted at Sorana S.P. and Clyde S. P. to evaluate 1975 H. P. selections. At Sorana where 16 new selections are tested six selections had mean girth better than the best control clone, RRIC 121 which had a mean girth of 56.47 cm. Unregistered clone 75 – 79 recorded the highest mean girth of 61.67 cm. At Clyde S. P. there were 9 new selections which had better mean girth than that of the best control, RRIC 121. In this trial unregistered clone 75 – 143 had a mean girth of 64.60 cm followed by 75 – 141 with a mean girth of 64.60, RRIC 121 had a girth of 51.66. Mean girth of new clones that exceeded best control are given in table along with mean girth of control clones. (N. E. M. Jayasekera and K. B. Karunasekera)

Table 3. *Mean girth of new selections that exceeded the mean girth of best control clones planted in two small scale trials at Clyde S. P. and Sorana S. P. (BST/HPS/75/1, 2)*

Clyde S.P.			Sorana S.P.		
Clone No.	Mean girth (cm)		Clone No.	Mean girth (cm)	
75 – 143	64.60		75 – 79	61.67	
75 – 141	60.60		75 – 104	58.88	
75 – 240	58.03		75 – 71	58.17	
75 – 118	56.30		75 – 118	57.72	
75 – 232	56.17		75 – 4	57.11	
75 – 125	55.46		75 – 125	56.73	
75 – 166	55.45		RRIC 121	56.47	Control clones
75 – 79	55.25		RRIC 100	51.83	
75 – 104	55.13		RRIC 130	52.21	
RRIC 121	54.96	Control clones			
RRIC 100	51.66				
RRIC 130	46.84				
RRIM 600	47.64				

Evaluation of part of 1974, 1975 and 1978 H. P. selections (BST/HPS/74, 75) at Payagala S. P.

One selection from 1974 H.P. seedling and seven each from 1975 and 1976 H.P. seedling populations are tested in this small scale trial. A girth measurement was recorded in this trial. RRIC 102 had the highest mean girth of 37.0 followed by 76 – 268 (a new selection) with mean girth of 36.8 (N. E. M. Jayasekera and K. W. Rupatunga)

Evaluation H. P. Selections (BST/HPS/76/2) Tempo Division Hillstream S.P.

A girth measurement was recorded in this trial. Out of the three control Clones RRIC 121 had the highest mean girth (28.7). Three new selections, 76 – 8, 76 – 52 and 76 – 182 registered mean girth higher than the best control. (Table 4). (N. E. M. Jayasekera and K. W. Rupatunge)

Table 4. *Mean girth of three control clones and new selections that exceeded the girth of the best control clone (BST/HPS/76/2)*

Clone	Mean girth (cm)
76 – 8	43.8
76 – 52	41.4
76 – 182	41.1
RRIC 121	40.3
RRIC 100	34.4
RRIC 102	33.9

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

A girth measurement was recorded in this seedling population. Highest mean girth was recorded by the family generated by crossing RRIC 103 and RRIM 623.

Only three test tappings were possible in 1989. Highest mean yield was registered by the family obtained by crossing RRIC 101 and RRIM 623. Mean yield and girth values are presented in Table 5.

Table 5. *Mean girth and yield of 1979 H. P. families. (BST/HPS/79/2)*

Family	Family size (No. of seedlings)	Mean girth (cm)	Mean yield (g/t/t)
RRIC 101 x RRIM 600	274	55.8	19.4
RRIC 101 x RRIM 623	01	54.0	30.0
RRIC 100 x RRIM 600	18	60.4	25.1
RRIC 100 x RRIM 623	16	58.6	22.4
RRIC 102 x RRIM 600	22	54.4	13.3
RRIC 102 x RRIM 623	3	50.0	8.5
RRIC 103 x RRIM 600	9	58.2	12.5
RRIC 103 x RRIM 623	15	63.7	26.7
RRIC 103 x RRIC 101	5	61.4	27.7

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

A girth measurement was recorded in this seedling population. Mean girth of each family, family size and parentage are given in Table 6. (N. E. M. Jayasekera and K. W. Rupatunge)

Table 6. *Mean girth and family size of 1981 H. P. seedlings. (BST/HPS/81/2)*

Family	Family size	Mean girth (cm)
RRIC 52 x PB 28/59	17	65.6
RRIC 52 x IAN 45/710	3	64.8
RRIC 102 x IAN 45/710	1	61.0
RRIC 102 x PB 28/59	10	58.9
PB 28/59 x IAN 45/710	32	58.5
PB 28/59 x RRIC 52	10	58.0
PB 28/59 x RRIC 102	27	52.7
PB 28/59 x RRIC 121	18	52.3

Clone evaluation (HPS/BST/V/73/37) Bibile Group

Neither girth measurement no test-tapping was possible in this trial as traveling to Bibile was not possible due to the unrest prevatiled in the country during 1989. (N. E. M. Jayasekera, B. M. S. G. Peris and R. A. S. K. Ranatunge)

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

A girth measurement was reorded in 1990. In this small scale trial 10 of the 17 Amazonian clones collected by Ivory Coast are tested. RRIC 121 recorded the highest mean girth. Means of clones are given in Table 7. (N. E. M. Jayasekera and K. W. Rupatunge)

Table 7. *Mean girth measurements (BST/ICC/85/2) Payagala S. P.*

Clone	Mean girth (cm)
RO 51	29.7
GU 1296	29.1
P 122	28.2
RO 46	27.2
GU 86	26.7
RO 55	26.4
AC 54	24.6
PFB 5	22.9
AC 57	21.9
AC 55	20.2
RRIC 121	37.1
RRIC 100	33.1
RRIC 102	32.1

Small scale clone trials at Kuruwita Sub station (BST/VSM/67/5, BST/VSM/68/2)

Mean girth and yield (based on 4 test tappings) of clones planted in BST/VSM/67/5 given in Table 8. It is seen from Table 8 that RRIC 121 had the highest mean yield and girth while other four clones had only mediocre yield and girth. It had been the case for last few years. Therefore test tapping and girth measurements will be discontinued from next year. (N. E. M. Jayasekera, B. M. S. G. Peris and R. A. S. K. Ranatunge)

Table 8. *Mean girth and yield (BST 1/VSM/67/5/) Kuruwita Sub-station. Tapped S/2/, d/2; Panel B 1 – 1*

Clone	Trees tapped	Girth (cm) at 150 cm.	Yield (g/t/t) 1988	1989	Dry trees
RRIC 121	17	93.9	95.2	78.0	4
7281	16	87.0	33.0	41.5	6
RRIM 623	26	76.6	52.6	36.0	4
10727	16	86.2	24.3	20.5	3
RRIC 122	5	76.3	27.3	19.0	1

Mean girth and mean yield (based on 5 test tappings) of BST 1/ VSM/68/2 are given in Table 9. in this trial RRIC 121 had the highest mean girth while RRIC 45 registered the lowest mean girth and mean yield. Unregistered clone 6 – 451 also showed a good vigour and yield potential. (N. E. M. Jayasekera, B. M. S. G. Peris and R. A. S. K. Ranatunge)

Table 9. *Mean girth and mean yield BST 1/VSM/68/2 Kuruwita Sub-station. Tapped S/2, d/2, ; Panel B 1 – 1*

Clone	Trees tapped	Girth (cm) at 150 cm.	Yield (g/t/t) 1988	1989	Dry trees
RRIC 121	6	122.9	142.2	113.1	1
RRIC 131	7	88.3	84.8	76.7	2
6 – 541	7	105.6	84.0	67.5	2
RRIC 110	11	93.5	60.4	65.5	1
RRIC 133	8	124.2	56.6	58.2	6
RRIC 130	11	84.8	69.0	54.4	3
RRIC 102	18	93.0	75.2	53.9	8
RRIC 113	7	94.5	74.9	53.5	1
RRIC 120	16	84.7	57.1	51.7	2
RRIC 123	11	100.3	66.9	43.3	5
RRIC 112	16	84.7	53.5	43.3	2
RRIC 45	17	77.2	42.4	33.0	3

Miscellaneous clone trials

International clone trial – Hewagam Estate (BST/ICT/78/2) and (BST/ICT/79/2).

Girth measurements and test–tapping were not possible due to disturbances. (N. E. M. Jayasekera, B. M. S. G. Peris and R. A. S. K. Ranatunge)

Genotype – environment interction studies (PB/GE/75/1)

Girth measurements in some sites had to be postponed till 1990. Expected number of test-tappings was also not possible due to unrest in the country, lack of transport facilities and disruption of normal estate work during 1989. In distant sites such as Kegalle there was not a single test-tapping possible while in other sites either only two or three test tappings were carried out. Table 10 gives the number of test tappings carried out in each site.

Table 10. *Number of test tapping carried out in each experimental site (PB/GE/75/1)*

Site	No. of test-tapping
Hunuwella S.P.	3
Bibile Estate	3
Golinde Estate	Nil
Densworth Estate	3
Bentota S.P.	2
Miriswatta S.P.	3
Monrovia S.P.	2

In this trial panel BO – 2 has been fully consumed at some sites. Therefore Superintendents of estates in which experiments are located have been advised to change the tapping panel from 1990. (N. E. M. Jayasekera, K. B. Karunasekera, K. W. Rupatunge and I. D. M. J. Sarath Kumara)

1981 IRRDB Germplasm collection GPC/85/4

Routine maintenance work was carried out in the germplasm multiplication nursery at Dickhena Division of Neuchatel S. P.

In the small scale trials established at Kuruwita Sub-station to evaluate first 100 germplasm clones received a Morris–Man test tapping was carried out towards the end of 1989. (N. E. M. Jayasekera, K. B. Karunasekera, B. M. S. G. Peris and R. A. S. K. Ranatunga)

REVIEW OF THE SPECIFICATIONS AND ANALYSIS DEPARTMENT

BY

L. M. K. TILLEKERATNE

SUMMARY

The Specifications and Analysis Department has been engaged in the following activities during this year:

(a) Analysis, grading and issuing shipping certificates for all TSR produced in the country.

(b) Analysis and quality checking of rubber chemicals and water used in the rubber industry.

(c) Analysis and certification of concentrated latex manufactured in the country for local industries and for export.

(d) Research on developing substitutes for chemicals used in the rubber industry, based on locally available raw materials.

(e) Research in chemical modification of natural rubber.

Experiments and surveys carried out to check the quality of Sri Lanka latex for export and for the manufacture of finished products were one of the main projects of this Department during this year.

It was possible to prove beyond doubts that the magnesium level in Sri Lanka latex is even below the level in latex from other rubber producing countries. Analysis of n–nitrosoamine level in crepe rubber produced in Sri Lanka by all the different methods used in the country was shown to be below the measurable limit and hence our crepe rubber is a very safe raw material to be used in making rubber appliances used in contact with food and medicines.

It has been possible to make a castor oil based soap, capable of improving the mechanical stability time of latex better than the lauric acid soap used at the moment. This may replace the use of imported lauric acid in the concentrated latex industry.

It has also been possible to develop a bitumen and rubber based adhesive sealent for skirt type rain guards; which does not crack on girthing of the tree and does not melt at high temperature. The new compound tends to vulcanise slowly in the hot sun thereby improving its stretchability.

Another important contribution made during this year was the development of microwave oven based test methods for determing the volatile matter content of raw rubber and also for the determination of dry rubber content and total solids content of latex. These new techniques are not only cheaper to use, but also consume very little time thereby increasing the laboratory out put. This will definitely help the latex based rubber product industry in Sri Lanka, which is a fast growing industry.

In an investigation carried out in the Horana area it was found that the quality of the formic acid reaching the small holders is below the standards and hence action must be taken to rectify this mistake which will increase the cost of production of the sheet and crepe rubber and also increase wastage of rubber too.

It has also been shown that adulteration of latex with warm water before selling to a collecting centre, appreciate the drc measurement by means of the "metrolac" tremendously. Hence action has already been taken to circulate a calibration curve giving the temperature increase against the excess drc recorded, so that at the time of purchase of latex by measuring the temperature of the latex, an accurate correction factor could be obtained from the curve.

While working in collaboration with the University of Maine, it has also been possible to graft an unsaturated acid like methacrylic acid on to the epoxidised liquid natural rubber thereby making the liquid rubber useful in the enamel paint industry.

In collaboration with the advisory services department it was possible to develop a low cost mini smoke house adjoining a kitchen to produce improved quality smoked sheets.

DETAILED REVIEW

Staff

Dr L. M. K. Tillekeratne Head, Specifications and Analysis Department attended the ISO TC 45 conference and Polytech '89 conference held in Bangkok. The Head, Specifications Department presented a paper at the LNR workshop held in the Ivory Coast as an invitee from UNIDO. Mr L. Karunanayake, Asst. Specifications Officer passed the first degree exam of the French course conducted by the Alliance Francaise de Colombo with a merit pass. Mr A. S. Dekumpitiya, Experimental Officer was on duty throughout the year. Mrs Shrianthi Weeraman proceeded to UK for a training course in instrumentation and testing at the

RAPRA in mid July, 1989. Mr P. H. Sarath Kumara, Technical Officer was on duty throughout the year. Mrs Nanda Baduge, Mrs Vasantha Gamage, L. Wanigafunga and Miss Champa Gallage, Technical Officers were on duty throughout the year. Mr W. A. S. Wijesekara, Specification Assistant (Special Grade) Messrs G. Wanigatunga, N. Karunathilaka, K. K. Austin, G. Gunasiri, W. Nandasena and P. L. Perera, Specification Assistants, were on duty thoughout the year.

Publications

Tillekeratne, L. M. K., Karunanayake, L., Sarath Kumara, P. H., Weeraman, S., (1988). A rapid and accurate method for determining DRC and TS of NR latex. J. Ploy. testing, Vol. 8 No. 5.

Tillekeratne, L. M. K. Scott G., (1988). Mechanism of action of Aromatic thiols on carotenoids. Int. Symp. on Micromolecules–Kyoto, Japan. 1 – 6 Aug. 88.

Tillekeratne, L. M. K., Derouet, D., and Brosse, J. C., (1989). Fixation of Methacrylic acid on to the ELNR, UNIDO Symp. Dec. 1989 A bidjan.

Tillekeratne, L. M. K., (1989). Mechanism of Antioxidant Action. The photo antioxidant behaviour of nitro alkanes–European Poly. J. (In press)

Patent

Tillekeratne, L. M. K., Stabilisation of alkanes by nitrogroups formed on them. Patented in W. Europe by AKZO – Netherlands.

Seminar

Dr L. M. K. Tillekeratne delivered a lecture on Quality of Sri Lanka Latex at the seminar on latex based industries in November conducted at the SLAAS.

Committees

Dr L. M. K. Tillekeratne and Mr L. Karunanayake attended the Raw Rubber Standards Committee meeting of Sri Lanka Standards Institution. Dr L. M. K. Tillekeratne attended examiners committee meetings of NIPM.

Training

Dr L. M. K. Tillekeratne delivered lectures to the trainee planters from SLSPC and JEDB sitting for the diploma course organised by the NIPM.

DRC determination of latex

Experiments carried out to develop a rapid and accurate method to determine DRC and TS contents of rubber latex were very successfull. The new method developed by RRISL cuts down the time taken for the above determinations from 6 hours to 30 min. and from 10 – 12 hours to 40 min. respectively. A more rapid method developed using alcohol and acid mixture for coagulation, lowered the time taken for the DRC determination to 10 min. while giving the same accuracy as the British Standard or ISO methods. A paper presented on this work appeared in the December issue of the Journal of Polymer testing. The same paper presented at the ISO TC 45 conference was accepted for circulation among member countries for comments.

On a complaint made by the SRMC, an experiment was carried out to see the effect of warm water addition on the DRC indicated by the metrolac. It was observed that the metrolac indication depends to a great extent on the temperature of the latex and if the temperature of the latex is raised by 15°C at the time of measuring, the metrolac reading goes up by 30%. Hence a calibration curve was prepared to circulate among latex purchasing factories which measures directly the elevated % DRC against each degree rise in temperature of the latex.

In order to eliminate the problem of under estimating the DRC of small holders latex by the factories and latex collecting centres, arrangements have already been made to standardise the metrolac ready reckoner chart in collaboration with the Sri Lanka Standards Institution (SLSI). Along with the standard metrolac chart with the SLS mark, the temperature correction curve/chart will also be provided. (L. M. K. Tillekeratne, L. Karunanayake, W. W. Nandasena and A. S. Dekumpitiya).

Analysis of Fe content in NR

Following by a complaint received from IRAN, a project was started to detect the Fe content in Sri Lanka rubber using atomic absorption spectroscopy. As the 1st set of results received were highly out side the expected range of Fe values compared to the Malaysian samples, experiment is now being repeated with several types of NR produced in Sri Lanka to confirm this finding. (L. M. K. Tillekeratne and L. Karunanayake).

Use of rubber seed oil & castor oil fatty acid as a stabiliser for latex.

Several fatty acids of locally available vegetable oils were tested for their ability to improve MST of concentrated latex. It was observed that some of the fatty acids such as linolinic acid from rubber seed oil is capable of improving the MST of the latex as good as or even better than the imported lauric acid. However, with the time of storage their stability drops. But castor oil fatty acid, which is made locally, improve the MST of latex with time of storage, and give results as good as lauric acid soap. (L. M. K. Tillekeratne and L. Karunanayake).

Epoxidised liquid NR

Research carried out using epoxidised liquid natural rubber (ELNR) have indicated that using pyridine catalyst, cinnamic acid could be grafted to ELNR. A MSc student working on this project is continuing her work. (L. M. K. Tillekeratne, L. Karunanayake and M. Rajapakse).

Magnesium levels in latex

On a complaint made against Sri Lanka latex, an investigation was carried out to detect the Mg levels in concentrated latex. It was observed that, if properly tested, the Mg level in Sri Lanka centrifuged latex is below 25 ppm. But during the wintering period high Mg levels may be recorded by the latex of any origin due to biochemical reactions taking place in the tree just before wintering. (L. M. K. Tillekeratne and L. Karunanayake).

Pre-vulcanised sole crepe

Work on this project was badly affected due to the travelling difficulties during the year. Work will re-commence soon. (L. M. K. Tillekeratne, L. Karunanayake and A. S. Dekumpitiya)

Sealent for skirt type raingurards

An adhesive suitable for pasting and water sealing skirt type polythene rainguards for rubber trees was developed using a rubber and bitumen mixture. The new sealent partially vulcanizes during use in the field thereby forming a gum which expands with the girthing of the tree. It does not become too hard and brittle during cold weather. It does not melt and drip down the tree in the hot climate either. Large scale trials of this new rainguard sealent will be caried out in the four main rubber growing districts of Sri Lanka during the first half of 1990 before commercialising it. (L. M. K. Tillekeratne, K. K. Austin, A. S. Dekumpitiya in collaboration with the staff in the Plant Science Dept.)

Effect of defoliation during wintering on the quality of latex

In collaboration with the Colombo University this project was re-started to study the anomalous changes taking place in the latex just before wintering. A number of samples from various clones were collected in ice at different stages of wintering of the tree such as.

(a) when the leaves are green prior to wintering.
(b) when the leaves are yellow just before wintering.
(c) after complete defoliation.
(d) when the tender leaves just appear.

The serum will be seperated from those samples for mainly GLC & TLC analysis for proteins, carbohydrates, enzymes and polyphenolic compounds in order to identify the reasons for,

(a) Poor stability of latex on storage.
(b) Difficulty to acid coagulate.
(c) Poor PRI of the dry rubber produced, during December to February each year.

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

Inspection visits

Number of inspection visits made during this year was minimal due to the uncertain conditions which prevailed in the country. However inspection visits were made to almost all TSR factories in production at least once a quarter. Few special visits had to be made to some of the TSR factories to calibrate their testing equipment. Visits were also made to Dartonfield, Waharaka and a few other rubber factories for experimental purposes. Investigations were carried out in these visits on new types of packing materials used for crepe packing.

A programme was also carried out in sole crepe producing factories to monitor the variation of moisture levels in albizzia planks used for making sole crepe crates.

Inspection of imported TSR for re–export in bonded warehouse was also carried out during this year. A shipment of TSR contaminated by rain was reprocessed and graded as TSR 20 under RRI inspection during this year.

Miscellaneous

Table 1. *Number of samples tested from each TSR factory during 1989.*

Code	Producer	No. of samples
AA	Sri Lanka (Cey.) Rubber Manufacturing Co., Ltd., Natural Rubber Complex, Mawanella.	396
AD	Station Block Rubber Factory, Getahetta.	482
AF	Ceymac Block Rubber Factory, Horana.	9435
AE	Shermans Block Rubber Factory, Ingiriya.	1781
AI	Associated Traders Ltd., Colombo 13.	192
	Total	12286

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

Rubber Samples	971
Latex Samples	44
Chemicals	17
Water	3
Carbon Black	180

REVIEW OF THE BIOCHEMISTRY DEPARTMENT

BY

M. T. WARNAKULA

SUMMARY

Research work of the Department was affected by unfavourable circumstances that prevailed almost throughout the year.

Lack of staff continues to affect the research work of the Department.

The departure of the Head of the Biochemistry Department, Dr P. A. J. Yapa who served for over 20 years for the benefit of the nation whilst being in rubber research as an eminent scientist publishing a number of research papers and having a number of patents to his credit has seriously affected the research work of the Department.

Even under such pressures, the Biochemistry Department continued its research work. Colllaborative work is also been done with some other Departments.

Staff

Dr P. A. J. Yapa, Head of Biochemistry Department resigned in June. M. T. Warnakula, Asst. Biochemist, M. D. C. Seneviratne, Technical Officer and P. D. J. Rodrigo, Specifications Assistant were on duty throughout the year. Susil de Zoysa Post graduate student continued with his studies on application of factory effluent as a fertiliser under a CIDA funded programme supervised by Dr P. A. J. Yapa and Dr N. Yogaratnam.

Brown Bast

Studies on brown bast continued. Biochemical studies with latex were carried out to get more information about the cause of this physiological disorder. Determination of alkaline and acid phosphatase activities in latex was continued during the year. Further investigations are in progress. (M. T. Warnakula, P. A. J. Yapa)

A review paper on brown bast incidence in Sri Lanka was prepared for presentation at the IRRDB Symposium, on Brown Bast held in Penang, Malaysia in June. (P. A. J. Yapa, C. Samaranayaka)

Effluent treatment & utilization

Effluent utilization

Rubber factory effluents as a fertiliser for young rubber (experiment 1)

Possibility of using rubber factory effluents as a fertiliser on young rubber was tested in this experiment. 60 plants of clone PB 86 were used in a green house trial. Responses to the recommended nursery fertiliser mixture, different dilutions of effluents (serum) and fertiliser/serum combinations were evaluated. This experiment was completed in 1989 and the following evaluations were made.

Plant height, plant diameter as plant girth, shoot dry weight, root dry weight, leaf dry weight, leaf area, leaf weight ratio, and N, P, K, Mg and Ca contents of soil and leaves.

1:1 dilution was the most effective of the dilutions used, as it increases plant height at the 6th week and continued thereafter. Undiluted serum also indicated similar results with regard to plant height first and plant diameter later. No visual symptoms of nutrient deficiencies were observed in serum treated plants throughout the experiment. All serum treatments showed significant responses in comparison with the control after the 20th week on plant height and girth. (Susil de Zoysa, N. Yogaratnam and P. A. J. Yapa)

Effect of Skim rubber effluents on mature rubber (experiment – 2)

Fertiliser effects of effluent of centrifuged latex are being tested at the Vincit Estate – Waharaka. 1977 replanting of clone PB 86 was used in a randomised block design. Similar to the above experiment, different dilutions of effluent are being compared with recommended fertiliser rates. Due to unforseen reasons, effluent applications were not made according to the work programme. Latex yield and N, P, K, Mg and Ca contents of soil and leaf are being determined. (Susil de Zoysa, N. Yogaratnam, P. A. J. Yapa, M. D. C. Seneviratne and P. D. J. Rodrigo)

Crepe rubber effluents on mature rubber (experiment 3)

Effect of effluents as a fertiliser and as a water source for rubber trees are being tested at the Culloden Estate Plantation – Neboda. This trial is conducted in an area of about 06 acres on clone PB 86 from a 1980 replanting. Treatments given were similar to experiment 1 and 2. Moisture distribution in different soil depths are determined using depth gauge (neutron probe technique) Latex yield and leaf and soil N, P, K, Mg and Ca are being determined (Susil de Zoysa, N. Yogaratnam, P. A. J. Yapa, M. D. C. Seneviratne and P. D. J. Rodrigo)

Effect of Rubber factory effluents on paddy (experiments 4, 5 and 6)

Fertiliser effects of rubber effluents (crepe rubber serum) on paddy plants were tested in a green house trial at Dartonfield. Variety BG 94 – 1 was grown in large plastic containers, filled with paddy soil. Plants were treated with recommended fertiliser rate, different effluent dilutions and fertiliser/effluent combinations.

Experiments 4 and 5 were conducted in Maha 88 and Yala 89 respectively. Soil pH, plant height, root dry weight, shoot dry weight, tiller count, pannicle count, grain yield and N, P, K, Mg and Ca contents of soil and plant samples were determined.

All serum treated plants gave significantly higher yields than the control. The yield of serum treated paddy plants were almost equal to that of fertiliser treated plants. No symptoms of abnormal plant growth or root damages due to effluents were observed.

Experiment 6 was started in Maha 89, with some modifications in the treatments of the experiments 4 & 5. Performance of paddy plants in the absence of different fertiliser components when serum is also added, are being tested in this trial.

Treatments given are :

T_1	Serum only
T_2	Serum + NPK
T_3	Serum + NP
T_4	Serum + NK
T_5	Serum + PK
T_6	NPK only.
T_7	Control

Plant height, tiller count, pannicle count, plant dry weight, grain yield, soil pH and N, P, K, Mg and Ca contents of soil and plant samples are being determined. Residual effects of the serum treatments will also be studied in the next season. (Susil de Zoysa, N. Yogaratnam and P. A. J. Yapa)

Effluent Treatment

Some isolated bacteria were tested for use as purifying agents for rubber factory effluents. No positive results were obtained. Further investigations are in progress. (M. T. Warnakula, S. W. Karunaratne and C. K. Jayasinghe)

A micro-organism with high proteolitic activity and short maturation period was received from Dr Jrgen Biilow, Denmark. The effect of this microorganism on rubber factory effluents is under investigation. (M. T. Waranakula, S. W. Karunaratne)

Growing of NATA organism in rubber serum

NATA organism was received from Dr Peries, Director, Food Technology Department, IDB.

Growing of NATA organism in rubber serum in order to use it as an animal feed was studied. No positive results have been obtained so far. Further investigations are in progress. (M. T. Warnakula and C. K. Jayasinghe)

Other

The centrifuge unit was run under Biochemistry Dept. and was involved in the production of centrifugal latex for Specifications, Rubber Technology, Raw Rubber Development and Polymer Chemistry Departments throughout the year.

REVIEW OF THE RUBBER TECHNOLOGY AND DEVELOPMENT DEPARTMENT

BY

N. M. V. KALYANI

SUMMARY

A study has been undertaken to investigate the correlations between the characteristics of uncompounded latex and its processability. It has been found that certain properties of NR latex such as VFA and KOH number have a significant effect on the processing behaviour of NR latex. It was observed that proteins influence the rate of thickening of NR latex in the presence of zinc oxide. A highly stable latex was developed to prevent the destabilisation of NR latex in the presence of n-butyl acrylate which is used as a sensitiser in the irradiation of latex. Work on latex-bitumen emulsion in road construction was revitalised. Depolymerisation of NR in latex form was achieved using singlet oxygen. NR based adhesives were prepared for application on cellophane and transfer tapes. It was possible to formulate stable adhesive compounds. Rubberised fabrics and rubberised coir carpets were prepared by the use of low temperature vulcanising systems. Impregnation with latex was improved by the addition of a wetting agent. Commercial Scale trials were undertaken to test the new technology of tyre rebuilding using a cushion gum compound based on latex. Several minerals and clays found locally could be developed as rubber compounding ingredients. A study to blend NR with polystyrene, poly methyl methacrylate and SR was undertaken with a view to improve the properties of NR.

DETAILED REVIEW

Staff

Dr (Miss) N. M. V. Kalyani, Asst. Rubber Chemist, was on duty throughout the year.

Dr W. M. G. Seneviratne, Asst. Rubber Chemist, resumed duties on 23 October 1989 after successfully completing the PhD at Sussex University.

Mr B. P. Weeraratne, Asst Rubber Chemist, was on duty throughout the year.

Experimental Officers, Messrs D. D. Medagama and P. P. Jayasinghe were on duty through out the year.

Technical Officers, Messrs K. M. U. Mithrananda, D. P. Wethasinghe and Mrs Sryani Yapa were on duty throughout the year.

Mr. W. Somasiri was promoted as a Laboratory attendant on 1st January 1989.

Publications

Kalyani N. M. V. (1989) 'Stability Criteria of NR latex Concentrate' A paper presented at a seminar on centrifuged latex manufacture held at SLAAS.

Sooriyaarachi S. S., Nadarajah M., Kalyani N. M. V. and Chandralal H. N. K. K. (1989) 'Improvements in the radiation vulcanisation of NR latex' A paper presented at the National Executive Management seminar on 'Radiation Vulcanisation of NR latex' held at the Institute of Engineers.

Kalyani N. M. V. (1988) "Thickening of Natural Rubber latex by zinc/ammine system" A paper submitted to RRISL journal for publication.

Patents

Sooriyaarachi S., Nadarajah M., Kalyani N. M. V., Chandralal H. N. K. K. and Devendra R. "Improvements in the radiation Vulcanisation of NR latex" patent pending.

Seminars

Dr (Miss) N. M. V. Kalyani attended a seminar organised by AEA on "Radiation vulcanisation of NR latex" held at SLAAS on 17 August 1989.

Dr (Miss) Kalyani and Mr P. P. Jayasinghe participated in a seminar organised by Coast Conservation Dept. on "Use of filter materials on coastal constructions" held at Sausiripaya.

Officers of the staff of RT & D Dept. participated in a seminar conducted by RRI on Centrifuged latex manufacture held at SLAAS on 28 November 1989. Dr (Miss) Kalyani presented a paper "Stability Criteria of NR latex Concentrate" at this seminar.

Officers of the staff of RT & D Dept participated in the National Executive Management Seminar on "Radiation Vulcanisation of NR latex" at Institute of Engineers.

Workshops

Mr B. P. Weeraratne participated in a workshop organised by the IFS on "National Workshop on major research instruments" held at IFS Kandy.

Mr B. P. Weeraratne attended and successfully completed a German Language course for a period of one year at the German Cultural Institute.

Committees

Dr (Miss) N. M. V. Kalyani participated in 5 committee meetings of RVNRL Committee.

Mr P. P. Jayasinghe Experimental Officer attended drafting committee meetings conducted by SLSI.

Field & Laboratory Investigations

Latex Technology

Properties and Processability of NR latex concentrate

It is well known that the behaviour of compounded latex is very different from that of uncompounded or raw latex. This is a consequence of presence of various compounding ingredients such as zinc-oxide, thickening agents etc. in compounded latex. The influence of these compounding ingredients upon the processing behaviour of NR latex has been found to vary with the characteristics of raw latex. As a result of this latex based product manufacturers encounter processing problems such as wall thinning thickening & coagulation of latex etc. from time to time. Therefore a study has been undertaken to investigate the correlations between the characteristics of uncompounded latex and its processability. Latex samples have been collected from various processing centres and their processing behaviour in relation to their raw characteristics has been evaluated. It has been found that certain properties of NR latex such as VFA number, KOH number greatly control its processing behaviour. It has also been found that certain factors such as period of maturation and method of manufacture of latex concentrate also play a significant role in determining its processing behaviour. (N. M. V. Kalyani, Sriyani Yapa & U. Wijesinghe (University student)

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

The non rubber constituents in NR latex, particularly proteins and lipids play a significant role in determining the extent of thickening of NR latex. A study has been conducted to investigate this aspect in depth using the following types of NR latex.

HA double centrifuged latex
HA centrifuged latex
HA fresh latex
HA fresh ammoniam oleate stablished latex
Deproteinised latex

It has been found that some of the non rubber constituents, mainly proteins influence the rate of thickening of NR latex markedly in the presence of ZnO. Further work on this project is in progress. (N. M. V. Kalyani, Sriyani Yapa & D. P. Wethasinghe)

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

It is known that the cost involved in the irradiation process, which appears to be the principal limiting factor of commercialisation of this process, could be brought down with the use of sensitisers. According to the literature available on the use of various monomers as sensitisers n-butyl acrylate (n-BA) appears to be the most suitable sensitiser to be used in radiation vulcanisation of NR latex. However, the use of n-BA has been limited due to the unstability of latex caused by the monomer with its incorporation into latex. Thus it became apparent that it is necessary to develop special types of NR latex which could withstand the destabilisation caused by the monomer. For this purpose a few special types of NR latex have been developed. The stability of these latices towards the sensitisers has been found to be good. The variations in colloidal properties and technological properties of these latices after irradiation are being investigated. (N. M. V. Kalyani, H. N. K. K. Chandralal, M. Nadarajah, S. Sooriyaarachi (Atomic Energy Authority) & R. Devendra (CISIR)

Evaluation of radiation prevulcanised NR latex

An investigation of the technical properties of irradiated latex samples prepared using different sensitisers has been carried out. The following parameters were also taken as variables in this study.

Type of latex
Radiation dose
Thickness of tensile test piece
Leaching solvent
Aging temperature

During this investigation it was experienced that the stability of NR latex samples containing sensitisers which had to be kept undisturbed for 24 hours at room temperature, prior to irradiation was very poor. This was particularly marked when the sensitisers were directly added to the latex. However, it was possible to overcome this problem by modifying the method of incorporation of sensitisers into the latex. As regards technological properties of irradiated latex it was observed that properties such as tensile strength, modulus etc. were dependent on the parameters listed above. (S. W. Karunaratne, N. M. V. Kalyani, H. N. K. K. Chandralal, Nirmal de Silva (University student)

Performance of irradiated NR latex blends

An investigation has been initiated to study the performance of irradiated NR latex blends. It has been demonstrated by a few research workers in this field that the techonological properties of irradiated/unirradiated NR latex blends are superior to those of irradiated NR latex. The principal objective of this project is to carry out a systematic investigation of the

performance of NR latex blends crosslinked to various crosslink densities by means of irradiation. The results of initial trials suggest that the film forming properties of these blends are much more superior to those of the components of the blends. Technological properties of these blends are being investigated. (N. M. V. Kalyani, H. N. K. K. Chandralal, K. M. U. Mithrananda, S. Sooriyaarachi (Atomic Energy Authority)

Latex bituman emulsions in road construction

A research project on the use of latex bitumen emulsion in road construction in Sri Lanka has been initiated with the collaboration of Road Development Authority and Road Construction and Development Co. (Pvt.) Ltd. It has been published that both softening point and ductility, two of the most important characteristics of bitumen, can be improved with the incorporation of natural rubber : various trials have been conducted by the RRI in collaboration with the Road Development Authority (RDA) and University of Moratuwa using rubber incorporated hot bituman. It appears that some of these trials have produced promising results. However in spite of the various long term benefits of the use of such mixtures their applications have been rather limited. According to the views of RDA and RCD this is mainly a consequence of the difficulties encountered with the applications of rubber incorporated bituman on the road. Thus the objective of this project is to evaluate the performance of NR latex incorporated bitumen emulsions. Initial small scale trials have been carried out using two types of bitumen emulsion namely CSS 1 and CRS 1. Stable blends of NR latex – CSS 1 bitumen emulsions have been produced. Experiments have been planned for the preparation of stable NR latex CRS 1 bitumen emulsions. (N. M. V. Kalyani, P. P. Jayasinghe, I. H. D. Sumanaratne, N. H. D. P. Pushpakanthi and B. C. Bodhinayake (RDA)

Depolymerisation of NR latex

Depolymerisation of NR latex had been carried out at RRISL and the method gives significantly positive results. The reaction of Sodium hypochlorite with hydrogen peroxide at elevated temperatures gives singlet oxygen and this reacts mainly with C-H bonds of NR chain leading to chain scission in the NR long chain molecules resulting in small chain NR molecules. We have shown that viscosity average molecular weight of NR can be brought down to around 10,000 – 15,000 by this method without any difficulty.

Evaluation of properties of this depolymerised grade has been completed and we are now in the process of commercialisaion.

Various chemical modifications such as chlorination and epoxidation can also be carried out with this latex. Chlorination has already been carried out with normal field latex and the product seems to contain crosslinked products. Although we have managed to prepare the stable product, solubility of it in appropriate solvents had been a major problem and it is our belief that this can be overcome if depolymerised latex is used. (W. M. G. Seneviratne & D. P. Wethasinghe)

Latex based coating for fish net floats

At present the fish net floats which are used to facilitate the floating of fish nets are imported from Japan. It was thought that these floats could be made out of rigifoam with a thick rigid coating which would not deteriorate under marine conditions. The possibility of the use of chemically modified NR latex compounds as coating materials was investigated. It was found that the densities of the coated rigifoam was around 0.034.

This experiment was further extended by using compounded NR formulations to obtain low density product, to be used in place of existing material. A product of specific gravity of 0.0928 which is very similar to the density of the existing fish net floats was obtained. Further work is in progress. (N. M. V. Kalyani, B. P. Weeraratne & K. M. U. Mithrananda)

NR based adhesives

It has been found that the adhesive systems prepared in our laboratory are suitable in many applications. A few of these applications can be listed as follows :

Tapes such as cellophane and other polyethene

Fabric tapes

Transfer tapes etc

Adhesive tapes out of heat resistant PVDP and TPVC gave satisfactory results. The major drawback of this project is nonavailability of adhesive spreading machine and a set of equipment for adhesive testing. (B. P. Weeraratne & K. M. U. Mithrananda)

Rubberised fabrics based on latex

Laboratory trials were conducted to obtain light coloured spreading compounds, Carpets backed with low temperature curing systems showed promising results. Evaluation of the effect of wetting agents reveals that there is a profound effect of wetting agents on latex impregnation of fabrics. Universal wetting agent is suitable for latex impregnation of most fabrics. (B. P. Weeraratne & K. M. U. Mithrananda)

Rubber Compounding

New Technique for Tyre rebuilding

Commercial scale trials have been undertaken to evaluate the feasibility of this project. These investigations reveal the following: Although the cost of a gallon of solvent is almost equal to the cost of a gallon of compounded latex, when starting the experiments in 1987, the cost per gallon of latex cement was twice as high as the cost per gallon of solvent cement now. This is basically due to the present demand for the latex. But the number of tyres which can be cemented with latex is also twice as high as number of tyres which can be cemented with solvent cement. Although the cost factor is the major draw back of this new technique these are several advantages. Pollution is less and there is no risk of fire hazard as no hydrocarbon solvents are used. Accurate estimation of drying is possible by visual means and therefore process control becomes easier. It is possible to use the new technique in a number of ind ustries other than tyre retreading. Further investigations are in progress. (W. S. E. Fernando, B. P. Weeraratne & K. M. U. Mithrananda)

Oil emulsion & OENR masterbatches

It has been found that oil extended RSS is prefered in manufacturing OENR since smoking of sheet rubber reduce fungal contamination. Further work is in progress. (B. P. Weeraratne, W. S. E. Fernando & K. M. U. Mithrananda)

Evaluation of locally available mineral and clays

It has been found that locally available calcium carbonate which is known as "Hirigal" can be used in dipping industries as coagulant solutions. Proposals have been made to carry out collaborative research with industrialists.

The use of Dolamite in casting and other latex based industries has been evaluated at the request of a latex industrialist. The major drawback of this investigation is the non availability of a suitable metal crusher. Experiments are further extended to use other minerals and clay samples such as Wallastonite as fibrous fillers. (B. P. Weeraratne, W. S. E. Fernando & K. M. U. Mithrananda)

Thermoplastic Natural Rubber Blends

Rubber incorporated polystyrene and polymethylmethacrylate

Polymerisation of a monomer containing 5 – 10% dissolved rubber has been practiced for over two decades in the production of high impact thermoplastic materials. The graft polymer thus formed result in a many fold increase in rubber toughening efficiency when compared to mechanical blending. Detailed study in this area carried out at University of Sussex showed that it is not the amount of rubber which is important on yielding high fracture energy but the size of the dispersed rubber particles and the interfacial adhesion between the rubbers and the thermoplastic matrix.

Currently in Sri Lanka there are few companies which import high impact grade of thermoplastics for various engineering applications, mainly in the manufacture of electrical appliances. It will be beneficial to such industries if one can make these grades in this country. Since the method of preparation of these materials do not require sophisticated machinery target can be achieved at a reasonable cost. Initial talks for collaborative work have alrady been conducted with firms such as Nawaloka Polysacks Ltd. and Phoenix Ltd. Plans are underway to carry out trials as soon as chemicals and the materials are available (W. M. G. Seneviratne, P. P. Jayasinghe & K. M. U. Mithrananda)

PP/NR blends

The blending of rubber with PP to provide improvements in impact strength has been studied widely by many authors and blends of PP with EPDM rubber are produced commercially as impact resistant PP. Different elastomers have been prepared as alternative to EPDM and recent work shows that NR/PP blends are potentially the cheapest to produce. Initial work carried out at Sussex seemed to be promising and the blends can be produced commercially in Sri Lanka, using proper machinery. It has been shown that interfacial adhesion between rubber and PP phase can be improved by adding certain crosslinking agents in the mixing stage. Crystalline texture of PP can also be modified by incorporating certain polymers in small proportions which is also incremental to the impact strength properties of the blend.

Collaborative research work has already been initiated and some trials will be carried out at Phenix Plastic Company, Ragama as a step towards the success of the project. (W. M. G. Seneviratne & P. P. Jayasinghe)

Industrial extension

The following industries have requested the services of Rubber Technology and Development Department for product development and testing during the year 1989.

Jaipur Footwear Programme – Low temperatue vulcanising compounds
Sisimal Industries Ltd. – Carpet backing
Road Development Authority – Rubber membranes
State Engineering Corporation – Compounded nitrile rubber
Industrial Development Board – Coir dust pads
Bata Shoe Co – Testing of Vulcanised rubber samples
Ceyesta – Testing of Chemicals and rubbersised coir
Jinasena Ltd. – Rubber diaphrams
Elastomeric Engineering Company Ltd. – Compounding and testing of hard microcrumb compound.
Arpico Factory – Testing of Vulcanisates.
Various individual small industrialists – rubberised coir, carpet backing, balloons, castings, compounded latex.

REVIEW OF THE POLYMER CHEMISTRY DEPARTMENT

BY

K. G. KARNIKA DE SILVA

SUMMARY

A significant progress has been achieved in the development of Thermoplastic Natural Rubber (TPNR). Since TPNR bridges the property gap between conventional rubber and plastics it has a potential for replacement of rubber and plastics in the existing products. TPNR developed at the RRISL is now in the commercial implementation stage. Industrialists in various product manufacture have shown keen interest in the manufacture of a series of utility products such as electrical components, shoe soles, toilet seats and covers, coagulating pans, tapping cups, refregerator components etc.

Heat resistant tellurium rubbers for the production of solid tyres have been carried out. Development of a new natural rubber latex based can sealant has been achieved and semi commercial scale production of the material has been tried out. Further investigations in the preparation of heat resistant rubbers using non toxic chemicals are in progress.

Improvements in the stability of deplomerised latex have been achieved through the proper choice of stabilisers, initiators and the pH of the medium.

A few tackifying formulations based on depolymerised latex have been prepared. Further studies on this aspect are in progress.

Studies on antioxidant diffusion and solubility are being continued. Work on cyclised rubber, carbon black masterbatches and chlorinated rubber have been initiated.

Staff

Dr A. Coomarasamy, Head Polymer Chemistry Dept. resigned from the Institute on 25 February, 1989.

Dr (Mrs) K. G. Karnika de Silva, Rubber Chemist visited Canada to attend the 4th International Conference on Industrial uses of Se and Te held in Banff from 7 – 11 May '89. This visit was sponsored by STDA, USA.

Dr (Mrs) Pushpa Sirimanne, Assistant Rubber Chemist resumed duties on 16 October '89 after successfully completing the PhD degree at the University of Sussex, UK.

Mr S. M. C. E. Silva, Assistant Rubber Chemist and Mr H. N. K. K. Chandralal Experimental Officer were on duty through out the year.

Mrs Manel Nilaweera Senior Technical Officer was promoted as an Experimental Officer with effect from April 1989.

Mrs Indra Denawake Technical Officer was promoted to Senior Technical Officer with effect from August 1989.

Mrs Chithra Kuruppu, Mrs Lakshmi Dissanayake and Mr N. Wickramasinghe were on duty through out the year.

Mrs Mangalika de Costa Technical Officer, resigned from her post with effect from 26 January 1989.

Mrs Ranjini Bogahawatte, Technical Officer Soils & Plant Nutrition Dept was transferred to the Polymer Chemistry Dept with effect from June 1989.

Mrs Renuka Wijayaratna, Clerk/Typist was on duty through out the year.

Messrs Sunil Weerasiri, P. G. Sigera were promoted as Laboratory attendants with effect from 1 February 1989.

Local Training

Mr S. M. C. E. Silva participated in two workshops on Major Research Instruments held at the IFS laboratories, Hanthane on 12 May and 9 June '89.

Mr H. M. K. K. Chandralal participated in the workshops on Chromotography sponsored by IPICS/IFS held in Peradeniya from 19 October – 22 October '89.

Meetings and Lectures

Dr (Mrs) Karnika de Silva participated in the following discussions, meetings, seminars and conferences during the year. The staff also participated at different occasions when requested.

Two meetings with SLSPC and JEDB officers regarding crepe rubber marketing, two Rubber Task Force meetings, one central committee meeting, one meeting with the ANRPC delegates, four discussions with officers of the Nawaloka Polysacks Ltd. on TPNR, two seminars on radiation vulcanisation organised by the Atomic Energy Authority, seminar on natural rubber industry organised by the PRI and seminar on centrifuged latex manufacture.

H. N. K. K. Chandralal served several committee meetings on Radiation Vulcanisation.

Publications

De Silva K. G. Karnika, Dissanayake Lakshmi, Costa Mangalika, Some Developments in Heat Resistant Superior Processing Tellurium Rubber, Proceedings of the 4th International Conference on Industrial Uses of Selenium and Tellurium May 1989.

De Silva K. G. Karnika, Dissanayake Lakshmi, Kuruppu Chithra and Edirisinghe Dilhara, A study of film properties of tellurium prevulcanised latex and some physical properties in their raw state submitted for publication in the Jour. of Rubber Research Institute of Sri Lanka Oct '89.

De Silva K. G. Karnika, Thermoplastic Natural Rubber. Article submitted to Periodical News Letter, MPI April '89.

Pushpa Sirimanne, Diffusion and Solubility of antioxidants in Rubber, PhD Thesis (1989) University of Sussex UK.

Laboratory Investigations and Industrial Extension

Thermoplastic Natural Rubber (TPNR)

A significant progress has been achieved to improve the quality and the performance of TPNR during this year.

Development of soft grades of TPNR with a good balance of properties and processability has continued. Two leading shoe manufacturing companies, Bata Shoe Co., Ltd. and DSI Ltd. had been supplied with soft grades of TPNR from Nawaloka Polysacks Ltd. for consideration as a suitable material for shoe soles.

Hard grades of TPNR were introduced to various product manufacturers of ceiling roses (Clipsol, Elastomerics), toilet seats and covers (Aztecs Ltd.), ice cube trays, (AMW) bowls, cups (Nawaloka) and tapping cups (Mouldex). It is now clear that the improved TPNR has wide potential applications in injection moulded, extruded and compression moulded products in various applications. It could be used as a light weight, corrosion resistant material which possesses high impact strength to replace steel and other traditional materials used to manufacture car components such as bumpers.

TPNR based latex collection cups have been made using the moulds available and field experiments on the use of these cups for latex collection has indicated that the scrap percentage is substantially reduced when these cups are used in place of coconut shells.

New processing aids such as Vestonomer 6012 and 8012 from West Germany have been introduced to Polypropylene/NR blends to improve the properties of TPNR. Certain additives have also been tried with these blends to improve the interfacial adhesion.

A few samples of calendered TPNR had been sent to Japan through an education officer on request for the consideration of the material for embossing, these papers could be used as reading material for blind people.

Methyl methacrylate grafted rubbers have also been tested for their suitability in shoe soles as a thermoplastic material. All these materials have been tested for acid, water and ageing resistance and impact and tensile strength. It is expected to use TPNR as a suitable material for the manufacture of coagulating pans to meet the demand of aluminium coagulating pans used in the rubber processing factories.

Discussions were held at Nawaloka Polysacks Ltd at several occasions on various aspects such as developments, cost of manufacture, marketing etc. Possibilities of using recycled polypropylene to replace virgin polypropylene has been suggested once at a discussion to reduce the cost of manufacture of TPNR. Further developments and efforts to commercialise the product are in progress. (A Coomarasamy (first two months) K. G. Karnika de Silva, H. N. K. K. Chandralal, N. Wickramasinghe and Manel Nilaweera)

Heat resistant superior processing tellurium rubber

Work on this project was continued. Discussions were held at Bergougnon Lanka Ltd. to see the possiblities of using tellurium rubber in the solid tyre manufacture. The temperature stability of solid tyres should be high to withstand the long curing times required in the manufacturing process. The tests carried out show that it is possible to reduce the dosage of antioxidants, accelerators and crosslinking agents when tellurium rubber is used in the chemical formulations. These trials have shown very promising results and it is expected to carry out a factory scale trial in the near future.

The tellurium prevulcanised latex film properties were also tested. It has been found that the tensile properties improve significantly on leaching. Different amounts of chemical ingredients were tested in the prevulcanisation formulation to study the effect of these ingredients on prevulcanisation and leaching. A part of the study was carried out as a MSc project.

Another system without tellurium has also been tried out to manufacture heat resistant rubbers. This system contains non toxic compounds and the initial trials on films and dry rubber blending have shown promising results. Further work on this compound is in progress.

A paper titled some developments on heat resistant tellurium rubber had been presented at the International Conference on "Industrial Uses of Selenium and Telurium" held at Banff, Canada from 7 – 11 May 1989. This visit was sponsored by Selenium and Tellurium Development Association (STDA), USA. An agent in Europe had been appointed at a discussion held with the STDA committee to deal with our problems and marketing of this speciality rubber. (K. G. Karnika de Silva, Lakshmi Dissanayake, Chithra Kauruppu, Dilhara Edirisinghe (Msc student).

Methyl Methacrylate Grafted Rubber (MG)

Use of rubbers in hard, light weight, light coloured and transparent articles had been studied during the year. Trials with blowing agents were also studied to get light weight, hard cellular materials used in various applications such as fish net floats balls. (K. G. Karnika de Silva, Lakshmi Dissanayake, Chithra Kuruppu, Hemantha Sisira Kumara (MSc student)

The application of MG rubbers in the manufacture of shoe soles has been carried out in collaboraton with Bata Shoe Co., Ltd. It has been found that MG rubber can be used as a suitable thermoplastic in this application. Film properties of MG rubbers have also been carried out. The suitability of MG rubber as a base material in the following applications have been tested.

Emulsion Paints
Can Sealants
Coated Gloves
Adhesives

Semi commercial scale batches of 250 kg. of MG 30 and MG 49 rubber have been prepared at C. W. Mackies, Horana Complex using the available facilities. These batches are prepared by the patented method developed by the Polymer Chemistry Dept. The consumer has informed that this material is ideal for their use and would like to place orders through C. W. Mackies in the future. (K. G. Karnika de Silva, Lakshmi Dissanayake, Chithra Kruruppu)

Can Sealants

Developments of a new sealnt based on NR has been carried out for a small scale can manufacture, Silver Rays Ltd. on a request. A few samples had been tested for the suitability as sealants for curling the galvanised tins. Solvent leaking, water and solvent resistance tackiness etc have been studied with different chemical formulations, to select the best sample for commercial scale manufacture of the sealants. It has been found that the sealant developed at the RRISL cost only 1/3 of the imported material presently used. Amico Ltd., a large scale manufacturer, has been contacted in view of expanding the usage of this material. An order

for 50 kg of sample had been requested initially by Silver Rays for their industry. Further work is in progress. (K. G. Karnika de Silva, Indra Denawaka)

Coated gloves for heavy duty glove manufacture

A few trials have been carried out with blends of polyvinyl chloride paste and MG rubber latex and some modified latices to coat cotton gloves. These trials were carried out on a request made by Themoplastics pvt Ltd. for heavy duty glove manufacture. Different formulations were tried to get the required oil resistant properties. Further work on the project is in progress. (K. G. Karnika de Silva, S. M. C. E. Silva, H. N. K. K. Chandralal)

Carbon black masterbatches

The incorporation of carbon black into natural rubber is generally done by dry mixing of carbon black and rubber on a two roll mill or in a Banbury. This process requires a lot of energy in mixing carbon black and natural rubber and causes environmental pollution. Therefore mixing of natural rubber and carbon black has been attempted in the latex stage. But this method has not been successful due to the low retention and the high mooney viscosity of the final product. In our method the reduction in Mooney viscosity has been achieved by reducing the molecular weight of natural rubber by generating singlet oxygen chemically in the latex phase.

It has been found that there is a considerable retention of carbon black in reduced molecular weight samples when compared with the normal natural rubber samples. The mooney viscosity values of the carbon black masterbatches prepared from depolymerised NR latex are higher than the carbon black masterbatches prepared from undepolymerised NR latex. This may be due to formation of crosslinking with alkylic hydroperoxide and the storage hardening. Trials have been carried out to prevent the hardening effect and the results obtained are very satisfactory.

It has been found that centrifuged latex after depolymerisation is the best suitable latex for the manufacture of carbon black masterbatches. Further work on the project is in progress. (S. M. C. E. Silva, Karnika de Silva, N. Wickramasinghe)

Depolymerised natural rubber latex

Depolymerised NR latex can be prepared by using non toxic chemicals, such as H_2O_2 and NaOCl. The condition for this reaction are the concentration of reagents, temperature and the pH of the latex. The optimum temperature and the pH value to achieve best results have been found. It has been found that the level of depolymerisation could be controlled by varying the amount of reagents. The serious problem in depolymerised latex is the poor stability on long term standing. Experiments have been carried out to overcome the problems and the trials have shown some successful results. Some samples with high, medium and low molecular weight have been dispatched to Weber and Schaer West Germany.

Further trials have been attempted to prepare low viscosity dry rubber by blending depolymerised latex with field latex. Further experiments are in progress. (S. M. C. E. Silva, K. G. Karnika de Silva, N. Wickramasinghe)

Migration of antioxidants in rubber

Studies on the diffusion and solubilities of phenolic antioxidants in rubber were carried out during the post graduate training in UK. Antioxidants were so chosen that they will reflect the structural effect on the diffusion and solubility. Natural rubber vulcanisates with different crosslink densities as well as different cross link structure such as monosulfidic and carbon – carbon bonds were used to study the effect of crosslinking on diffusivity. Semi-efficient vulcanised NR and peroxide vulcanised NR films were used in this study.

It was observed that the crosslinking has also significant effect on diffusion as well as the solubility of antioxidants in rubber. With the increase of cross link density the diffusion coefficient is found to reach an optimum value.

Volatality studies of the antioxidants were also carried out to relate the antioxidant properties to the diffusion of antioxidants and their loss.

Physical loss of additives from polymer by process such as volatilization or leaching into contacting media is a very important aspect of additive performance. In order to understand this loss process a theoratical model has been derived. Using the data of diffusion coefficient, solubility and the volatility of antioxidants, the life time of the additive in the polymer can be predicted using the theoretical model.

The loss of three benzophenone type UV stabilisers from polypropylene films were studied and the experimentally observed loss times were compared with theoretical values. It has been found that the predicted loss times are in good agreement with the experimentally observed value.

After completing these studies at the University of Sussex for the post graduate training, it has been planned to continue the diffusion and solubility studies of antioxidants in rubber.

Corelation of solubility and the diffusion of antioxidants with the technical properties of vulcanisates after leaching and ageing is planned. (Pushpa Sirimanne)

Cyclised rubber

Various types of latices have been tried out for the preparation of cyclised rubber. A white, fine powder of cyclised rubber was obtained by using depolymerised NR latex. Further developments to achieve the solubility of the product are in progress. (Pushpa Sirimanne, S. M. C. E. Silva, Indra Denawaka)

Chlorinated natural rubber

A method has been developed for the preparation of chlorinated natural rubber, by varying the chlorinating agent. Also the type of latices have been varied to study the solubility of chlorinated rubber in various solvents. (Pushpa Sirimanne, S. M. C. E. Silva and Indra Denawaka)

REVIEW OF THE RAW RUBBER DEVELOPMENT DEPARTMENT

BY

E. D. I. H. PERERA

SUMMARY

The main areas of research in this department have been the raw rubber and factory development work, drying aspects and energy management.

Crepe rubbers having specifications required by a few foreign consumers were manufactured and samples were sent for further evaluation. The softening temperature of ebonite samples prepared using different types of NR was determined and types of rubbers that give higher softening temperatures were identified. Studies were undertaken to optimise the milling procedure of sole crepe to give a better surface finish, and to find out the possibility of using rejected gloves from glove manufacturing industry as a filler/extender.

The possibility of improving the quality of scrap crepe produced by the remillers have been looked at and an advisory circular giving guidelines for processing of better quality scrap crepe was prepared and sent to the remillers. Visits were made to the rubber estates by the officers of the department for advisory work on manufacture and for inspection of items for subsidy payments. The plans of effluent disposal systems were provided to factories and their performence were monitored.

Work on drying aspects of rubber was continued. The effects of partitioning the Dartonfield drying tower on the efficiency of drying was studied.

Staff

Dr M. C. S. Perera, Head of the Raw Rubber Development Department, resigned from the post with effect from 13 January 1989. Dr E. D. I. H. Perera, Rubber Chemist, was on duty throughout the year. Two cadre vacancies available for Research Officer/Research Assistant were not filled during the year.

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

Miss S. Jayaweera, Clerk/Typist, attached to this department was transferred to Dartonfield with effect from September without sending a replacement.

Dr E. D. I. H. Perera participated in the second phase of the intergrated market development programme to promote speciality grades of Natural Rubber in the Netherlands and West Germany from 14.01.1989 to 28.01.1989. The programme was organised by the CBI in the Netherlands and the EDB and a comprehensive report on this study was submitted to the RRB.

The departmental staff paid advisory visits to various rubber factories on manufacture of raw rubber, drying and energy management.

Publications

Perera, E. D. I. H. and Dunn P. D. (1989) 'Use of vegetable Oils as Fuels for Diesel Engines with specific reference to Rubber Seed Oil' J. Rubb. Res. Inst. Sri Lanka (in press).

Perera, E. D. I. H. (1989) Composition of Natural Rubber Latex and Effect of Non-Rubber Substances' Bull. Res. Inst. Sri Lanka (in press).

Reports

Perera, E. D. I. H. and Samaraweera (1989) Report on the second phase of the Intergrated Market Development Programme to promote speciality grades of NR in the Netherlands and West Germany.

Perera, E. D. I. H. et al (1989) Report on the evaluation of the vacuum drier at Frocester Estate Plantation.

Perera, E. D. I. H. et al (1989) Report on the evaluation of forced convention drying tower at Vogan State Plantation.

Meetings/Seminars

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

Programme on Energy Management organised by the National Institute of Business Management in collaboration with the Sri Lanka Energy Managers Association.

Seminar on irradiated latex held at SLAAS.

Rubber task force meeting held at SLAAS.

National Executive Management seminar on Radiation vulcanization of NR latex held at Institute of Engineers.

Training programmes

Dr E. D. I. H. Perera delivered five lectures and served as an examiner for the programme for rubber manufacture examination organised by the National Institute of Plantations Management.

Visitors

Mr L. J. Lindeboom, the rubber consultant to the CBI in the Netherlands visited the Institute during the first week of February.

Two MSc students (Polymer Chemistry) from the University of Sri Jayawardenepura, Miss K. Dheerasinghe and Miss J. G. R. Malkanthi carried out their reserach projects at the department, under the supervision of Dr E. D. I. H. Perera. The research areas were "Manufacture of crepe rubbers to suit end-user requirements" and "development/identification of NR grades which give higher softening temperatures for ebonite materials", respectively.

Field and Laboratory Investigations

Raw Rubber Development

Manufacture of high Mooney RSS in estates in Matale region.

As reported earlier, Matale region is facing a precoagulation problem due to high hardness of water in the area. The problem, however, could not be overcome even by using softened water from the water purification plant installed at Yatawatte State Plantation, by the Environmental Laboratories Limited. The problem, therefore appears to be a result of a combined effect of characteristics of latex and properties of water and this needs further investigation.

A few trials were carried out at Yatawatte State Plantation to find out the possibility of making high Mooney RSS. During these trials, dilution of latex and drying conditions were varied. Although some trials produced RSS with Mooney viscosity between 80 – 85, batch to batch variations were observed.

Further trials could not be carried out as had been planned during the latter part of the year due to the situation which prevailed in the country. (E. D. I. H. Perera, S. L. Weerasinghe and S. Siriwardena)

Manufacture of crepe rubber grades to suit end-user requirements ;

The crepe rubber samples prepared at Sorana State Plantation, Frocester State Plantation and Dartonfield Estate were tested to find out whether they meet the requirements specified by the end-users abroad.

These end-users requirements were gathered from recent market surveys.

The tests included :

Initial Plasticity (Po)

Plasticity Retention Index (PRI)

Ash Content

Silica Ash content

Dirt content

Mooney viscosity (V_R)

Copper content

Manganese content

and vulcanisate properties such as tensile properties and rheological properties including, minimum and maximum torques, cure rate index etc. The test results showed that the properties of some rubbers are within the specified limits set by the product manufacture. These samples were sent to the prospective buyers for further evaluation. (E. D. I. H. Perera, C. Senanayake, C. Jayawardena and K. Dheerasinghe (University student)

Composition of properties of ebonite made from different types of NR :

Ebonite compounds are used in large quantities in lining of various metalic containers and pipelines used in chemical industries. Among the factors which determine the suitability of an ebonite compound, the softening temperature is of much importance. Perhaps this is the most limiting factor of using ebonite in this particular application. Therefore with the aim of developing/identifying raw rubbers which give higher softening temperatures a study was undertaken.

Amongst the tests available for the determination of softening temperature of plastic materials, the Vicat softening point test was found to be ideal for ebonite. The Vicat softening point appratus was designed and fabricated according to ISO standard No. 306 : 1987 (E)at Gamini Engineering Works. Ebonite samples prepared were tested for their softening temperatures using the above apparatus.

The preliminary results show that the Vicat softening temperature varies considerably with the type of rubber used in the compounding. Further work on this project is in progress. (E. D. I. H. Perera, B. P. Weeraratne, S. Siriwardena, C. K. Nalini and J. G. R. Malkanthi (University student)

Modified milling procedure for sole crepe

The profit margin of sole crepe can be considerably low due to increase in cost of manufacture, especially in the area of milling. A preliminary trial was carried out with the aim of optimising the milling procedure to give an improved surface finish for sole crepe. Further trials will be carried out during the course of next year. (E. D. I. H. Perera, S. L. Weerasinghe , S. Siriwardena and C. Jayawardena)

Use of rejected gloves as a filler/extender (cheapening agent) for rubber product manufacture

In glove manufacturing factories, the percentage of rejects sometimes amount to about 5%. Factories are facing a problem of disposing these rejected gloves. Presently they are either burnt or buried. Burning of gloves certainly cause environmental pollution and burying cannot be continued due to scarcity of land. Experiments are in progress to reclaim this material for use in rubber compounding.

Quality of scrap crepe rubber produced in Sri Lanka:

It has been found that scrap crepe produced in Sri Lanka has the following defects.

High dirt content.

High volatile matter content.

Low Po and PRI

Lack of consistency in quality

These defects are primarily due to, not following the correct manufacturing procedure and non-availability of adequate facilities. It is clear that the quality of scrap crepe gardes has the most important bearing on the method of manufacturing as well as the quality of TSR 20. When quality considerations of tyre retreading and other products are considered it is in both the consumer and product manufacturer's interest that a better quality rubber be used, Therefore the quality improvement of scrap crepe grades produced by the remillers is essential.

A collaborative project with C. W. Mackies Company Ltd. was initiated in order to find out the possibility of improving the quality of scrap crepe. The following remilling factories were visited during the year.

Wijaya Rubber Mills	—	Horana
Sandagiri Rubber Mills	—	Dompe
Totamune Rubber Mills	—	Ingiriya
Ratnayake Rubber Mills	—	Kalagedihena
Madola Rubber Mills	—	Mahagama
Ukwelkanda Rubber Mills	—	Govinna
Wataraka Rubber Mills	—	Padukka
Horana Rubber Mills	—	Kabellagoda
Kedelpitiya Rubber Mills	—	Bandaragama
Latex Lanka Rubber Factory	—	Morontota
Hanwella Rubber Mills	—	Hanwella

Having studied the quality of rubber produced at each factory and factory conditions, an advisory circular giving guidelines for processing of better quality scrap grades was prepared and sent to the remillers. (E. D. I. H. Perera, Chintha Jayawardene, C. K. Nalini and officers from Mackies)

Effluent disposal

The plans were provided to the following centrifuged latex factories to construct effluent disposal systems on an experimental basis.

Factory	Type of system
Hanwella Rubber Factory	Ponding
Glenross Rubber Factory	Soakage pit

It was found that soakage pit system is not satisfactory as the soil become saturated due to clogging effect by tiny rubber particles, after a few weeks of operation. The ponding system at Hanwella Rubber Factory seems to work quite satisfactorily. However the performance tests will be carried out continuously. (E. D. I. H. Perera, S. L. Weerasinghe, C. K. Nalini and Chintha Jayawardene)

Magnesium in latex

A project was initiated to study the pattern of variation of magnesium content in latex in Kalutara region as this information is vital to the latex industry. (S. W. Karunaratne, E. D. I. H. Perera, Chintha Jayawardene and C. K. Nalini)

Advisory visits on crepe rubber RSS and block rubber

The following estates were visited and advised on the problems encountered in manufacture.

Kiribathgala State Plantation – Nivithigala
Pussella State Plantation – Parakaduwa
Usk–Valley State Plantation (Trafalgar Division) – Baduraliya
Pelmadulla State Plantation – Kahawatte
Madampe State Plantation – Rakwana
Arapolakanda State Plantation – Tebuwana
Statcon Rubber Factory – Avissawella

Reports on each visit were submitted to the relevant authorities (E. D. I. H. Perera, S. L. Weerasinghe, S. Siriwardene and C. Senanayake)

Factory Development

Crepe rubber factories

The total requirement of water for Dela factory – Kiribathgala State Plantations, Nivithigala was worked out and a report was submitted with the details of water purification plant. (E. D. I. H. Perera)

Factory Development Subsidy

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

Glenross Rubber Factory	–	Neboda
Elston Estate	–	Avisawella
Rubber Convertors Ltd.	–	Horana
Hanwella Estate	–	Hanwella
Godagampola Rubber Mills	–	Ratnapura
Lalen Rubbers	–	Warakapola
Parambekanda Estate	–	Parambe
Lak Latex (Pvt.) Limited	–	Baduraliya
C. W. Mackies Ltd.	–	Nathupana
Edna Plantation	–	Monaragala
Dipped Products Limited	–	Homagama
Associate Traders	–	Yatideriya

(E. D. I. H. Perera, S. L. Weerasinghe and S. Siriwardene)

Drying and Energy

Forced convection drying system at Vogan State Plantation, Matugama

The work on the evaluation of this new drying system (details can be found in previous reports) was completed and a detailed report was submitted to the relevant authorities. The drying cost at present was found to be comparable to the cost of conventional drying cost. In this report the shortcomings and the possibilities of further improvements to the system were discussed. (E. D. I. H. Perera, S. L. Weerasinghe, C. Senanayake and S. Siriwardene)

Vacuum Drier at Frocester State Plantation

The work on the evaluaton of "SUNRA" Vacuum Drier at Frocester State Plantation was also completed and a comprehensive report was submitted to the relevant authorities. The present drying cost using the vacuum drier was found to be twice the drying cost of conventional drying system. (E. D. I. H. Perera, S. L. Weerasinghe, S. Siriwardene and C. Senanayake)

Analysis of vertically partitioned drying tower at Dartonfield (Solar Project)

Preliminary trials were carried out after partitioning of Dartonfield drying tower. The upward hot air flow was monitored and improved air flows could be observed when one chamber was completely shut. Further trials are ahead to find out the true effect of partitioning on efficiency of drying of laces. A progress report of the project was submitted to the Commonwealth Secretariat in London. (E. D. I. H. Perera, S. L. Weerasinghe, S. Siriwardene and C. Senanayake)

Energy Survey at Ambatenna State Plantation and Culloden State Plantation

The report on the preliminary energy survey conducted at the above two plantations by the NERD Centre was submitted to the relevant authorities. It is clear from this report that nearly Rs. 50,000 per annum could be saved at each of above two factories, if appropriate corrective measures are undertaken. In addition to this it is possible to increase the drying tower capacity and efficiency. In order to give precise recommendations, details of equipment required etc, the NERD Centre had proposed a detailed energy survey. This detailed survey could not be carried out due to non-availability of funds. (E. D. I. H. Perera, S. Weerasinghe, M. W. Leelaratne* and N. M. Jayalath*)

* NERD Centre

Drier for ADS curing

It was not possible to carry out trials using a tobacco barn in Matale region, as had been planned earlier, due to unavoidable circumstances. It is now planned to conduct experiments/trials using the pilot scale drying tower at Ratmalana. (E. D. I. H. Perera and S. L. Weerasinghe)

REVIEW OF THE BIOMETRY SECTION

BY

W. N. WICKREMASINGHE

SUMMARY

About 250 data sets were analysed and interpreted this year, despite interruptions beyond our control. Out of these, about 50% is connected with post graduate work of research students. The SAS software system was updated, also adding some new products. Dbase – SAS interactive work was successfully supported. Records of the Dartonfield meteorology station, for the last 5 years were computerized. A paper on the application of statistical modelling in the rubber industry, was presented at a regional symposium. Another 2 papers, one technical, and one general, were also submitted for publication. A guide for beginners in the use of SAS package, and a handbook on statistical methods were compiled. The latter was in progress towards the end of the year. Mr R. A. P. Abeypala received one year's extension to his no – pay leave and Mr T. B. Dissanayake was transferred to Soils & Plant Nutrition Department on his request.

DETAILED REVIEW

Staff

Mr W. N. Wickremasinghe, Biometrician, was on duty throughout. Mr L. T. Peiris, Senior Technical Officer, Ms J. D. Nandani, Technical Officer (Special Grade), and Mr L. P. P. Vitharana, Technical Officer, were also on duty throughout. Mr R. A. P. Abeypala, Senior Technical Officer, received one year's extension to his no – pay leave and continued to work for the I. R. D. P., Kalutara, as a Programmer and Mr T. B. Dissanayake was transferred to the Soils & Plant Nutrition Department with effect from May, on his request.

Reports

Wickremasinghe, W. N. (1989) Annual Review of the Biometry Section.

Training

Ms J. D. Nandani, Technical Officer (spe. grade) underwent a 16 – week course of training on the use of Statistical Analysis System (SAS) package, at the Computer and Information Technology Council (CINTEC) commencing December 1.

Symposia & Workshops

Mr W. N. Wickremasinghe, Biometrician, participated in a Regional Symposium on Statistical Modelling held from December 12 – 14, at the Institute of Fundamental Studies (IFS), Kandy.

He presented a paper titled "An Application of Statistical Modelling in the Rubber Industry" at this symposium. Mr L. P. P. Vitharana, Technical Officer attended a 1 – week work shop on agro – meteorology at the Dept. of Meteorology, Colombo.

Publications

Wickremasinghe, W. N. and Peiris, L. T. (1988). Writing Reports with a Computer : Word Processing. (submitted for publication in the bulletin)

Jayasekera, N. E. M. and Wickremasinghe, W. N. (1989). An Evaluation of Methods of Dry Rubber Content (DRC) Estimation in *Hevea* Clone Trials. (submitted for publication in the journal)

Routine Statistical Service

This consists of two types of services : One is the assistance given to research staff of the Institute in their routine, as well as special, projects leading to post – graduate degrees. The other is the assistance provided to Research Students and Temporary Research Assistants attached to research departments of the Institute, carrying out short term, and post – graduate projects.

These are summarized below :

Genetics and Plant Breeding Department

The biometrician continued to pay routine visits to the Nivitigalakele substation on the request of the Head of this department. He also worked on a joint paper on "Methods of DRC Estimation in *Hevea* Clone Trials" with Dr N. E. M. Jayasekera, Head.

Plant Pathology Department

One data set from "VA Mycorrhiza studies" and another large set of a research student were analysed and interpreted, using simple statistical tools. Twelve simple descriptive (graphical) presentations were provided as a part of continuation of the post – graduate project "Comparative Biological Aspects of Nutrient Cycling" of a research student.

Plant Science Department

One data set from the project on "Gas – Exchange Studies" was analysed and interpreted. Apart from this, designs were provided for 2 field experiments. One of which, titled "To study the performance of Young Buddings as compared to Conventional Techniques" on clone RRIC 100, was completed with field lay – out and demarcation of plots, as for a Randomized Complete Block Design with 8 blocks and 3 treatments.

Soils and Plant Nutrition Department

The statistical service rendered to the Soils and Plant Nutrition Department, is summarized in the following table:

Project/Expt.	Parameters analysed	# of data sets	Type of analysis
SM/83/1	Leaf Nutrients	10	ANOVA
SM/82/5	Leaf Water assessments and Nutrients	04	ANOVA
Organic fertilizer Expt. (Payagala)		02	ANOVA
K–Mg deficiency Expt.		06	ANOVA
@ Pot Expt. (Dartonfield)	Height, Girth on 3 different times & N, P, K, Ca, Mg & Mn	60	ANOVA
@ Pot Expt. (Dartonfield)	N, P, K, Ca, Mg & Mn at 2 depths	24	ANOVA
@ Field Expts. Eladuwa & Dorset	Leaf Nutrients	24	ANOVA
@ Field Expts. Eladuwa & Dorset	Girth & Height	05	ANOVA
@ Field Expts. Eladuwa	7 Soil treatments, 2 depths & 2 leaf Mn assessments	16	ANOVA
@ Field Expt. Dorset	7 Soil treatments, 2 depths & 2 leaf Mn assessments	24	ANOVA
Field Expt. Lowmont	Girth, Yield	06	ANOVA

Project/Expt.	Parameters analysed	# of data sets	Type of analysis
Eladuwa–Tapping Expt.	Girth, Yield	04	ANOVA
Eladuwa (immature)	Girth	02	ANOVA
@ Pot Expt. (Dartonfield)	Girth, Height	16	ANOVA
@ Nutrient cycling in Rubber Plantations & effect of mulching on Soil & Rubber trees	Litter components (on 30 fortnights)	30	GRAPHS

@ – post–graduate projects.

Computer Work

The SAS software package was updated by replacing the old version with the new 6.03 version. The new version carried several changes and enhancements. The added procedures like NLIN, for non–linear model fitting, were invaluable. The related manuals were also purchased from the CINTEC. Another add – on product called SAS/ASSIST for on – screen menu driven assistance which was received free–of–charge from CINTEC, was also installed.

The dBase – SAS interactive data base management and analysis work was successfully supported. The WORDSTAR 4000 word processor was used for compiling a hand book on statistical methods for biologists & agriculturists.

All the analyses provided by the section, were done using SAS running on EPSON PC/AX system. This PC system was also used by officers of other departments mainly for word processing.

Statistical Projects

An easy–to–understand guide for the beginners in the use of SAS package (with emphasis on data step) was compiled as a part of a proposed project to educate research staff on basic statistical and related computing methods.

The work on the second phase of this project viz. compilation of a 11 – chapter hand book on statistical methods for biologists and agriculturists, was in progress towards the end of the year.

Miscellaneous

The routine activities of the Dartonfield meteorology station, were continued without interruption. The officer handling meteorology work at Dartonfield station attended 1 – week workshop on agro – meteorology at the Department of Meteorology, Colombo.

Meteorological records of the Dartonfield station for the last 5 years, have been computerlized using LOTUS – 123 spread sheet.

The graph of rainfall, temperature and sunshine duration at Dartonfield, in shown in Fig. 1.

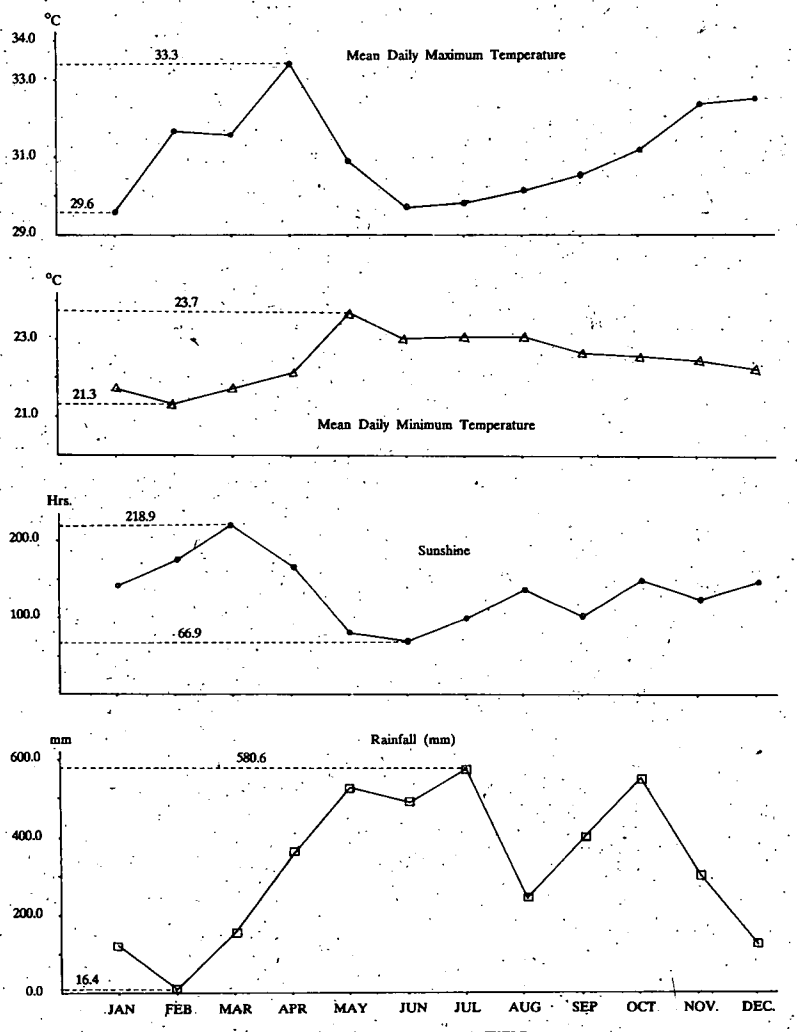

Fig. 1. Rainfall, duration of sunshine and temperature at DARTONFIELD

REVIEW OF THE AGRICULTURAL ECONOMICS SECTION

BY

SUMEDHA DE SILVA

SUMMARY

Staff

Mr H. Talgaswatta left for Lincoln College, New Zealand on the 12th of February for his postgraduated studies. Mr Sumedha De Silva was covering up the duties. He completed an MSc. in Agriculture specializing in Agricultural Economics from the Postgraduate Institute of Agriculture, University of Peradeniya on 31st March 1989.

General

A survey on stand per hectare of all clearings in state owned estates was completed. Carried out a feasibility study on replanting clearings with a low stand in their early years of tapping. Assisted the Departments of Genetics and Plant Breeding and Plant Science in planning the replanting programme for 1990 for the JEDB and SLSPC. Data on a small holder survey carried out as a preliminary survey for the Adaptive Research Programme was analysed together with the Technical Assistant to the Director Mr Kithsiri Jayasuriya.

Survey on Stand Per Hectare

This survey and its analysis was completed and the results are given below.

The overall average stand/ha and yield/ha was 336.6 trees and 975.3 kg respectively.

Table 1. *Comparison of Stand/ha and yield/ha among regions*

Region	Stand/ha	Yield/ha (kg)
Kegalle	334.5	1119.4 a
Avissawella	332.4	1032.0 b
Galle	348.7	944.6 c
Ratnapura	333.0	900.0 c d
Horana	339.7	874.1 d

Values followed by the same letter do not differ significantly. = 0.05

Table 2. *Comparison of Stand/ha and yield/ha among clones*

Clone	Stand/ha	Yield/ha (kg)
RRIM 600	313.8	1225.5 a
PB 28/59	337.8	1099.6 b
RRIC 100	398.3	1006.5 b
RRIC 102	373.5	1004.7 b
PB 86	335.0	926.0 c

Value followed by the same letter do not differ significantly = 0.05

Table 3. *Comparison of Stand/ha and yield/ha by region by clone*

Region	Clone	Stand/ha	Yield/ha (kg)
Avissawella	PB 86	329.7	989.8
Avissawella	PB 28/59	337.4	1002.9
Avissawella	RRIC 100	392.7	1067.4
Avissawella	RRIC 102	336.5	980.8
Avissawella	RRIM 600	308.6	1357.4 **
Kegalla	PB 86	333.7	1046.4
Kegalla	PB 28/59	354.9	1287.0 **
Kegalla	RRIC 100	395.3	1037.2
Kegalla	RRIC 102	384.4	899.3
Kegalla	RRIM 600	317.3	1334.7 **
Galle	PB 86	342.8	864.7
Galle	PB 28/59	346.6	1185.7 **
Galle	RRIC 100	407.0	889.1
Galle	RRIC 102	395.0	1736.0 **
Galle	RRIM 600	346.2	981.4

Region	Clone	Stand/ha	Yield/ha (kg)
Horana	PB 86	338.8	848.8
Horana	PB 28/59	333.8	845.5
Horana	RRIC 100	409.7	1207.3 **
Horana	RRIC 102	409.9	922.0
Horana	RRIM 600	305.1	1011.1
Ratnapura	PB 86	333.9	810.4
Ratnapura	PB 28/59	308.7	1065.0 **
Ratnapura	RRIC 100	392.4	976.2 **
Ratnapura	RRIC 102	313.5	1069.7 **

Yields are compared within Region.

** Significantly different from mean yield of PB 86 at = 0.05

Feasibility of replanting clearings with a low stand/ha in their early years of tapping in the Kegalle Region (JEDB IV)

This study was undertaken on the request of the Kegalle Regional Board. Financial analysis indicated that replanting these areas is not as beneficial as retaining them.

Replanting programme for estates coming under the JEDB and SLSPC for the year 1990

Assisted the Departments of Genetics and Plant Breeding and Plant Science in planning the above. Summary of the extents and their percentages out of the total recommended area for the different regions is given in Table 4.

Meetings and Seminars

Mr. Sumedha De Silva attended a meeting of the Rubber Task Force of the JEDB Regional board of Avissawella.

Mr. Sumedha De Silva attended the 12th meeting of the ANRPC committee of experts, as an observer, held in Colombo on 2 – 3 October 1989.

Mr Sumedha De Silva participated in the Regional Symposium on Statistical Modelling from 12 – 14 December 1989 held at the IFS in Kandy.

Table 4. *Extents and percentage extents of the different clones to be replanted in the different regions of the JEDB and SLSPC*

REGION	RRIC 100	RRIC 102	PB 28/59	RRIM 600	PB 217	RRIC 121	RIC 110	RRIC 117	RRIC 130	BPM 24	TOTAL
Avissawella	218.54	38.12	35.00	62.50	0.00	147.09	56.50	7.22	29.34	4.00	598.31
	36.53%	6.37%	5.85%	10.45%	0.00%	24.58%	9.44%	1.21%	4.90%	0.67%	100.00%
Kegalle	167.31	129.50	19.00	18.00	0.00	27.00	40.38	7.27	0.00	0.00	408.46
	40.96%	31.70%	4.65%	4.41%	0.00%	6.61%	9.89%	1.78%	0.00%	0.00%	100.00%
Galle	276.39	5.00	0.00	0.00	0.00	115.12	0.00	7.00	8.00	0.00	411.51
	67.16%	1.22%	0.00%	0.00%	0.00%	27.98%	0.00%	1.70%	1.94%	0.00%	100.00%
Horana	309.13	78.85	0.00	35.00	0.00	118.67	24.35	2.00	41.00	0.00	609.00
	50.76%	12.95%	0.00%	5.75%	0.00%	19.49%	4.00%	0.33%	6.73%	0.00%	100.00%
Ratnapura	380.29	33.50	4.50	0.00	0.00	100.98	0.00	0.00	13.20	0.00	532.47
	71.42%	6.29%	0.85%	0.00%	0.00%	18.96%	0.00%	0.00%	2.48%	0.00%	100.00%
TOTAL	1351.66	284.97	58.50	115.50	0.00	508.86	121.23	23.49	91.54	4.00	2559.75
	52.80%	11.13%	2.29%	4.51%	0.00%	19.88%	4.74%	0.92%	3.58%	0.16%	100.00%

REVIEW OF THE LIBRARY AND PUBLICATIONS SECTION

BY

D. C. THAMBAWITA

SUMMARY

Library and Publications Section continued its activities during the year controlling the estimated funds only for very urgent necessacities. Much emphasis was given on publication programme which has lagged behind schedule. Printing of publications were done according to the normal programme due to restrictions on financial allocations.

DETAIL REVIEW

Staff

Mrs V. S. Jayaratne, Librarian & Publications Officer was on no pay leave from 12 March 1989 and the rest of the staff Mr D. C. Thambawita, Library Assistant and Assistant Publications Officer, Mrs T. Dantanarayana, Library Assistant and Assistant Publications Officer Colombo Office, Mrs R. Amaratunga Clerk/typist and two Attendants were on duty throughout the year.

Reports

Jayaratne, V. S. (1989). Review of the Library and Publications Section. *Ann. Rev. Rubb. Res. Inst. Sri Lanka,* 1989

Acquisitions

Text books and periodicals

The collection of text books increased to 4256 and the bound volumes to 2483. The release of financial allocations to purchase new books was restricted due to limited allocation. 176 books were received from the American Centre on donation, and we are very grateful to the above Centre for their kind gesture.

Periodicals were received regularly except for few lapses due to the recent troubles.

Information services

Dissemination of information

Abstracting journals are regularly read over and articles of importance are indexed and kept for future reference. Contents pages of the relevant periodicals were circulated among the research staff for information, and whenever requests were made the periodicals were supplied.

Agricultural Information Network (AGRINET)

The AGRINET Service was in progress and our research Officers were benefited to a very great extent, and in return we were also able to assist other libraries.

The writer represented the meetings organised by the AGRINET whenever possible.

Inter library loans

Photocopies of articles were sent to libraries and other Institutes as and when they are requested for and we were also received photocopies of articles requested by our Research Officers.

We record with great pleasure that we could help most of the Institutes by supplying photocopies of articles through this programme.

Publication Unit

The publications programme was arranged to the schedule and printing could be done according to the estimated funds.

Visitors

NAB trainees and other University students were given the approtunity to use the library during the training period and every assistance was given to them for their training.

REVIEW OF THE ESTATE DEPARTMENT

BY

V. M. KATUGAHA

SUMMARY

Dartonfield Group managed by the Rubber Research Institute has 3 divisions namely Dartonfield and Gallewatte in the Agalawatte electorate and Nivitigalakele division in the Matugama electorate.

The total extent of the group is 331.02 ha, and the planted area is 251.58 ha, of which 107.06 ha, were in bearing during the year.

The weather experienced during the 1st quarter of the season was very dry and wet weather prevailed thereafter. The over-all weather pattern during the year was conducive towards the crop harvest, where we have been able to secure 4061 kgs over the estimated crop.

The replanting programme could not be undertaken as per schedule due to the unrest that prevailed in these areas for almost half the year. The uprooting contractors too defaulted in keeping to the date of completion.

Budwood of clones RRIC 100 and PB 86 were issued to the SLSPC/JEDB estates and the small holders of the area, during the season.

All agricultural operations were carried out in mature and immature areas and nurseries of the group.

Staff

Mr V. M. Katugaha, Estate Superintendent, Mr S. A. L. Chandrawansa Chief Clerk, Mr K. K. P. Gunawardena, Senior Asst Clerk, Mr K. D. Sumanasena, Mrs C. Dissanayake, Mr A. K. A. Wickremasinghe, Junior Assistant Clerks, M/s N. L. D. Piyadasa, A. K. D. Hemapala, H. M. J. Premalal, S. K. S. de Silva, Field Officers, Mr J. A. Wimalasena Asst Field Officer, M/s S. R. Vadivel, T. Somaratne and N. L. D. Reggie Field Supervisiors, Mr D. S. K. Ranaweera, Rubber Factory Officer, Mr W. D. D. Senanayake Factory Supervisor, Mrs C. H. Hettiarachchi Creche Attendant, M/S H. W. Amaradasa Tractor Driver, H. L. Sarath Jeep Driver, Mr A. K. Piyasena Office Peon were on duty throughout the year.

The Dartonfield Group Cadre stood at 20 at the end of the year made up as follows.

Senior Staff	01
Assistant Staff	15
Minor Staff	04

Agricultural Advisor

Mr H. G. Mendis, Superintendent of Sapumalkande Group, Dehiowita, was appointed as Agricultural Advisor, w.e.f. 1989, and visited the property on 25 January 1989.

Hectarage :

A summary of the hectarage is given in Table 1.

Table 1. *Land distribution in Dartonfield Group*

	Darton-field	Gala-watte	Niviti-galakele	Total
Mature Area	5.49	57.65	43.92	107.06
Immature Area	33.08	110.52	.92	144.52
Nurseries	7.27	—	7.69	14.96
Paddy Fields/Deniya	—	1.22	—	1.22
Abandoned Area	3.74	—	8.06	11.80
Swamps	—	—	1.21	1.21
Uncultivated, rocky, waste land and earthslip area	3.29	1.54	2.62	7.45
Jungle	—	—	.71	.71
Stream Reservation	—	.84	—	.84
Roads	3.27	6.86	.32	10.45
Buildings/Garden	16.14	5.07	7.79	29.00
Rocks	—	1.80	—	1.80
Total	72.28	185.50	73.24	331.02

Weather

Rainfall figures (mm) for 1988 and 1989 are given below in Table 2.

Table 2. *Rainfall distribution for 1989 and 1988*

	1989	1988
January	79.13	73.38
February	30.63	159.08
March	114.36	174.77
April	273.37	347.04
May	493.34	536.80
June	437.98	465.90
July	516.22	331.10
August	179.31	526.09
September	338.80	648.90
October	524.15	127.70
November	272.90	206.56
December	105.10	328.10
	3365.29	3925.42
Total wet days	166	189

The highest rainfall was recorded during the month of October which was 524.15 mm on 17 wet days.

CROP

The yield data for the last five years is given below in Table 3.

Table 3. *Yield records from 1985 – 1989 (kg/ha.)*

	1989	1988	1987	1986	1985
Dartonfield	612	1094	1416	1015	825
Galewatte	795	802	1229	1114	741
Nivitigalakele	706	1083	729	648	635
Average	738	1002	1128	1049	730
Estimated	700	1244	1213	870	913
Tapping Ha.	107	148	177	196	213

An overall drop in yield was recorded this year due to a large extent being on 400% intensified tapping and also the work stoppages etc. experienced from time to time due to subversive activities.

The crop secured during the season was 79,061 kgs as against the estimate of 75,000 kgs.

100 days tapping was lost due to rain and 24 days Recovery Tapping was carried-out. 32 days tapping was lost due to unavoidable circumstances experienced owing to subversive problems and official curfew imposed by the Government

The tapping standard was good, and the tapping panels were treated with fungicides.

Manufacture

A summary of Manufacture records during the year is given in Table 4. Details of Manufactured crop in Dartonfield. (aggregate of latex and scrap percentage).

Latex Grade	Total Kgs.	Percentage
Pale Crepe No. 1	129,616	89.61
Pale Crepe No. 3	6.034	4.17
R. S. S. No. 1	—	—
R. S. S. No. 3	—	—
Scrap Crepe No. 1	6,602	4.56
Scrap Crepe No. 2	2,139	1.48
Scrap Crepe No. 3	260	.18
	144,651	100.00

The Estate continues to purchase latex from small-holders, and the total purchase in 1989 is 25821 kgs, against 21,994 kgs in 1988, and the small-holders were paid an average price of Rs. 21/48.

The total crop manufactured during the year was 144,651 kgs including 25821 kgs of bought crop.

The produce of this estate were sold through M/s H. W. J. Dias Bros (Pvt), Ltd.

Factory Machinery

An overall condition report and an Estimate for all machinery was obtained from M/s Colombo Commercial Company (Engineers) Ltd, no work was undertaken due to the liquidity problems faced by the organisation.

Factory Buildings

Condition of the buildings could be considered satisfactory.

Roads

The macadamised roads which are leading to the Institute Bungalows and the Estate divisional roads were well maintained.

Pest & Diseases

The periodical diseases which were evident was controlled.

Fertilizer

Application of fertilizer in Mature and Immature fields was carried-out as per programme.

Replantings

The clearings which were scheduled to be planted in 1989, could not be undertaken due to the delay caused by the contractor, in uprooting old rubber trees. Arrangements have been made to replant these fields in 1990.

Nurseries

All nurseries were well maintained. The cost of a plant was high owing to the inability in carrying out the proper nursery practices at regular times mainly due to the uncertain conditions.

Field and Factory Experiments

The Research Departments were given the necessary assistance in carrying out their field and technological experiments.

Institute Buildings

The general maintenance expected from the Estate Department was undertaken and individual problems attended to, when necessities arose.

Labour and Health

All non working resident children over one year of age and below 13 years continued to be issued with 1/4 lb bread per day per head.

The health of the entire population was satisfactory during the year.

National tree planting campaign

Medicinal and herbal plants were planted in Dartonfield Group on the 17 September 1989.

Accounts

Final Accounts for 1989 is in progress.

Estimates

Estimates of Capital and Revenue expenditure for 1990 in respect of Dartonfield Group were submitted to the Rubber Research Board and awaiting approval of the Estate Committee.