THE
RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW FOR 1976

CONTENTS

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

BOARD OF MANAGEMENT
(As at 31st December, 1976)

Ex-Officio Members

The Director of Agriculture — Dr. E. F. L. Abeyratna, B.Sc. Hons. (Lond.), Ph.D.

The Deputy Secretary to the Treasury — Mr. C. Chanmugam, B.Sc. (Cey.), A.R.I.C., S.L.A.S.

The Rubber Controller — Mr. B. K. Abeyratna, B.A. Hons. (Cey.), S.L.A.S.

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

Nominated Members

Member of National State Assembly under the Rubber Research Ordinance

Mr. Daya T. Pasqual, M.N.S.A.

Members Nominated by the Planters' Association of Ceylon

Mr. H. G. R. de Mel
Mr. R. F. Poulier

Members Nominated by the Low-Country Products Association of Ceylon

Mr. D. Jayasiri Perera (*Chairman*)
Mr. Gunasoma Hettiarachchi

Member Representing Smallholders under the Rubber Research Ordinance

Mr. M. R. B. Daswatte

STANDING COMMITTEE

Administrative Committee :

Mr. D. Jayasiri Perera (*Chairman*)
Dr. O. S. Peries
Mr. B. K. Abeyratne (R.C.)
Mr. C. Chanmugam (D.S.T.)

Estate Committee :

Mr. D. Jayasiri Perera
Dr. O. S. Peries
Mr. G. Hettiarachchi
Mr. H. G. R. de Mel
Mr. R. F. Poulier
Mr. Rajah Salgado
Mr. M. W. Thompson
Mr. M. R. C. Pieris
Mr. Salie M. Dias
Mr. W. A. Fonseka

Scientific Committee :

Mr. D. Jayasiri Perera
Dr. O. S. Peries
Mr. G. Hettiarachchi
Mr. H. G. R. de Mel
Mr. R. F. Poulier
Mr. B. K. Abeyratne
Heads of Scientific Depts.
Mr. Douglas de Fonseka
Mr. L. H. T. de Mel
Mr. W. L. Bogstra
Mr. D. C. Gauder
Mr. A. B. Weerasekera
Mr. A. H. B. Kalpagé (representing District P.A.A.)

Provident Fund Committee :

Mr. G. Hettiarachchi (Chairman of P.F. Committee)
Dr. O. S. Peries
Mr. A. B. Dissanayake
Mr. J. D. S. Wickremaratne

Secretary to the Board

Mr. M. N. J. Jayaratne, B.A. Hons. (Cey.), A.M.B.I.M. (Lond.)

Lawyers

Attorney-General's Department,
Torrington Square,
Colombo 7.

Auditors

Satchithananda, Schokman, Wijeratne & Co.,
Chartered Accountants,
P. O. Box 918,
Colombo 1.

Bankers

Bank of Ceylon,
York Street, Colombo 1.

People's Bank, Matugama.

Registered Office and Laboratories

Dartonfield, Agalawatta.

Colombo Office

Consisting of the :

Advisory Services Department & Economic Research Unit, Rubber Chemistry Department, Specifications Laboratory, and Board Office.

74, Telawala Road,
Ratmalana,
Mr. Lavinia.

THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

(As at 31st December, 1976)

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

RESEARCH DEPARTMENTS

Botany

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

Botanists .. R. Satchuthananthavale, B.Sc. (Madras), M.A. (Madras), Ph.D. (Sheffield).

Mrs. A. C. I. Samaranayake, B.Sc. (Cey.), Ph.D. (Lond.)

U. P. de S. Waidyanatha, B.Sc. (Cey.), M.Sc. (Cey.), Ph.D. (Lond.), D.I.C.

Senior Technical Assistant .. W. G. V. Fernando

Technical Assistants .. L. S. S. Pathiratne, L.I. Biol.
J. G. de Mel
Miss C. W. Ranasinghe, B.A. (Cey.)
T. C. Weerasinghe, B.A. (Cey.)
W. A. Ariyaratne

Senior Field Assistant .. M. C. Perera

Field Assistants .. D. A. Brahakmana
R. B. Gunaratne
S. Kodikara
W. A. T. Silva
S. Wilbert
U. K. D. Lewis

Genetics and Plant Breeding

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

Assistant Geneticists & Plant Breeders .. N. E. M. Jayasekera, B.Sc.Ag.(Cey.), Ph.D. (Birm.)
*C. M. B. Ratnayake, B.Sc. (Cey.)

Senior Technical Assistant .. P. Samaranayake

Technical Assistants .. W. D. Gunadasa, B.A. (Cey.)
K. B. A. Karunasekera
K. W. Rupatunga

Senior Field Assistant	..	H. B. H. de Silva
Field Assistants	..	D. S. Gamage B. M. S. G. Peiris A. K. M. S. Senaratne W. A. C. Wijesinghe

Plant Pathology

Head of Department	..	A. de S. Liyanage, B.Sc. Ag. (Cey.), Ph.D. (Lond.)
Assistant Plant Pathologist	..	G. W. Liyanage, B.Sc. Ag. (Cey.), M.Phil. (Lond.)
Experimental Officer	..	Mrs. N. I. S. Liyanage, B.Sc.Ag. (Cey.)
Senior Technical Assistant	..	Z. E. Irugalbandara
Technical Assistants	..	L. Halangoda L. W. Amaratunga D. M. Danthanarayana A. Dharmaratne S. S. Jayasooriya W. A. D. D. S. Wettasinghe E. Bharath Fernando K. A. N. S. Fernando

Soils Chemistry

Head of Department	..	O. S. Peries, B.Ag.Sci. (Melb.), Ph.D. (Bristol) M.I. Biol.
Soils Chemist	..	C. G. Silva, B.Sc. (Cey.), M.S. (Hawaii).
Assistant Soils Chemists	..	*M. K. S. A. Samaraweera, B.Sc. (Cey.) N. Yogaratnam, B.Sc.Ag. (Alhabad), Ph.D. (Lond.)
Senior Technical Assistants	..	W. C. Dayaratne F. P. W. Silva -
Technical Assistants	..	B. P. M. Arsecularatne B. G. K. Jayawardene A. M. A. Perera H. A. Seeman L. J. Wickremasinghe S. P. S. R. de Silva G. G. Weerawansa T. A. C. S. Wasanthadeva K. S. K. Wijeratne
Field Assistants	..	W. M. Abeysinghe A. D. M. Karunaratne M. A. Mendis K. S. A. C. Peiris K. A. J. Wijenayake

Rubber Chemistry & Technology

Head of Department ..	M. Nadarajah, B.Sc. (Cey.), M.Sc. (Birm.), A.I.R.I.,F.I. Chem. (Cey.).
Chief Rubber Technologist ..	S. W. Karunaratne, B.Sc. (Cey.), M.Sc. (Aston), A.R.I.C., A.N.C.R.T., A.I.R.I.
Biochemist ..	P. A. J. Yapa, B.Sc. (Cey.), Ph.D. (Lond.)
Chemical Engineer ..	R. Tharmalingam, B.Sc. (Cey.), Dip. Chem. Eng. (U.C. Lond.), M. Phil. (Aston).
Rubber Chemist ..	A. Coomaraswamy, B.Sc. (Cey.), Ph.D. (Aston).
Assistant Rubber Chemists ..	A. M. A. Amarapathy, B.Sc. (Cey.), M.Sc. (Aston), Ph.D. (Aston) M. R. N. Fernando, M.Sc. (Moscow), M.Sc. (Aston), Ph.D. (Aston) *W. S. E. Fernando, B.Sc. (Cey.), M.Sc. (Aston)
Experimental Officer ..	L. B. K. Silva, B.Sc. (Cey.)
Assistant Specifications Officer	L. M. K. Tillekeratne, B.Sc. (Cey.), M.Sc. (Aston)
Asst. Development Officers ..	D. S. Muthukuda E. G. Mendis
Senior Technical Assistant ..	T. Kanthasamy
Technical Assistants ..	M. A. Baduge, B.A. (Cey.) A. S. Dekumpitiya W. D. Dharmasena P. P. Jayasinghe, L.I.R.I. S. Kasinathan, L.I.R.I. D. D. Medagama K. A. Piyadasa K. P. N. de Silva P. V. A. G. Perera, B.Sc. (Cey.) N. A. A. Silva W. A. Lionel R. Surendrakumar G. D. Nimal K. A. R. M. Perera N. A. A. S. Kurera Miss T. Nirmala Miss C. L. Punchihewa Miss M. G. M. Mangalika
Specifications Assistants ..	W. D. P. R. Abraham T. M. Ahamadeen D. R. Peiris W. A. S. Wijesekera A. G. R. S. Perera T. A. S. Siriwardene Miss H. S. Wickremanayake

Statistical Section

Assistant Statistician	..	G. A. J. P. R. Gunasekera, B.Sc. (Cey.), Dip. Stat. (Vidyodaya, Cey.)
Technical Assistant	..	L. T. Peiris

Advisory Services Department & Economic Research Unit

Head of Department	..	A. B. Dissanayake, B.Sc.Ag. (Cey.), B.A. (Cey.), M.Sc. (Cey.)
Deputy Head of Department		R. P. M. de Zoysa, B.Sc. (Cey.), M.Sc. (Oregon).
Assistant Agricultural Economists	..	G. R. Chandrasiri, B.Sc. (Cey.), M.Phil. (Lond.) H. D. B. H. Gunasekera, B.Sc. Ag. (Cey.)
Assistant Advisory Officer	..	A. Dahanayake, B.Sc. Ag. (Cey.)
Divisional Advisory Officers		H. A. D. Ariyaratna K. I. Ariyaratna W. S. Dassanayake A. J. L. de Silva K. P. Siriwardene A. Sooriyaarachchi J. D. S. Wickremaratne L. A. Wijesinghe D. R. Wijesuriya
Rubber Instructors	..	K. A. S. Abeygunawardena D. L. Abeysinghe U. S. B. Alagoda C. S. V. O. Anthony M. Athauda S. D. Athukorale D. D. Dasanayake P. W. David K. D. Dharmasena W. H. R. Dias K. Ekanayake E. A. F. S. Fernando S. S. K. Fernando W. G. Galigamuwa Arachchige R. Gunadasa D. G. L. Gunapala A. S. A. Gunasekera W. W. Gunasekera U. D. V. Gunasinghe R. K. Gunatillake G. Gunawardena H. K. R. Heendeniya T. B. Herath D. Hettiarachchi S. D. Hidellaarachchi

H. J. Hirimuthugoda, B.A. (Cey.)
D. P. P. Jayakody
T. W. Jayalath
A. K. Jayatissa
L. S. Kasthuriratne
N. C. Katukurunda
I. Kiridena
K. S. Kodikara
D. D. Kotalawela
E. N. Liyanage
T. P. Liyanage, B.A. (Cey.)
W. E. W. de Mel
P. R. Nonis
D. Palihakkara
Mrs. G. N. P. Perera, B.A. (Cey.)
M. P. V. P. S. Perera
U. L. C. Perera
U. L. R. A. Perera
P. P. S. Perera
D. Podimahatmaya
R. W. U. Rajapaksa
S. C. Rajasinghe
R. M. B. Ranasinghe
D. J. Ratnayake
G. S. Ratnayake
W. D. D. Rupasinghe
M. C. Samarasekera
G. Senarath
S. Senawickrema
S. H. B. L. de Silva
M. Sirisena
U. S. Somapala
J. Sumanasekera
W. J. H. Swaris
O. M. W. Tillakaratne
S. S. Waidyakularatne
S. Weerakoon
K. W. N. B. Weragama
C. Wickrematillake
U. S. Wijepala
W. A. S. Wijesekera
D. U. Wijesinghe
V. Wijesinghe
W. M. D. Wijesundara
R. P. D. J. Wijewardena

Technical Assistants . .

S. K. de Silva, B.A. (Cey.)
B. A. D. A. S. Balachandra, B.A. (Cey.)
K. D. Chandradasa, B.A. (Cey.)
P. W. Karunaratne, B.A. (Cey.)
A. Kalubowilage, B.A. (Cey.)
K. S. Peiris, B.A. (Cey.)
I. H. S. L. Weerasinghe, B.A. (Cey.)

Administration Department

Chief Administrative Officer & Secretary to the Board	..	M. N. J. Jayaratna, B.A. Hons. (Cey.), A.M.B.I.M. (Lond.)
Assistant Administrative Officer	..	G. M. R. Wimalaweera, B.A. Pub. Adm. (Cey.)
Office Assistant	..	T. H. Wijesena
Personal Assistant to the Director	..	P. Samarasinghe
Chief Clerk	..	W. D. Jayawansa
Establishment Clerk	..	D. G. Udawatte
Translator cum Typist	..	J. A. A. R. I. St. R. Perera
Clerk Typists	..	J. D. Gunaratne R. G. D. Sakaraja Miss R. S. Seneviratne Mrs. W. Paul Mrs. D. F. Thambawita
Graduate Assistant	..	Miss A. M. L. Angammana, B.A. (Cey.)
Junior Clerk Typist	..	Miss G. R. H. de Alwis
Clerk cum Steno/Typist (Board Office)	..	P. H. Seneviratne

Administration Unit — Colombo Office

Assistant Administrative Officer	..	W. J. P. Dias, B.Sc. (Cey.)
Office Assistant	..	A. L. Gunawardena
Chief Clerk	..	C. Jayasinghe
Clerks	..	G. P. A. I. G. Pathirana R. E. Perera
Clerk/Typists	..	Mrs. M. A. P. P. Seneviratne Mrs. I. Swaris
Junior Clerk/Typist	..	H. B. de Silva
Clerk (Accounts)	..	Mrs. L. J. C. Perera
Clerk/Translator	..	I. L. Sirisena
Artist Clerk	..	M. J. P. Lusena

Graduate Assistants	..	Miss D. S. Elvitigala, B.A. (Cey.) Miss W. Yasawathie, B.A. (Cey.) Mrs. J. N. de Silva, B.A. (Cey.)

Library

Librarian & Publications Officer	..	J. A. Amaraweera, B.Sc. (Cey.)
Library Assistant & Assistant Publications Officer	..	Miss L. I. T. Ramanaden
Library Clerk	..	D. C. Thambawita
Clerk/Typist	..	Mrs. D. T. Danthanarayana

Accounts Department

Accountant	..	M. E. A. Peiris, Dip. Acc. (Cey.), A.C.M.A. (Lond.)
Accounting Assistant	..	E. P. D. Roberts, F.C.B.I. (Lond.)
Foreign Order Clerk	..	K. G. A. K. Dharmawardena
Book-Keeper	..	A. K. D. Amaradasa
Accounts Clerks	..	R. L. Fernando K. D. D. Navaratne J. H. C. S. Perera A. L. Ratnayake N. C. de Silva
Graduate Assistants	..	Miss G. Caroline, B.A. (Cey.) Mrs. K. K. Jagoda, B.A. (Cey.) L. Wickrema, B.A. (Cey.)
Clerk/Typists	..	W. Kularatne Mrs. C. C. Silva
Cashier	..	D. C. A. D. B. de Silva
Store keeper	..	D. P. W. Goonasekera
Assistant Store-keeper	..	P. D. Somadasa

Works Section

Works Engineer	..	P. C. J. F. Keerthisinghe, Comp. I. E. (Sri Lanka)
Mechanical Foreman	..	M. M. Anderson
Electrical Foreman	..	J. Weerakoon
Building Foreman	..	W. S. J. Benjamin
Transport Assistant	..	B. D. Ponnamperuma

RUBBER RESEARCH INSTITUTE OF SRI LANKA

DIRECTOR'S REVIEW FOR 1976

BY

O. S. PERIES

Rubber Centenary

The rubber plant was introduced into South East Asia through Sri Lanka in 1876. Therefore, the year under review marked the Centenary of the introduction of one of the most important crop plants into the Far East. The occasion was celebrated by us in the traditional manner by holding an all night Pirith Ceremony at Dartonfield, the Headquarters of the Institution, on 6th December. This was followed by an International Rubber Conference held in Colombo, at the end of the year.

The Centenary International Rubber Conference, held on 15, 16, 17 December, 1976, at the Bandaranaike Memorial International Conference Hall, was undoubtedly the highlight of the year. This Conference was well attended by both local and foreign participants. Sixty eight papers were presented during the three day sessions, with nearly half the papers being presented by overseas research organisations. Parallel sessions had to be held to accommodate the papers on the biology of the crop and rubber chemistry, respectively. Representatives from all rubber growing countries participated in the Conference, which was attended by over one thousand invitees and registrants. The quality of the papers presented was uniformly high and the Institute is justly proud of the fact that this was one of the best scientific conferences ever held in this country.

Prospects for Natural Rubber

Natural Rubber (NR) prices are attractive today; therefore, it is an opportune time to assess the long term prospects of the industry. First, the break up of total rubber demand: the expert's opinion is that in future 20 – 25 per cent of the demand will be met by NR, 40 per cent by Synthetic Rubber (SR) and 35 – 40 per cent by NR or SR. Therefore, considering the "floating" demand of up to 40 per cent, there is a large potential market open for NR in the future.

In the past NR prices have been subject to violent fluctuations, and this was one of the most important weaknesses in the marketing of NR. The recent multinational agreements on the establishment of a buffer stock system to stabilise prices of NR is bound to increase the penetration of NR into the US market. A large swing in favour of NR in the USA is more likely in the long rather than in the short term. This is mainly because of the heavy investment in the SR industry by the consumers themselves, so that the SR market is essentially a capitve market. However, when existing plant and machinery run down, a clear and correct assessment of future investments will be made and the balance will then be very much on the side of NR.

Malaysia has recognised this and she is planning to produce 2.25 million tons of NR in 1980, compared to her present production of 1.5 million tons. Malaysia is hoping to achieve this by an ambitious programme of replanting and new planting. She has started a programme for replanting 1.6 million acres of the original 2.4 million acres of seedling rubber already replanted and by the end of the seventies a further 500,000 acres will be replanted or brought under rubber from jungle land. In comparison to this, Sri Lanka's efforts are disheartening. We have no new land to bring under rubber; therefore our immediate job is to replant old rubber and in this respect the replanting of well under 7,000 acres per year at present is woefully inadequate, when the minimum area to be replanted should be 15,000 acres and we should really strive for around 25,000 acres of replanting per year, as NR prices are going to be better as we go along.

Research

The work of the Research and Extension Departments is summarised below :

Botany

Over a 6-year period, clone PB 86 has responded well to tapping daily on a half spiral cut, with the incidence of dry trees remaining within acceptable limits. This is of significance in relation to the smallholders' problems during periods following prolonged wet weather, when a majority of them tap daily in periods of fine weather. This also has a bearing on recovery tapping on Estates in the wet zone. The clone, PB 86, appears to be better adapted for daily tapping than any other popular clone grown in Sri Lanka at present.

The recommended clones IRCI 2 and 9, PR 252, RRIC 36 and 48 and RRIM 600 continued to maintain high yields in all large scale trials. Clone RRIM 600 has recorded the highest yields in all trials sited in both the wet and dry planting districts. Among the clones of the RRIC 100 series, clone RRIC 101 has recorded a yield of over 1000 kg dry rubber per hectare in the first year of tapping.

All polyclone plantings have continued to maintain higher yields than monoclone plantings. In a large scale planting, a yield of over 1000 kg per hectare has been recorded in a poly-clone planting in the second year of tapping. None of the clones included in this trial has reached this yield level in monoclone plantings.

Clonal seed of all commercially planted clones in Sri Lanka appear to be suitable for use as rootstocks, in regard to both the growth and yield of the scion clones. There is no advantage in the periodic thinning of poor growers in seedling nurseries, planted at normal spacing, from the viewpoint of increasing the percentage of plants reaching the buddable girth. However, thinning out improves the growth of seedlings remaining in the nursery.

Interplanting rubber during the immature phase with perennial crops such as bananas, passion fruit, pineapples and forage grasses has not adversely affected the growth of rubber. On the contrary, where these subsidiary crops have been adequately fertilized, a distinct improvement in the growth of the rubber has been recorded.

Genetics & Plant Breeding

The studies on 10 modern clones, to assess the effect of environment on genotype, have shown that there is a significant interaction between these two factors.

Therefore, clones have to be selected on this basis for various districts, and this study is being pursued.

The clone RRIC 110 was found to match RRIC 101 on the factor of early high yields. Clones, RRIC 100 and 102, showed later high yields and RRIC 103 was found to be resistant to drought and to develop a spreading canopy in areas such as Bibile and Moneragala. This makes it a suitable clone for planting on a large scale in these areas.

One of the first smallholdings to plant clones of the RRIC 100 series was tapped and RRIC 103 was found to yield over 800 kg/hectare dry rubber in the first year of tapping.

Plant Pathology

The wintering pattern, host phenology and the incidence of secondary leaf-fall due to infection by *Oidium heveae* was recorded on four cultivars. Rod traps were successfully used for the first time in Sri Lanka, to trap *Oidium* spores. The pre-and post - penetration behaviour of *O. heveae* on several cultivars were examined. Scanning electron microscopy of leaves, naturally infected by *O. heveae*, showed several interesting morphological features.

A useful technique was developed to examine the structural details of *Phytophthora* species, by growing the fungus on a smear of Lima Bean Agar (LBA) on a microscope slide. Biochemical investigations on resistance to *Phytophthora* spp. showed that there were differences in the phenolic compounds present in different *Hevea* clones. Some of those compounds inhibited spore germination in the Phytophthoras isolated from rubber. Clone RRIC 101 had the highest phenolic content in pods.

The content of phenolics was significantly higher in healthy bark of clone PB 86 than in bark infected by Bark Rot, caused by *Phytophthora* spp. The clones which are known to be susceptible to Bark Rot had a higher bark moisture content than resistant clones. It was found that there was no significant difference in the number of latex vessel rings in virgin and callused bark. Therefore, the excision of Bark Rot infected bark in the curative treatment of this disease is not likely to result in a reduction in yield, if there is a direct relationship between the number of latex vessel rings in the bark and yield. There were no significant differences between several proprietory and local formulations on the rate of bark renewal. Therefore, the use of expensive proprietory formulations to encourage bark renewal, after surgical treatment for Bark Rot control, is not warranted. It was observed however that bark of Clones RRIC 52 and RRIM 513 calluses over more rapidly and evenly after injury, than that of clone PB 86. The use of preserved latex as an adjuvant with fungicides has given promising results in controlling Bark Rot.

Clonal susceptibility to *Oidium*, *Phytophthora* and *Gloeosporium* leaf diseases, Bark Rot and White Root disease were determined under laboratory and field conditions. Most of the high yielding Eastern clones were susceptible to *Oidium* and *Gloeosporium* leaf diseases, but clones of F, FX and IAN origin were resistant. It was found that clones could be screened for Bark Rot control at an early age. Varying degrees of clonal resistance were noted for Bark Rot.

Studies on the effect of temperature, pH, light and dark and relative humidity on the growth of several isolates of *Rigidoporus* (*Fomes*) *lignosus* have shown that

there are marked differences in the rate of growth, morphology and pathogenicity of different isolates of this fungus. Its growth pattern in different soil types is also different. The development of the sporophore and the pattern of basidiospore release of *R. lignosus* showed that there was a bimodal pattern of spore release in the fungus, with peaks between 0400 h and 0800 h and 1900 h and 2100 h. Spores were abundant during the period 0400 to 0800 h. A seedling technique has been successfully developed to evaluate clones against infection by *R. lignosus*. RRIC 52 appears to be resistant to infection by this fungus.

Soils Chemistry

Studies on the uptake of soil phosphorus have shown that rubber trees absorb phosphatic fertilizers more efficiently when crushed rock phosphate is placed in bands and a good ground cover is grown in the area concerned. Incubation studies and pot and nursery experiments have shown that local apatite may be substituted for imported saphos phosphate. Forking rock phosphate into the soil has been found to ensure a uniform distribution of the fertilizer in the soil.

A field experiment has confirmed that the growth and yield of rubber trees planted on Boralu soils can be improved by the addition of potassium. It has been shown experimentally that rubber trees, grown in areas previously planted in tea, can produce good growth on lower dosages of fertilizer than those recommended by the Institute in areas where the former crop was also rubber.

Studies on ground cover have shown that: (a) *Mimosa invisa* does not fix nitrogen effectively, (b) the practice of applying rock phosphate to covers is very beneficial, and (c) it is most important to grow a suitable legume cover in all replanted areas. In its absence about thrice the normal quantity of nitrogen fertilizer must be applied to the rubber for comparable growth during its immature period.

It has been shown that there is a direct relationship between the uptake of aluminium and phosphorus in *Pueraria* plants. The significance of this in the nutrition of *Hevea* is being investigated.

The area sampled for soil and foliar analyses is twice that done in 1975. It is expected that the total area under rubber in Sri Lanka will come under this survey by 1980.

Rubber Chemistry

A market survey has shown the great potential for the sale of sole crepe in overseas markets. Steps are being taken, therefore, to step up the present production of 4500 tons of sole crepe by at least another 4000 tons annually in future. Sri Lanka is unique amongst natural rubber producing countries in that she produces more than one third of her output in the form of light coloured rubbers. The Institute is of the opinion that Rubber Trade Centres should be set up in the major consuming countries to promote sales and at least maintain our markets, as the very vigorous promotional work of other producing countries is eroding this market and more and more SNR 5L is being used in place of pale crepes. The Government should take cognisance of this immediately and take the necessary action.

Steps are being taken to develop the research findings on network bound antioxidants on a commercial scale. This is one of the most important contributions made by this Institute in the field of rubber chemistry.

The establishment of small units for manufacturing rubber products as extensions to the existing rubber factories has commenced. Sri Lanka has about 150 crepe rubber factories with the required power, water, workshop facilities and management skills to develop this scheme. These factories can produce high quality rubber goods and thereby increase employment opportunities at minimum cost on a given investment of capital. The following products are already being manufactured on the Estates managed by the Institute, and at the Block Rubber Factory, Mawanella:

1. Cyclised rubber, for use in paints and as a reinforcing filler (Elston Estate, Puwakpitiya.)

2. Road marking paints using cyclised rubber (Elston Estate, Puwakpitiya.)

3. Prevulcanised formaldehyde stabilised field latex for use in emulsion paints and for water-proofing concrete structures (Block Rubber Factory, Mawanella.)

Advisory Services

The construction of Group Processing Centres (GPCC) for the manufacture of high quality sheet rubber from Smallholders' latex has been given priority in the work of this Department. One hundred and two (102) GPCC have been completed up to date under this scheme, and another 38 have been planned. In addition to this, 3009 coagulating pans were distributed to GPCC at a subsidised rate and 308 sq ft. of monel metal mesh were sold at subsidised rates to smallholders and GPCC.

Twenty training classes and 2203 demonstrations were held for smallholders and 76 fertilizer demonstration plots were serviced during the year. A scheme of seminars was also conducted for the benefit of the personnel of the Land Reform Commission.

A survey on the economics of production of smallholders was started during the year and is being continued. An analysis was conducted on the effect of the fuel crisis on the natural rubber industry, and it was found that, in spite of the increase in cost of labour and all inputs, the NR industry was still very profitable. The data collected on the economics of resource use are being coded for computer analysis.

The survey conducted to assess the reasons for the lack of interest of some smallholders in their GPCC showed that this was mainly due to three factors: (a) inaccuracies in the measurement of the drc of their latex, (b) problems in payment for latex, (c) poor management by the committee. Steps are being taken to remedy these shortcomings.

Staff

The Director, the Heads of Departments and all the Senior and Intermediate Staff Officers of the Institute were on duty throughout the year.

Mr. D. M. Fernando, Head of Genetics & Plant Breeding Department returned to the Island on 14th May, having completed a course of training in Mutation Breeding at the University of Bristol.

Mr. L. B. Chandrasekera, Head of Botany Department, attended a Symposium of the International Rubber Research & Development Board at Djakarta in Indonnesia from 8th to 10th November.

Mr. S. W. Karunaratne, Chief Rubber Technologist attended a Seminar on Marketing of Rubber with special reference to Crepe Rubber for 2 months, which was organised by the United Nations.

Mr. L. M. K. Tillakeratne attended the ISO/TC45 meetings held at Barcelona, Spain, from 30th September to 9th October.

Dr. A. de S. Liyanage, Head of Plant Pathology Department attended the Second Meeting of the ANRPC Technical Committee on SALB held in Djakarta from 3rd to 5th November.

Dr. N. Yogaratnam, Soils Chemist attended the FAO-CIDA Regional Workshop on Organic Fertilizer in Asia at Bangkok in Thailand from 26th October to 5th November.

Mr. G. R. Chandrasiri, Assistant Agricultural Economist, returned to the Island on 17th November, having attended a training course on Agricultural Economics for 71 days at the National University, Australia.

The following officers who were sent abroad earlier under Colombo Plan Scholarships, continued their post-graduate studies :

Mr. W. S. E. Fernando, Assistant Rubber Chemist, at the University of Aston in the United Kingdom.

Mr. M. K. S. A. Samaraweera, Assistant Soils Chemist at the University of Bristol in the United Kingdom.

Mr. C. M. B. Ratnayake, Assistant Geneticist, at East Malling Research Station in the United Kingdom.

Mr. R. A. Wijewansa, Assistant Advisory Officer, resigned from the services of the Institute with effect from 1st October.

Mr. R. B. Mapa, Assistant Agricultural Economist who was appointed on 1st March, resigned this position with effect from 23rd March.

Mr. H. D. B. H. Gunasekera was appointed Assistant Agricultural Economist, with effect from 1st September.

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

Officers in Grades I & II	24
Officers in Grade III	14
Officers in Grades IV to IX	236
Officers in Grades X to XIII	138
Visiting Superintendent, Kuruwita Sub-station ..	1
TOTAL	413

Visitors

Visitors to the Institute included :

Mr. P. O. Thomas, Malaysian Rubber Research & Development Board Malaysia.
Professor Pickard, Washington University.
Mr. K. B. Mistry, IAEA Bhabha Atomic Research Centre, Bombay, India.
Mr. K. M. Pretty, Potash Institute of Canada, Mississauga, Canada.
Professor R. N. Arnold, Rubber Research Institute of Malaysia.
Professor F. Beinorth, Rubber Research Institute of Malaysia.
Dr. L. Napitupulu and Ir Lukman, Balai Penelitian Perkebunan, Medan.
Mr. Saw Seng Hoo, Toho Rubber Processing Co. Ltd., Singapore.
Mr. Firdi Salah Udin, Sri Lanka Trade Centre, Singapore.
Dr. P. A. Chadhokar, Tropical Pasture Expert.
Mr. K. P. Broadbent, Commonwealth Agricultural Bureau, U.K.
Mr. D. M. Etherington, Australian National University.
Mr. Kaj Rogeman, SIDA, Stockholm, Sweden.
Dr. G. Verhaar, Royal Tropical Institute, Amsterdam, Holland.
Trade Delegation of the Government of the People's Republic of China. Peking, China.

Visits

The following are some of the conferences and seminars attended by the Director and Research Officers of the Institute :

Annual Sessions of the Ceylon Association for the advancement of Science (CAAS)
I. R. I. Committee Meetings
Meetings of the Rubber Replanting Advisory Board
Meetings of the panels convened by the Industrial Development Board
Standing Committee meetings on agro-chemicals and fertilizers
Ad hoc meetings of the Ministry of Trade & Commerce
Ad hoc meetings of the Ministry of Plantation Industries
Meetings of the Soil Conservation Society
Meetings of various panels appointed by the Bureau of Ceylon Standards
Meetings of the Working Group on Fertilizers.

The Director served on the following Boards and Committees :

Rubber Research Board (RRB)
Administrative Committee of the RRB
Estate & Experimental Committee of the RRI
Scientific Committee of the RRB
National Science Council (NSC)
Sri Lanka Tyre Corporation Board of Directors
Coconut Research Board (CRB)
Scientific Committee of the CRB
Research Planning Council of the Ceylon Institute of Scientific and Industrial Research (CISIR)
Academic Council of the Faculty of Agriculture, Peradeniya Campus of the University of Sri Lanka
Rubber Replanting Advisory Board
Committee of the Plastics and Rubber Institute (Sri Lanka).

Workers from overseas

Professor Gerald Scott, of the University of Aston in Birmingham, our Consultant in Polymer Science & Technology, visited the Institute in December, soon after the Conference, to review the work of the Rubber Chemistry Department. His advice to the research staff of the Institute through the years has been invaluable and we are most grateful to him for his continued interest in the work of the Institute.

Visiting Officers

Mr. V. Abeywardena, Biometrician, Coconut Research Institute, continued to visit the Rubber Research Institute regularly throughout the year to help us with statistical studies. We are very grateful to the Coconut Research Institute for the services rendered to us by this officer.

Six final year students of the Department of Crop Science, University of Sri Lanka, Peradeniya Campus, were provided with a short course of training at the Institute.

Facilities were also provided for students from the Engineering Faculty of the Peradeniya Campus to work at the Institute under a Vacation Training cum Employment Programme.

Publications

The following papers were prepared by the Director for publication during the year :

O. S. PERIES — Director's Review for 1975

O. S. PERIES — Developments — Biological and Technological — achieved by the Rubber Research Institute of Sri Lanka. *Ceylon Daily News*, 15th December 1976.

O. S. PERIES — SE Asia's Plantations began with this tree. *The Sunday Times*, 12th December, 1976.

O. S. PERIES — Rubber — how it all began. *Ceylon Daily Mirror*, 15th December, 1976.

O. S. PERIES — Realistic view between natural and synthetic rubber in Sri Lanka. *Lankadipa*, 15th December 1976.

BARLOW, C. AND PERIES, O. S. — On the generation of biassed Technologies by Rubber Research Stations. *Paper presented at the International Rubber Conference, Sri Lanka* 1976.

LIYANAGE, G. W., LIYANAGE, A de S., PERIES, O. S. AND HALANGODA, L. — Studies on the variability and pathogenicity of *Rigidoporus lignosus*. *Paper presented at the Centenary International Rubber Conference Sri Lanka*, 1976.

Institute Publications

General

Annual Review for 1975 (English)
Annual Report of the Rubber Research Board for 1974 (Trilingual) (in press)
RRISL Bulletin vol. 11

Quarterly Journal of the Rubber Research Institute of Sri Lanka vol. 52.
Journal of the Rubber Research Institute of Sri Lanka. vol. 53 (in press).
Rubber Puwath Sinhala Bulletin vol. 7 (in press).
Advisory Circular No. 82 — Manuring of rubber (Sinhala & English)
Advisory Circular No. 83 — Cover crops (Sinhala & English)
Smallholdings Advisory leaflet No. 12 — RSS Manufacture (Sinhala & English).
Smallholdings Advisory leaflet No. 13 — Tapping (Sinhala & English).
Smallholdings Advisory leaflet No. 14 — Soil Conservation (Sinhala & English).
Smallholdings Advisory leaflet No. 15 — White Root Disease (Sinhala & English)
Smallholdings Advisory leaflet No. 16 — Bark Rot and Canker (Sinhala & English).

Papers

AMARAPATHY, A. M. A. Rubber tree that develops the country (in Sinhala) *Lankadipa*, December, 15, 1976.

AMARAPATHY, A. M. A. AND SCOTT, G. Preparation of natural rubber latex with bound antioxidants. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

AMARAWEERA, J. A. Plant diseases and its prevention. (in Sinhala) *Vidya* **10** (3) 21—29, 1976.

AMARAWEERA, J. A. One Hundred Years of *Hevea* in Ceylon (in Sinhala). *Vidya.* **10** (**10**), 1976.

AMARAWEERA, J. A. Natural Rubber Plantation Industry: One Hundred Years (in Sinhala). *Rubber Puwath*, vol. 7 — 1976 (in press).

AMARAWEERA, J. A. *Hevea*: The weeping tree (in Sinhala) *Mithra*, 27th December, 1976.

AMIN, M. U., SCOTT, G. AND TILLEKERATNE, L. M. K. Mechanism of the photoinitiation process in polyethylene. Q. *JL.* Rubb. Res. Inst. Sri Lanka, **52**, 20—28.

BARLOW, C. AND PERIES, O. S. On the generation of biassed Technologies by Rubber Research Stations. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

CHANDRASEKERA, L. B. Recommended *Hevea* clones for planting in Sri Lanka, (in Sinhala). Rubber Puwath, vol. 7, 1976 (in press).

CHANDRASEKERA L. B. A maximum return from rubber cultivation (in Sinhala). *Vidya*, **10** (**10**), 15—20.

CHANDRASEKERA, L. B. The influence of yield stimulation, tapping systems and replanting cycles on production of natural rubber. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

CHANDRASIRI, G. R. The socio-economic aspects of Group Processing of Smallholders' latex in Sri Lanka. *Paper presented to the ANRPC Conference on Progress and Development of Smallholders held in Hat Yai, Thailand,* 1976.

CHANDRASIRI, G. R., CARRAD, B., TEO, C. K. AND WEERASINGHE, S. The specification and estimation of a production function for smallholding rubber in Sri Lanka. *Paper presented at the Centenary International Rubber Conference, Sri Lanka,* 1976.

COOMARASAMY, A. Epoxidation of Rubber Seed Oil. *Paper presented at the 32nd Annual Session of the SLAAS, December 09, 1976.*

COOMARASAMY, A. Raw materials from rubber. *Ceylon Daily Mirror,* 15th December, 1976.

COOMARASAMY, A. AND SILVA, K. Modification of natural rubber. *Paper presented at the Centenary International Rubber Conference, Sri Lanka. 1976.*

DE ALWIS, O. Natural Rubber Industry in Ceylon (in Sinhala). *Rubber Puwath* 7, 1976 (in press).

DE SILVA M. S. C. Manufacture of rubberised coir products using rubber latex. *Karmantha* (Sinhala & English). vol. 3 No. 12, 1976.

DE ZOYSA, R. P. M. Group Processing Centre Scheme (in Sinhala) *Rubber Puwath* 7, 1976. (in press).

DISSANAYAKE, A. B. 'Extension methods'— Our experience at the RRI Sri Lanka. *2nd Seminar on progress and development of rubber smallholders. Hat Yai, Thailand, October 1976.*

DISSANAYAKE, A. B. The competitive position of natural rubber. *Ceylon Daily News,* 15th December, 1976.

DISSANAYAKE, A. B. Guidelines for running GPCC (in Sinhala). *Rubber Puwath* 7, 1976 (in press).

DISSANAYAKE, A. B. Advisory Service: how it should function. *Lankadipa,* 15th December, 1976.

DISSANAYAKE, A. B. Natural Rubber: its development and global outlook (in Sinhala). *Vidya,* **10** (**10**), 1976.

DISSANAYAKE A. B. The origin of natural rubber (in Sinhala). *Rubber Puwath* vol. 7, 1976 (in press).

DISSANAYAKE A. B. The economics of Group Processing Centres. *Vidya Vyapthi-Magazine of SLAAS Popularization of Science* 1976 (in Sinhala).

DISSANAYAKE, A. B. Extension methods — our experience at the Rubber Research Institute of Sri Lanka. *Paper presented to the ANRPC Conference on Progress and development of Smallholders held in Hat Yai, Thailand, 1976.*

DISSANAYAKE, A. B. Problems in the purchasing and collection of Smallholders' rubber for Central Processing in Sri Lanka. *Paper presented to the ANRPC Conference on Progress and Development of Smallholders held in Hat Yai, Thailand, 1976.*

DISSANAYAKE, A. B. Economic evaluation of the profitability of the NR industry in Sri Lanka after the fuel crisis. *Paper presented at the Centenary International Rubber Conference, Sri Lanka. 1976.*

DISSANAYAKE, A. B., ARIYA ABEYSINGHE. Techno-economic co-operation exchange of expertise among Non-aligned countries. *Paper presented at the Special Session of SLAAS on Scientific and Technological co-operation among Non-aligned Countries, 1976.*

DISSANAYAKE A. B. AND CHANDRASIRI, G. R. The Agroeconomic norm and the development of agriculture among Non-aligned countries. *Paper presented at the special session of SLAAS on Scientific and Technological co-operation among Non-aligned countries, 1976.*

FERNANDO, D. M. Research for better crops began early. *Ceylon Daily Mirror.* 15th December, 1976.

FERNANDO, D. M. ASPECTS of *Hevea* breeding and selection in Sri Lanka. *Paper presented at the Centenary International Rubber Conference, Sri Lanka. 1976.*

FERNANDO, M. R. N., SCOTT, G AND STUCKEY, J. E. Reaction of antioxidants with NR using Thiol groups. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

GOONESEKERA, G. A. J. P. R. The effect of weather factors on *Hevea* growth and yield. Paper presented at the *Centenary International Rubber Conference, Sri Lanka. 1976.*

GOONESEKERA, G. A. J. P. R. AND PEIRIS, L. T. An analysis of personnel and finances of the Rubber Research Institute of Sri Lanka from 1964 to 1975, with special reference to research departments. *RRISL Bulletin,* **11**, 4—16.

GUNASEKERA, W. W. How we should develop our smallholdings (in Sinhala). *Rubber Puwath,* **7**, 1976 (in press).

JAYASEKERA, N. E. M. AND JINKS, J. L. Effect of gene dispersion on estimates of components of generation means and variance. *Heredity,* **36**, 31—40.

JAYASEKERA, N. E. M., SAMARANAYAKE P. AND KARUNASEKERA, K. B. Initial studies on the nature of genotype — environment interactions in some *Hevea* cultivars. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

JOHN, C. K., NADARAJAH, M. AND CHAN, B. L. Enzyme deproteinisation of NR latex. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

KASINATHAN, S. Introduction of rubber (in Tamil). *Virakesari*, 16th December 1976.

KARUNARATNE S. W. Pale crepe — A specific grade of NR for specialised applications. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

KARUNARATNE, S. W. AND THARMALINGAM, R. Preparation of powdered natural rubber. *Paper presented at the Centenary International Rubber Conference*, Sri Lanka, 1976.

LIYANAGE, A. de S. Control of white root disease caused by *Rigidoporus* (*Fomes*) *lignosus*, *RRISL Bulletin* **11**, 24 — 29.

LIYANAGE, A. de S. Influence of some factors on the pattern of wintering and their effect on the incidence of *Oidium* in PB 86. *JI. Rubb. Res. Inst. Sri Lanka* **53**, 1976. (in press).

LIYANAGE, A. de S. Control of *Hevea* disease of economic importance. *Ceylon Daily News*, 15th December, 1976.

LIYANAGE, A. de S., FERNANDO, D. M. AND PERIES, O. S. Disease screening programmes for leaf, panel and root diseases in Sri Lanka. *Contribution to the IRRDB Symposium. Cisarua, Indonesia*, November, 1976.

LIYANAGE, A de S., NADARAJAH, M., LIYANAGE G. W. AND DANTANARAYANA, D. M. Investigations on new fungicidal systems for control of Bark Rot in *Hevea brasiliensis*. *Paper presented at the Centenary International Rubber Conference, Sri Lanka. 1976.*

LIYANAGE, G. W., LIYANAGE, A. de. S., PERIES, O. S. AND HALANGODA, L. Studies on the variability and pathogenicity of *Rigidoporus lignosus*. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

MUTHUKUDA, D. S. AND AMARAWEERA, J. A. Rubber Industry: The Foreign Exchange earner — (in Sinhala). *Dinamina*, 16th December, 1976.

NADARAJAH, M. Recent developments in improvements in the manufacture of Sri Lanka crepe and RSS. *Paper presented at the Centenary, International Rubber Conference, Sri Lanka, 1976.*

NADARAJAH, M. Manufacture of crepe rubber. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

NADARAJAH, M. We produce 150,000 tons a year, but use only 7,000. *The Sunday Times*, 12th December, 1976.

NADARAJAH, M. AND FERNANDO, UPALI G. Development of natural rubber latex portland cement mixes for engineering applications. *Paper presented at the SLAAS 32nd Annual Session, December, 1976.*

NADARAJAH, M., THARMALINGAM, R., CHANDRASIRI, G. R., MUTHUKUDA, D. S. AND MENDIS, E. G. Recent developments in improvements in the manufacture of Sri Lanka latex crepe and RSS. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

PERERA, U. L. R. A. Metrolac and Smallholder, (in Sinhala). *Rubber Puwath* 7, 1976 (in press).

PERIES, O. S. Developments — Biological and Technological — achieved by the Rubber Research Institute of Sri Lanka, *Ceylon Daily News*, 15th December, 1976.

PERIES, O. S. S.E. Asia's plantation began with this tree. *The Sunday Times*, 12th December, 1976.

PERIES, O. S. Rubber — how it all began. *Ceylon Daily Mirror*, 15th December 1976.

PERIES, O. S. Realistic view between natural and synthetic rubber (in Sinhala). *Lankadipa*, 15th December, 1976.

SAMARANAYAKE, CHANDRA AND GUNARATNE R. B. Use of ''leaf' and 'scale buds in the vegetative propagation of *Hevea* budgrafting. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

SATCHUTHANANTHAVALE, R. AND WEERASINGHE, C. Ethrel stimulation of *Hevea* under conditions in Sri Lanka. *Paper presented at the Centenary International Rubber Conference, Sri Lanka — 1976.*

SENANAYAKE, Y. D. A., JAYASEKERA, N. E. M. AND SAMARANAYAKE, P. Growth of nursery rootstock seedlings of *Hevea brasiliensis* Muell Arg. *Cv.* Tjir 1—Part Two. *Q. JL. Rubb. Res. Inst. Sri Lanka*, **52**, 29—37.

SILVA, C. G. Fertilization of *Hevea*. *Ceylon Daily News*, 15th December, 1976.

SILVA, C. G. Use of Eppawala apatite for the nutrition of *Hevea. Paper presented for the joint seminar of the SLAAS and Soil Sci. Soc. of Sri Lanka 1976.*

SILVA, C. G., KUMARAKULASURIYAR, S. AND WICKREMASINGHE, L. J. Studies on the phosphorus fixing capacity of the major rubber soils of Sri Lanka. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

THARMALINGAM, R. Crepe Rubber Development Unit. *Ceylon Daily News*, 15th December, 1976.

THARMALINGAM, R., KOELMEYAR, C. AND PONNIAH W. T. Some improvements in Crepe drying. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

TILLAKERATNE, L. M. K. Technical specifications for crepe rubber. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

TILLAKERATNE, L. M. K. Insect infestation of TSR pallets. RRISL *Bulletin* **11**, 1—3.

TILLAKERATNE, L. M. K. A turning point in the Rubber Industry: Block Rubber (in Sinhala). *Rubber Puwath*, 7. 1976. (in press).

TILLEKERATNE, L. M. K. Bright future for Block Rubber. *The Sunday Times*, 12th December, 1976.

TILLEKERATNE, L. M. K., KULARATNE, R. M. AND DE SILVA, M. S. C. Solar energy for making liquid rubber. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

WAIDYANATHA, U. P. de S. AND ARIYARATNE, W. A. Breaking dormancy in seeds of cover legumes. *Jl. Rubb. Res. Inst. Sri Lanka* **53**, *1976* (in press).

WAIDYANATHA, U. P. de S., AND GOONASEKERA, G. A. J. P. R. Some methods for determining leaf areas in *Hevea*. *Q. Jl. Rubb. Res. Inst. Sri Lanka.* **52**, 10—19.

WAIDYANATHA, U. P. de S., KEYS, A. J. AND WITTINGHAM, C. P. Effects of carbon dioxide on metabolism by the glycollate pathway in leaves. *Jl. Exptl. Bot.* **26** (**90**), 15—32 (1975).

WAIDYANATHA, U. P. de S., PATHIRATNE, L. S. S. AND ARIYARATNE, W. A. Nitrogen fixation in *Pueraria phaseoloides* some effects of inoculation and nutrients. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

YAPA, P. A. J. The preparation and properties of low nitrogen constant viscosity rubber. *Q. Jl. Rubb. Res. Inst. Sri Lanka* **52**, 1—9.

YAPA, P. A. J. Some aspects of phenolic discolouration in natural rubber. *Jl. Rubb. Res. Inst. Sri Lanka* **53**, 1976. (in Press).

YAPA, P. A. J. Natural rubber and its versatility. *Ceylon Daily Mirror*, 18th December, 1976.

YAPA, P. A. J. The role of phenolics in discolouration of NR. *Paper presented at the 32nd Annual Session of the SLAAS, 9th December, 1976.*

YAPA, P. A. J. Use of NR latex (in Sinhala). *Vidya* **10** (**10**), 1976.

YAPA, P. A. J. Rubber plantation industry and our economy. *Lankadipa*, 18th December, 1976.

YAPA, P. A. J. Preparation and properties of DPNR and viscosity stabilized DPNR. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

YOGARATNAM, N. Effects of phosphate sprays on mineral composition of fruit storage quality of apple 1. Mineral composition of leaves. *Paper submitted for publication in Jl. Hort. Sci.*

YOGARATNAM, N. The use of organic materials as fertilizer by the plantation sector of Sri Lanka. *Country Report (Sri Lanka) presented at the FAO/SIDA Workshop on Organic materials as fertilisers in Asia, held in Bangkok, Thailand, 26th October — 5th November, 1976.*

YOGARATNAM, N. The present state of use of nitrogenous fertilizer for rubber. *Paper presented for the Annual Symp. of the Soil Sci. Soc. of Sri Lanka, 1976.*

YOGARATNAM, N. AND GREENHAM, D. W. P. Effects of foliar sprays containing nitrogen, magnesium, zinc and boron on fruit set, mineral composititon and fruit quality of apple. *Paper submitted for Jl. Hort. Sci.*

YOGARATNAM, N. AND SHARPLES, R. O. Effects of phosphate sprays on mineral composition of fruit storage quality of apples II. Mineral composition of fruits and storage quality. *Paper submitted for Jl. Hort. Sci.*

YOGARATNAM, N., SULAIMAN, H., KARUNARATNE, A. D. M. AND PERIES, K. S. A. C. Management of covers under *Hevea* in Sri Lanka. *Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.*

Social and Sports Activities.

Cricket :

The RRI took part in the Kalutara District Cricket Tournament, Sri Lanka State Service Cricket Tournament, 'C' Division and a six-a-side Cricket Tournament sponsored by the Institute to commemorate the centenary of the introduction of the rubber plant to Sri Lanka.

The Annual Sports Tournament of the Recreation Club was held as usual.

In social activities the RRIC Club organised a number of Club Nights and an excursion in addition to the year-ending party.

REVIEW OF THE BOTANY DEPARTMENT

By

L. B. Chandrasekera

SUMMARY

Ethrel trials in which stimulation was carried out at two monthly intervals with tapping on the S/2, d/2, 100% system have continued to show a declining yield response with time. In trials which are tapped at 100 per cent intensity with a limited number of stimulations a year, the results have been variable. In one trial tapped on the S/2, d/2, 100% system with two stimulations a year, an average yield increase of around 40 - 50 per cent has been maintained over a five year period. In another trial tapped at the same intensity with three stimulations a year, the yield increases over a three year period has been marginal. The use of 5% *a.i.* Ethrel has been as effective as 10% *a.i.* Ethrel.

Over a six year period, clone PB 86 has responded well to tapping daily on a half spiral cut with the incidence of dry trees remaining within acceptable limits. This is of significance in relation to the smallholders replantings and recovery tappings in estates in the wet zone. From the point of view of yields, there appears to be no benefits from an annual change over of tapping panels after the third year on the S/2, d/2, 100% tapping system, unless the 2S/2, d/4, 100% tapping system is to be introduced later on. Stimulated micro-tapped trees gave higher yields than those tapped on the S/2, d/2, 100% system immediately after stimulation, but this effect decreased with subsequent tappings.

The recommended clones IRCI 2 and 9, PR 252, RRIC 48 and 36 and RRIM 600 continue to maintain high yields in all large scale trials. Clone RRIM 600 has recorded the highest yields in all trials sited in both the wet and dry planting districts. Among clones of the RRIC 100 series, clone RRIC 101 has recorded a yield of over 1000 kg dry rubber per hectare in the first year of tapping. All these clones have given higher average yields than clone PB 86.

All polyclone plantings have continued to maintain yields in excess of monoclone plantings. A large scale trial has yielded over 1000 kg per hectare in the second year of tapping. None of the clones included in this trial have reached this yield level in monoclone plantings; clonal seed of all commercially planted clones in Sri Lanka appear to be suitable for use as rootstocks, both from the point of view of growth as well as yield of the scion clones. Green buddings established in polybags and transplanted in the field with one mature whorl of leaves have shown the lowest percentage establishment and the highest initial growth rate. In seedling nurseries planted at normal spacings, there were no advantages to be gained by periodic thinning of the poorer growers as far as the percentage of plants that reach buddable size is concerned. However, thinning out results in an improvement in the growth of seedlings that remain in the nursery.

The use of rubber rainguards in the wet zone has continued to give enhanced yields by reducing rain interference of tapping.

In tissue culture studies, callus cultures were established from explants of *Hevea* anthers, seedling stem sections and clonal stem sections. The cultures

maintained good callus growth on continuous sub-culturing except for callus established from clonal stem explants which showed a diminished growth rate after the third sub-culture.

In studies on nitrogen fixation in legume covers, none of the innoculant strains of rhizobia improved nitrogen fixation under field conditions. Good nodulation, growth and percentage leaf nitrogen in innoculated legume covers suggest active nitrogen fixation by indigenous rhizobia in local soils.

Interplanting rubber during the immature phase with perennial crops such as bananas, passion fruit, pineapple and forage grasses has not adversely affected the growth of rubber. Where these crops have been adequately manured, there has so far been a distinct improvement in the growth of rubber.

DETAILED REVIEW

Staff

Mr. L. B. Chandrasekera, Head of Botany Department, Dr. R. Satchuthananthavale, Dr. (Mrs.) A. C. I. Samaranayake, and Dr. U. P. de S. Waidyanatha, Botanists, were on duty throughout the year.

The Senior Technical Assistant, Mr. W. G. V. Fernando, Technical Assistants Messrs L. S. S. Pathiratne, J. G. de Mel, T. C. Weerasinghe, Miss C. W. Ranasinghe and Field Assistants, Messrs U. K. D. Lewis, D. A. Brahamana, W. T. Silva, S. Kodikara, R. B. Gunaratne and S. Wilbert were on duty throughout the year.

Mr. M. C. Perera, Senior Field Assistant, Estate Department was transferred to the Botany Department with effect from January 1976.

Messrs D. K. Angammane, W. A. Ariyaratne, L. S. Kariyawasam, I. R. M. Amerakone, L. B. Chandrasena and Miss N. C. Jagoda Arachchi were appointed Technical Assistants during 1976.

Visits

The technical staff of the Botany Department paid advisory visits to estates and routine visits to experimental areas where necessary.

Conferences

The following papers were read at the Centenary International Rubber Conference held in Colombo in December 1976:—

(1) The effects of the replanting cycle, tapping intensity, shortening the immature period and yield stimulation on production of natural rubber — L. B. Chandrasekera.

(2) Ethrel stimulation of *Hevea* under conditions in Sri Lanka — R. Satchuthananthavale.

(3) The use of "leaf" and "scale" buds in the vegetative propagation of *Hevea* by budgrafting — A. C. I. Samaranayake.

(4) Nitrogen fixation in *Pueraria phaseoloides* : Some effects of inoculations and nutrients — U. P. de S. Waidyanatha.

Publications

(1) Annual Review of the Botany Department 1975.

(2) Cover crops — Advisory Circular No. 83.

(3) Recommended *Hevea* clones for planting in Sri Lanka — **L. B. Chandrasekera,** *Rubber Puwath* Vol. 7 1976.

(4) A maximum return from rubber cultivation — L. B. Chandrasekera, *Vidya,* **10 (10),** 15 — 20.

(5) Breaking dormancy in seeds of cover legumes — U. P. de S. Waidyanatha and W. A. Ariyaratne. *Jl. Rubb. Res. Inst. Sri Lanka* **53** (1976.)

YIELD STIMULATION EXPERIMENTS

***Field Experiment** No: 58 — Ethrel stimulation experiment — Malaboda Estate:* (*L. B. Chandrasekera & D. A. Brahamana*)

Ten per cent Ethrel (ready for use formulation) is applied to a 3.8 cm strip of scraped bark below the tapping cut, once in two months, on panel D of clone PB 86, and tapped on the S/2, d/2, 100% system. The average yields recorded per tapping block for the first six years are given in Table I.

TABLE 1

AVERAGE YIELDS OF ETHREL STIMULATED AND CONTROL BLOCKS IN kg DRY RUBBER (INCLUSIVE OF SCRAP)

Year	Treatment	
	Stimulated	Control
1971	12.80	5.67
1972	9.19	4.83
1973	8.46	4.93
1974	5.83	4.30
1975	5.70	5.13
1976	5.90	5.06
No. of applications	6	—
No. trees tapped, 1976	355—311	290—260
Percentage of scrap, 1976	14.2	8.6
B. Bast cases		
Partially dry	24	9
Totally dry	17	15

In this trial, there has been no significant response to Ethrel stimulation after the third year.

Field Experiment No. 63 — Ethrel stimulation experiment — Eladuwa Estate (L. B. Chandrasekera & D. A. Brahamana)

Ten per cent Ethrel applied six times a year on a 3.8 cm strip of scraped bark below the tapping cut and tapped on the S/2, d/2, 100% system is compared with unstimulated control plots of the same tapping intensity in clone PB 86. In 1975 the tapping cuts were changed over to panel E. The average yields recorded per 50-tree plot in the first six years of the experiment are given in Table 2.

TABLE 2

AVERAGE YIELD OF DRY RUBBER (INCLUSIVE OF SCRAP) IN g/TREE/TAPPING OF STIMULATED AND CONTROL PLOTS

Year	Treatment	
	Stimulated	Control
1971	76.6	39.3
1972	57.3	34.8
1973	58.3	32.2
1974	44.7	34.7
1975	53.7	33.0
1976	36.9	28.3
No. applications, 1976	6	—
Scrap percentage, 1976	23.0	13.5
B. Bast cases, percentage		
Partially dry	2.9	—
Totally dry	4.9	3.5

There was a temporary increase in response to stimulation in 1975 after a change over of tapping panels. However, this was not maintained in the second year.

Field Experiment No. 73 — 1972 Ethrel stimulation experiment — Eladuwa Estate (R. Satchuthananthavale & T. C. Weerasinghe)

In this experiment there are 12 treatments with 20 trees per plot randomised within a tapping task and replicated three times. The 12 treatments include six above the cut applications and six below the cut applications. The application below the cut is on a 3.8 cm strip of scraped bark while above cut application is on a 2.5 cm band on the renewing bark. Only two Ethrel applications are made per year, and the yields recorded during the fifth year of the experiment are given in Table 3.

TABLE 3

MEAN YIELDS OF DRY RUBBER FOR THE VARIOUS TREATMENTS IN 1976

Treatments	Mean Yield g/tree/tapp.	Mean Yield as % of S/2, d/2, Control
Above cut application		
1. S/2, d/2, 100% Unstimulated Control	27.63	100
2. ,, + Coconut oil	29.83	107.96
3. ,, + 5% Ethrel 70-90 I	43.57	157.69
4. ,, + 10% ,, ,,	40.63	147.05
5. ,, + 5% Ethrel 70-90 K	40.59	146.91
6. ,, + 10% ,, ,,	42.21	152.77
Below cut application		
7. S/2, d/2, 100% Unstimulated Control	28.53	100
8. ,, + Coconut oil	27.50	96.39
9. ,, + 5% Ethrel 70-90 I	40.42	141.68
10. ,, + 10% ,, ,,	44.47	155.87
11. ,, + 5% Ethrel 70-90 K	37.69	132.11
12. ,, + 10% ,, ,,	35.38	124.01

Over the period of five years of this experiment, no marked depression in yield response to Ethrel stimulation was noted, which appears to be due to the limited number of Ethrel applications per year. As far as concentration is concerned, 5% a.i. Ethrel appears to be equally effective as 10% *a.i.* Ethrel. At 5% *a.i.* concentration, one can of Ethrel readymix (10% *a.i.*) could be used to treat approximately 600 half spiral cuts.

Field Experiment No. 80 — Ethrel stimulation experiment — Talgaswela Estate
(L. B. Chandrasekera & D. A. Brahamana)

This experiment, initiated in March 1974, compares three treatments applied to panel C of clone PB 86. The yield data recorded during the third year of the experiment are given in Table 4.

TABLE 4

YIELD OF DRY RUBBER IN kg FOR THE VARIOUS TREATMENTS IN 1976

	Tapped S/2,d/3,67% stimulated once in 2 months	Tapped S/2,d/2,100% stimulated once in 4 months	Tapped S/2,d/2, 100% Control
No. of Ethrel applications	6	3	—
Total yield (3 tapping tasks) 1976	2,616	2,438	2,339
Average yield in kg/tapping block per day	7.53	6.12	5.31

Field Experiment No. 93 — Ethrel stimulation experiment — Eladuwa Estate (R. Satchuthananthavale & C. Weerasinghe)

This experiment, started in 1976, compares 2% and 5% *a.i.* Ethrel applications below the tapping cut under S/2, d/2, 100% tapping system on clone PB 86. Test tapping results during the first year are summarised in Table 5.

TABLE 5

MEAN YIELD OF DRY RUBBER FOR 1976

	Mean yield g/tree/tapp.	Mean yield as % of Control
1. S/2, d/2,100% — Unstimulated control	25.10	100
2. ,, — 2% Ethrel 70-90 I	33.00	131.47
3. ,, — 5% Ethrel 70-90 I	40.07	159.64

Ethrel applications were limited to twice a year.

TAPPING EXPERIMENTS

Field Experiment No. 53 — Tapping Experiment — Dartonfield (U. P. de S. Waidyanatha & C. W. Ranasinghe)

Six tapping systems are compared on four clones on a randomised block design with 5 tree plots. The clones RRIC 7, 45 and 52 are replicated eight times and PB 86 six times. Tapping of all clones commenced in March 1968 on the S/2, d/2, 100% system. The present tapping treatments were introduced in 1971. The yield and brown bast data for 1976 are given in Table 6.

TABLE 6

MEAN YIELD (g/T/T) AND % BROWN BAST (BB) TREES

Tapping system	RRIC 7			RRIC 45			RRIC 52			PB 86		
	Mean Yield	Mean Yield	% BB	Mean Yield	Mean Yield	% BB	Mean Yield	Mean Yield	% BB	Mean Yield	Mean Yield	% BB
	'71 — '76	1976		'71 — '76	1976		'71 — '76	1976		'71 — '76	1976	
S/2, d/2, 100%	25·5	31·2	7·0	24·3	32·7	15·0	27·9	32·8	NIL	29·9	36·9	6·7
S/2, d/1, 200%	16·5	18·6	17·0	20·9	29·7	22·5	21·3	24·3	2·5	27·3	35·5	10·0
S/1, d/4, 100%	33·1	33·2	12·5	40·2	36·6	20·0	41·3	42·3	7·5	52·1	45·5	13·3
S/1, d/3, 133%	29·7	28·3	15·0	39·1	49·6	25·0	41·1	43·1	17·5	53·9	58·5	13·3
2S/2, d/4, 100%	41·8	41·7	2·5	43·5	46·7	7·5	44·3	39·2	12·5	69·8	66·0	6·7
2S/2, d/3, 133%	33·2	36·7	15·0	41·6	36·4	7·5	46·2	41·3	12·5	57·2	57·0	NIL

While there had been a progressive increase in yields over the years for the alternate daily half spiral tapping system, this increase is not so consistently evident for the other tapping treatments. As is to be expected, there is a noticeable difference in clonal response to various tapping treatments. Clone PB 86 has responded well to daily tapping with the incidence of dry trees remaining within acceptable limits.

Field Experiment No. 59 — Tapping experiment — Vogan Group (R. Satchuthananthavale & G. de Mel)

Comparisons are made of two tapping systems S/2, d/2, 100% and 2S/2, d/4,100% and two tapping knives — Michie - Golledge and Jebong knife — on clone RRIC 52. The data recorded for 1976 are summarised in Tables 7 and 8.

TABLE 7

MEAN YIELD OF DRY RUBBER IN g/TREE/TAPPING AND MEAN THICKNESS OF BARK SHAVINGS IN mm.

Tapping knife	Year	Yield g/tree/tapp. S/2,d/2	Yield g/tree/tapp. 2S/2,d/4	Mean thickness of bark shavings in mm
MG	1971	10.86	58.42	1.6
J		17.04	61.90	1.5
MG	1972	13.90	43.80	2.0
J		13.70	47.10	2.0
MG	1973	19.48	59.63	2.6
J		19.02	63.30	2.0
MG	1974	30.40	83.80	2.3
J		30.90	88.30	2.4
MG	1975	37.38	78.59	2.1
J		35.70	84.68	2.3
MG	1976	24.79	57.71	2.4
J		24.45	71.55	2.4

TABLE 8

MEAN GIRTH INCREMENTS

Year	S/2,d/2	2S/2,d/4
1971/72	3.5	2.5
1972/73	4.9	3.1
1973/74	3.8	3.4
1974/75	2.6	2.5
1975/76	3.2	3.9

Clone RRIC 52 has shown a better yield response to tapping on the double cut fourth daily system than on the alternate daily half spiral system.

Field Experiment No. 74 — Tapping experiment — Nivitigalakele (*U. P. de S. Waidyanatha & S. Wilbert*)

The treatments in this experiment are applied to 50-tree plots replicated four times in a randomised block design. The mean yield for the various treatments are given in Table 9.

TABLE 9

THE EFFECT OF PANEL CHANGE ON GIRTH AND BROWN BAST INCIDENCE

	Annual panel change after 3rd year of tapping S/2, d/2, 100%	Tapping one panel down to graft union before change over S/2, d/2, 100%	S/2, d/1, 200%
Yield (g/t/t)	37.1	40.3	26.5
Annual girth increment (cm)	2.55	2.98	2.10
% Brown Bast	6.0	6.0	16.0

There appears to be no benefit from annual change over of tapping panels. Daily tapping has depressed the yield per tapping and increased dryness in trees.

Field Experiment No. 85 — Tapping experiment — Nivitigalakele (*U. P. de S. Waidyanatha & S. Wilbert*)

Clones planted in this trial are still immature. The girth data of the clones planted for the year 1976 are given in Table 10.

TABLE 10

Clone	1976 Girth (cm)	Annual girth increment (cm)
RRIC 101	55.1	6.5
RRIC 45	42.7	4.1
RRIC 100	53.0	6.4
IRCI 2	38.6	3.8
AVROS 1734	43.3	2.8
WR 101	40.6	4.5
PR 252	45.7	4.0
RRIC 13	35.3	4.6

The girths of clones RRIC 100 and 101 in this trial confirm the high growth vigour of these two clones.

Field Experiment No. 94 — Tapping experiment — Nivitigalakele (U. P. de S. Waidyanatha & S. Wilbert)

Five tapping treatments are introduced to 5-tree plots of clone RRIC 45 and replicated seven times. The yields and girth increments for the period July 1975 to November 1976 are summarised in Table 11.

TABLE 11

YIELD AND GIRTH INCREMENTS FOR THE VARIOUS TAPPING SYSTEMS

Treatments	Yield of dry rubber (g/tree/tapp.)	Girth increments (cm)
S/2,d/2,100%	34.6	2.25
S/2,d/1,200%	38.3	2.54
S/2,d/2 (2 X 2d/4) 100%	32.8	2.00
S/2,d/1 (2 X 2d/2) 200%	27.9	1.96
2S/2,d/2,200%	52.9	1.89

Daily tapping (200% intensity) of the same panel so far appears to be better than tapping, at the same intensity, alternate panels by alternating each day the panel tapped or tapping both panels together alternate daily.

Field Experiment No. 95—Tapping experiment — Nivitigalakele (U. P. de S. Waidyanatha & S. Wilbert)

The treatments are applied to 5 tree plots of clone PB 86 planted in 1963. Each treatment is replicated five times. Experimental tapping commenced in August 1975 and the results recorded up to the end of November 1976 are given in Table 12.

TABLE 12

YIELDS AND GIRTH INCREMENTS FROM AUGUST 1975 TO NOVEMBER 1976

Treatments	Yield of dry rubber g/t/t	Girth increment (cm)	Total no. of tapping days	No. of recovery tapping days for the period
S/2, d/2, 100%	26.9	2.54	182	—
S/2, d/1, 200%	19.5	2.29	364	—
S/2, 2d/3, 150%	24.7	2.33	273	—
S/2, d/2, 100% — Recovery of lost tapping days by daily tapping in good weather	29.0	2.65	235	53
S/2, d/2, 100% — Maximum of six recovery tappings per month only	24.8	2.81	235	53

Daily tapping has decreased intake per tapping. There has still been no inimical effects due to recovery tapping as done in this experiment.

Field Experiment No. 96 — Tapping experiment — Eladuwa Estate (U. P. de S. Waidyanatha & M. C. Perera)

In this experiment, six tapping treatments are applied to 12-tree plots of clone RRIC 52. Each treatment is replicated five times. The high level cuts H_1 and H_2 were introduced at 53 cm and 106 cm above the existing half spiral cuts on low panels which at the time of opening high level cuts were at a height of approximately 76 cm above the graft union. All cuts were tapped downwards. The data recorded in this experiment are given in Table 13.

TABLE 13

MEAN YIELD (G/TREE/T) FROM 11/5/76 TO 17/9/76

Treatments	Panel L	Panel H_1 or H_2	Total (for 2 consecutive days)
S/2, d/2, 100% (Panel L)	17.6	—	17.6
S/2, d/1, 200% (Panel L)	14.0(x2)	—	28.0
S/2, d/1, (2 x 2d/2) 200% (Panel L or H_1)	19.3	10.7	30.0
S/2, d/1, (2 x 2d/2) 200% (Panel L or H_2)	21.0	9.7	30.7
2S/2, d/2, 200% (Panel L + H_1)	19.5	10.6	30.1
2S/2, d/2, 200% (Panel L + H_2)	19.6	9.9	29.5

L — Normal (lower) panel.
H_1 — 2nd panel 53 cm above L.
H_2 — 2nd panel 106 cm above L.

The yields recorded so far appear to suggest that tapping two panels at 200% intensity gives a better response than tapping the same panel at 200% intensity.

Field Experiment No. 97 — Tapping experiment — Dartonfield (U. P. de S. Waidyanatha & C. Angammana)

When this experiment was initiated, the trees of clone PB 86, which were planted in 1961, were in the 10th year of tapping (Panel B) on the S/2, d/2, 100% system. The following treatments were applied to single tree plots replicated ten times.

(1) S/2, d/2, 100%. (Normal tapping — NT)

(2) Tapping a vertical cut equal in length to the mean length of the half spiral cuts, alternate daily. The lower end of this cut is at a height of approximately 114 cm above the graft union (VT).

(3) Micro-tapping a vertical band 1 cm broad and equal in length to one half spiral cut and at the same height as the vertical cut. The micro-tapping was done with six 0.9 mm needle pricks (MT).

(4) Same as MT, but the vertical band stimulated with 1.0 g of 10% Ethrel (MTE).

The data recorded for this trial are given in Table 14.

TABLE 14

YIELD AND SUCROSE CONTENT IN LATEX

	Mean for 11 tappings		2nd tapping after stimulation	
	Total solids g / t / t	Sucrose mg/ml latex	Total solids g / t / t	Sucrose mg/ml latex
NT	58.9	3.48	48.0	3.20
VT	23.9	5.64	16.1	5.17
MTE*	39.4	6.16	65.7	5.52
MT	2.6	5.02	3.7	5.01

* Stimulated 1 day before the 1st tapping.

Stimulated micro-tapped trees gave higher yields than half spiral tapping soon after stimulation but this effect dwindled with subsequent tappings. It is significant that micro-tapped and vertically tapped trees maintained higher sucrose levels in the latex than normally tapped trees. This suggests that even the half spiral cut can impede the passage of photosynthates to the tapping panel appreciably. The physiological implications of this in relation to productivity and incidence of dryness need investigation.

CLONE EVALUATION TRIALS

Field Experiment No. 16 — 1956 clone trial — Hedigalla (*L. B. Chandrasekera & S. Wilbert*)

All clones are planted in monoclonal blocks of 300 trees per clone. Tapping commenced in 1963 and the average yields recorded for the best selections are given in Table 15.

TABLE 15

YIELD OF DRY RUBBER PER TREE PER YEAR FOR 140 TAPPINGS
(TAPPED ON S/2, d/2, 100% FROM 1963)

Year	CLONE			
	IRCI 9 kg	PR 252 kg	RRIC 48* kg	PB 86 kg
1966	5.44	4.63	5.58	3.95
1967	5.13	4.81	5.81	4.13
1968	5.44	4.54	4.90	3.63
1969	4.72	3.90	5.17	3.76
1970	6.44	6.53	5.50	5.08
1971	5.90	6.94	4.85	5.81
1972	5.40	5.44	3.76	5.03
1973	6.12	4.72	5.72	4.54
1974	6.62	6.08	5.08	4.67
1975	4.72	4.13	5.49	4.76
1976	4.45	4.17	5.62	4.22
No.trees tapped,1976	198—201	203—205	111—119	211—216
Average girth, cm	79.5	72.2	69.6	80.8
B. Bast cases 1976	2	2	4	3
W. Damage E 1976	1	—	2	2

*Tapped in 1964

All the four clones are now recommended for commercial planting.

Field Experiment No. 19 — 1962 clone trial — Nivitigalakele (L. B. Chandrasekera & W. T. Silva)

All clones are planted at 150 trees per clone. The yields of the selections that have yielded better than clone PB 86 are given in Table 16.

TABLE 16

YIELD OF DRY RUBBER PER TREE PER YEAR (140 TAPPINGS)
(TAPPED S/2, d/2, 100%)

Year	Clone RRIC 5 (Yield in kg)			
	RRIC 93		RRIC 39	PB 86
1969	4.72	3.54	3.95	4.17
1970	3.95	4.40	3.95	3.81
1971	5.58	5.53	4.67	3.72
1972	5.76	5.72	5.17	3.99
1973	6.67	7.85	7.21	4.81
1974	8.16	8.94	7.76	6.21
1975	7.62	6.58	5.49	5.22
1976	5.82	5.61	5.42	5.24
No. trees tapped, 1976	85—80	88—87	99—102	116—114
B. Bast cases ,,	4	—	—	—
W. damage cases ,,	1	1	—	2
Average girth '76 in cm	65.5	75.3	71.4	73.4

Field Experiment No. 23 — 1965 clone trial — Dartonfield (L. B. Chandrasekera & N. L. D. Ruban)

All clones are planted in 50-tree plots replicated three times. Test tapping results for the first four years are given in Table 17.

TABLE 17

YIELD IN GRAMMES DRY RUBBER PER TREE PER TAPPING
(TAPPED S/2, d/2, 100% FROM JUNE, 1973)

Clone	Trees tapped 1976	Girth 1976 cm	Yield g/tree/tapping			
			1973	1974	1975	1976
RRIM 600	129—125	68.5	43.5	42.5	35.7	41.0
RRIC 90	123—114	62.3	43.1	38.7	24.8	27.0
RRIC 91	101—89	78.7	27.4	27.4	21.8	24.4
RRIC 45	120—118	66.2	31.7	30.3	22.0	23.9
RRIC 88	122—118	73.4	21.6	23.5	23.3	23.6
RRIC 89	118—122	65.3	34.0	34.9	21.6	20.9

Clone RRIM 600 continues to be the best yielder in this trial.

Field Experiment No. 25 — 1957 clone trial — Estate A — Kalutara District (L. B. Chandrasekera & S. Wilbert)

Out of a large number of foreign clones planted in this trial, clone IRCI 2 has consistently been yielding better than the control clone PB 86. Tapping commenced in March 1965 and the yields recorded for clone IRCI 2 are compared with clone PB 86 in Table 18.

TABLE 18

YIELD OF DRY RUBBER PER TREE PER YEAR (140 TAPPINGS) OF CLONE IRCI 2 COMPARED WITH CLONE PB 86 (TAPPED S/2, d/2, 100% FROM MARCH, 1964)

Clone	Girth 1976 cm	Yield in kg						
		1970	1971	1972	1973	1974	1975	1976
IRCI 2	74.7	6.67	8.04	6.53	6.38	7.26	5.76	5.22
PB 86	72.2	3.72	4.99	4.85	4.85	5.58	4.45	4.22

Field Experiment No. 27 — 1958 clone trial — Estate B — Kalutara District (L. B. Chandrasekera & S. Wilbert)

Clones in this trial are planted at 300 trees per clone. The test tapping results of the best two selections are compared with clone PB 86 in Table 19.

TABLE 19

YIELD OF DRY RUBBER PER TREE PER YEAR (140 TAPPINGS) OF THE BEST YIELDING CLONES (TAPPED S/2, d/2, 100% FROM APRIL, 1965)

Clone	Girth 1976 cm	Yield in kg					
		1971	1972	1973	1974	1975	1976
RRIC 36	87.1	5.72	5.90	5.13	5.13	5.58	5.63
IRCI 2	67.5	6.04	5.35	5.94	4.26	4.76	4.24
PB 86	74.8	4.36	4.90	4.99	4.90	4.22	4.40

Field Experiment No. 41 — 1966 yield trial — Yatawatta Estate, Matale (L. B. Chandrasekera & N. L. D. Ruban)

Four clones RRIC 36, 41, 86 and PB 86 are planted in 265 tree plots replicated three times. Tapping commenced in 1973 of all trees that had reached a girth of over 45 cm. The trees were tapped for the first three years on the S/2, d/3, 67% system. The tapping system was changed to S/2, d/2, 100% in 1976. The average yields recorded are given in Table 20.

TABLE 20

YIELD IN GRAMMES DRY RUBBER PER TREE PER TAPPING
(TAPPED S/2, d/3, 67% FROM MARCH, 1973 S/2, d/2, 100% FROM, 1976)

Clone	Trees tapped 1976	Girth 1976 cm	YIELD 1973	1974	1975	1976
RRIC 36	632 — 696	58·2	27·3	28·8	29·3	26·9
RRIC 41	678 — 704	59·9	15·7	17·5	18·0	19·0
RRIC 86	552 — 607	55·4	14·1	16·5	18·3	15·7
PB 86	565 — 622	59·5	17·4	20·6	21·5	20·8

Clone RRIC 36 remains the best yielder in this trial.

Field Experiment No. 44 — 1967 yield trial — Udapolla Group, Polgahawela (L. B. Chandrasekera & N. L. D. Ruban)

All clones are planted in 135 tree plots replicated three times. The yields recorded for the first four years in tapping are given in Table 21.

TABLE 21

YIELD IN GRAMMES DRY RUBBER/TREE/TAPPING
(TAPPED S/2, d/2, 100% FROM AUGUST, 1973)

Clone	Trees tapped 1976	YIELD 1973	1974	1975	1976
RRIM 600	311 — 314	31·5	31·3	38·0	39·3
RRIC 36	330 — 333	31·3	30·6	34·1	34·7
RRIC 45	293 — 309	21·4	24·8	31·8	31·9
RRIC 89	318 — 335	28·2	25·4	30·2	27·3

Field Experiment No. 48 — 1969 yield trial — Salawa Estate, Hanwella (L. B. Chandrasekera & W. T. Silva)

In this trial, the four clones RRIC 45, 100, and 101 and AVROS 1734 are planted in 135-tree plots replicated 3 times. They were first tapped in April 1976 when the trees had reached a girth of 50 cm. Test tapping results for the first eight months are given in Table 22.

TABLE 22

YIELD IN GRAMMES DRY RUBBER PER TREE PER TAPPING
(TAPPED S/2, d/2, 100% FROM APRIL, 1976)

	CLONE			
	RRIC 100	RRIC 101	RRIC 45	AVROS 1734
Trees tapped in 1976	272	294—292	218	195—194
Yield	25.4	45.3	24.0	28.9
Girth — 1976 cm	49.3	51.9	49.6	48.6

In this trial, the first year yields of clone RRIC 101 have been outstanding.

SPACING TRIALS

Field Experiment No. 24 — Spacing trial — Kuruwita (*L. B. Chandrasekera & J. D. Karunatilleke*)

Each of the three clones RRIC 41, 45 and 52 are planted in 150-tree plots at spacings of 2.4 m x 9 m and 3.6 m x 6.0 m and replicated three times. Tapping commenced in 1971. The average yields and girths of clones in 1976 are given in Table 23.

TABLE 23

YIELD IN GRAMMES DRY RUBBER PER TREE PER TAPPING IN 1976
(TAPPED S/2, d/2, 100%)

Clone	Planting spacing 8′ x 30′		Planting spacing 12′ x 20′	
	Girth 1975 cm	Yield 1975 g	Girth 1975 cm	Yield 1975 g
RRIC 45	57·2	42·7	57·6	37·1
RRIC 41	63·8	39·3	64·4	39·1
RRIC 52	71·5	36·1	72·2	34·5
Mean	64·2	39·4	64·7	36·9

At the end of the 6th year of tapping there have been no significant difference in the growth or yield of trees planted at the two spacings.

Field Experiment No. 83 — 1966 small scale polyclone trial — Dartonfield (L. B. Chandrasekera & D. M. Wickremasinghe)

Twenty five local and foreign clones are planted in this small scale trial as unreplicated single tree plots. Tapping commenced in 1973. Test tapping results from the second year onwards are summarised in Table 24.

TABLE 24

SMALL SCALE POLYCLONE TRIAL
(TAPPED S/2, d/2, 100%)

	Year of tapping		
	1974	1975	1976
Average yield (g/tree/tapping)	41·3	52·7	59·9
Average theoretical yield/ tapping task in kg (250 trees)	7·9	13·2	15·0
Average theoretical yield in kg/ha (140 tappings/year)	1422	2730	3100
Average girth of trees (cm)	75·1	81·1	82·8

Field Experiment No. 84 — 1967 polyclone trial — Hedigalla (L. B. Chandrasekera & S. Wilbert)

Clones RRIC 41, 45, 86, 88 and 89 are planted as single tree plots replicated 90 times. Test tapping and girth data for the first two years of tapping are given in Table 25.

TABLE 25

1967 POLYCLONE TRIAL, HEDIGALLA
(TAPPED S/2, d/2, 100% FOR 1975)

	Year of tapping	
	1975	1976
Average yield (g/tree/tapping)	24·6	25·1
Average theoretical yield/tapping (task in kg (250 trees)	6·15	6·28
Average theoretical yield in kg/ha (140 tappings/year)	851	1037
Average girth of trees in cm	55·7	57·0

Field Experiment No. 86 — 1975 polyclone trial — Yatawatta Estate, Matale
(L. B. Chandrasekera & N. L. D. Ruban)

The clones planted were RRIC 13, 36, IRCI 2, RRIM 600 and PB 86. Randomly distributed monoclonal blocks of each of the clones serve as the controls and each treatment is replicated three times.

IMMATURE AREAS

A summary of the immature experimental areas is given in Table 26.

TABLE 26

Field Expt.	Year planted	Extent ha	Clone	Points per clone	Average girth in cm 1973	1974	1975	1976
48	1969	4·05	RRIC 45	135 × 3 = 405	31·8	44·8	48·2	49·6
			RRIC 100	,,	29·2	39·3	48·1	49·3
			RRIC 101	,,	33·2	45·0	51·8	51·9
			AVROS 1734	,,	30·5	39·7	47·0	48·6
49	1969	10·93	RRIC 91	165 × 3 = 495	35·6	42·9	54·6	64·1
			RRIC 101	,,	34·0	43·4	53·3	63·0
			RRIC 100	,,	28·2	37·6	52·1	64·1
			RRIC 89	,,	33·9	40·9	51·1	58·7
			RRIC 88	,,	28·4	36·6	48·8	59·0
			RRIM 600	,,	33·5	40·6	47·5	54·5
			RRIC 45	,,	32·1	40·6	46·4	53·6
			PB 86	,,	30·4	38·1	44·7	51·9
			RRIC 90	,,	27·3	35·1	40·9	47·7
64	1971	14·16	RRIC 13	300 × 3 = 900	—	18·0	25·4	32·1
			RRIC 45	,,	—	20·3	28·1	34·5
			RRIC 48	,,	—	18·8	26·3	33·2
			RRIC 50	,,	—	17·1	23·7	29·7
			PR 252	,,	—	20·3	29·3	35·2
			IRCI 2	,,	—	17·8	25·5	31·8
			AVROS 1734	,,	—	17·8	27·7	33·3
69	1970	4·05	RRIC 100	150 × 3 = 450	29·0	43·4	52·6	54·2
			RRIC 101	,,	29·0	41·7	49·8	52·1
			AVROS 1734	,,	27·4	39·6	44·7	45·4
			RRIC 45	,,	25·4	36·9	42·4	43·7
77	1972	4·05	RRIC 102	150 × 3 = 450	—	—	—	26·3
			RRIC 103	,,	—	—	—	24·6
			IRCI 9	,,	—	—	—	20·1
			PB 86	,,	—	—	—	19·0

STOCK EXPERIMENTS

Three trials were laid down in order to evaluate the suitability of seed of the popularly planted clones in Sri Lanka for use as rootstocks. The results to date indicate that most of these seeds are even superior to the selfed Tjir 1 seed.

Field Experiment No. 34 — 1966 small scale stock experiment (A. C. I. Samaranayake & W. T. Silva)

The clone PB 86 is grafted on to seedling stocks of 7 clonal families and *Hevea spruceana*. The mean girths of trees at 10½ years age and the yield in their fifth year of tapping are given in Table 27.

TABLE 27

MEAN GIRTH AND YIELD OF CLONE PB 86 ON DIFFERENT CLONAL ROOTSTOCKS

Rootstock	No. of trees	Mean girth cm	Mean yield g/tree/tapping
Tjir 1	8	67·4	30·4
RRIC 7	4	75·6	35·1
,, 88	5	71·1	45·5
,, 89	15	67·6	37·0
,, 86	9	72·1	40·9
,, 52	15	69·1	35·5
,, 41	11	69·9	35·1
H.spruceana	4	57·5	19·4

The growth rate and yield of clone PB 86 on all rootstocks, except on *H. spruceana*, have been satisfactory.

Field Experiment No. 47 — 1968 small scale stock experiment — Nivitigalakele (A. C. I. Samaranayake & W. T. Silva)

In this trial, clone RRIC 45 is budgrafted on rootstocks of 7 clonal families. The mean girth of trees at 8½ years of age and the mean yield in the second year of tapping are summarised in Table 28.

TABLE 28

MEAN GIRTH AND YIELD OF CLONE RRIC 45 ON DIFFERENT CLONAL ROOTSTOCKS

Rootstocks	No. of trees	Mean girth cm	Mean yield g/tree/tapp.
RRIC 7	10	51·9	24·0
,, 41	9	53·9	24·4
,, 52	9	56·5	26·0
,, 86	8	56·2	25·1
Tjir 1	6	51·7	26·9
Gl 1	17	54·2	24·9
Wagga 6278	11	48·9	25·1

The growth and yield of clone RRIC 45 on all rootstocks tested have been satisfactory.

Field Experiment No. 61 — 1969 stock experiment — Nivitigalakele (A. C. I. Samaranayake & W. T. Silva)

Clone RRIC 45 is budgrafted on rootstocks of six clonal families. The trees were first tapped in May 1976. The average yields for 1976 and the girth of trees at 7½ years of age are given in Table 29.

TABLE 29

MEAN GIRTH OF CLONE RRIC 45 ON DIFFERENT TYPES OF CLONAL ROOTSTOCKS

Rootstock	Mean girth cm	Mean yield g/tree/tapping
RRIC 5	51·2	21·5
,, 41	52·6	21·4
,, 52	52·4	21·2
,, 89	47·8	20·3
RRIM 623	50·6	21·8
Tjir 1	46·9	19·2

Growth and yield of clone RRIC 45 on the rootstocks tested have been better than on rootstocks of clone Tjir 1.

Field Experiment No. 88 — 1975 stock experiment — St. George Group, Matugama: (A. C. I. Samaranayake & R. B. Gunaratne)

The purpose of this experiment is to evaluate differential effects, if any, of the type of clonal rootstock on growth and yield of four clones. Each of the four clones PB 86, RRIC 45, RRIC 103, and Wagga 6278 is grafted onto its own seedlings as well as those of the other clones forming a combination of 16 treatments. Each treatment is replicated 4 times in a randomised block design. The girth measurements of the various clones at 1½ years of age are summarised in Table 30.

TABLE 30

MEAN GIRTH OF CLONES ON DIFFERENT CLONAL ROOTSTOCK (cm)

Scion	ROOTSTOCKS				Scion mean
	PB 86	RRIC 45	RRIC 103	Wagga 6278	
PB 86	10·56	10·60	10·07	10·07	10·32
RRIC 45	10·63	10·36	9·86	9·71	10·14
RRIC 103	10·94	11·67	10·85	11·38	11·21
Wagga 6278	9·77	9·74	10·05	9·10	9·66
Stock means	10·47	10·59	10·21	10·06	

The most widely planted clone PB 86 appears to show uniform growth on all the seedling stocks under test.

Field Experiment No. 78 — Intercropping trial — Yatawatta Estate, Matale (L. B. Chandrasekera & N. L. D. Ruban)

In this trial bananas were interplanted with rubber. Clone RRIC 45 is planted at spacings of 2·4 m x 9 m. A single row of bananas were planted centrally between each pair of rubber rows, spaced 3·6 m along the row. Three plots of 250 trees each (one tapper's task) serve as the controls. At the end of three years the average girth of rubber trees is given below.

AVERAGE GIRTH OF RUBBER
AT 3 YEARS OF AGE

Area interplanted with bananas	—	13·3 cm
Control (rubber only)	—	12·1 cm

There is generally an improvement in growth of rubber in the area interplanted with bananas. One variety of bananas (kolikuttu) failed to grow satisfactorily in this trial, probably due to an adverse effect of the limestone soils of the Matale District.

Field Experiment No. 79 — 1973 Intercropping trial-Yatawatta Estate, Matale : (L. B. Chandrasekera & N. L. D. Ruban)

This trial investigates the possibility of establishing Cacao under mature rubber in the dry districts. The clone PB 86 is planted at spacings of 2·4 m x 9 m. A single row of Cacao seedlings is planted between each pair of rubber rows spaced 2 m along the row. Cacao was first established in polybags before transplanting in the field. The Cacao was fertilized at regular intervals. The establishment and growth of Cacao has been very satisfactory. A further 20 acres of mature rubber planted at spacings of 2·4 m x 9 m were under planted in December 1976.

Field Experiment No. 87 — 1975 Intercropping trial — Hatbawe Group (L. B. Chandrasekera & U. K. D. Lewis)

In a 10 acre block, approximately 5 acres are interplanted with coffee seedlings in the form of 3 plots containing 300 rubber trees per plot distributed at random in the field. Three plots without coffee serve as the controls. Owing to the steep terrain, only a single row of coffee could be planted between each pair of rubber rows, spaced 1·2 m along the row. The growth of coffee so far has been very satisfactory.

Field Experiment No. 90 — Establishment of forage grasses and legumes in rubber : (U. P. de S. Waidyanatha & S. Wijesinghe)

The experimental design and details of this experiment appeared in the Annual Review for 1975.

All grasses were cut back in mid-March 1976 and growth assessments were made from the following cut from early May onwards. *Panicum* was cut back at mid bloom (every 5 — 6 weeks) and the *Brachiaria* when growth was adjudged as sufficient for harvesting (8 — 10 weeks). There were in all 7 cuts of *Panicum*, 4 cuts of *Brachiaria* and 5 cuts of *Pueraria* (from the *Panicum* + *Pueraria* plots). *Pueraria* was cut lightly at the same height as *Panicum* (6″ above ground level). Growth of *Centrosema* was very poor and there was none at all in some plots. The remaining *Centrosema* was removed from plots and the "Grass + "Centrosema" treatment was amended as grass planted in rows 1·2 m apart or 0·6 x 1·2 m. A summary of the forage dry matter and the mean girth of *Hevea* trees is given in Table 31.

TABLE 31

FORAGE DRY MATTER AND MEAN TREE DIAMETER

	Forage dry matter (kg/ha) May to December '76		Mean tree diameter (cm)	
	20 kg N/ha	80 kg N/ha	20 kg N/ha	80 kg N/ha
1. Pm planted 0·6 x 0·6 m	11011	11920	3·03	2·70
2. Pm planted 0·6 x 1·2 m	12503	13838	2·97	3·17
3. Pm planted 0·6 x 1·2 m + Pu in inter rows	12505 (Pm) 1439 (Pu)	12727 (Pm) 1362 (Pu)	2·80	2·93
4. Bb planted in rows 1·2cm apart	7287	7481	2·67	2·53
5. Bb planted in rows 1·2 m apart	10473	11058	2·83	2·80
6. Bb planted in rows 1·2 m apart + Pu in inter rows	9424 (Bb)	9354 (Bb)	3·07	2·83
7. Bm planted in rows 0·6 m apart	5905	9193	3·03	2·83
8. Bm planted in rows 1·2 m apart	7330	7898	2·91	2·93
9. Bm planted in rows 1·2 m apart + Pu in inter rows	7278 (Bm)	7357 (Bm)	3·10	2·90
10. *Pueraria* unfertilized and not cut back	—	—	3·20	
11. Naturals unfertilized and not cut back	—	—	3·40	

Pm — *Panicum maximum*
Bb — *Brachiaria brizantha*
Bm — *Brachiaria miliformis*
Pu — *Pueraria phaseoloides*

Field Experiment No. 91 — Varietal experiment with forage grasses—Eladuwa Estate : (U. P. de S. Waidyanatha & S. Wijesinghe)

The experimental design and treatment details are given in the Annual Review for 1975. All grasses were initially cut back in March 1975. The dry matter yields were recorded from the second cut onwards from May 1975. A summary of the dry matter yields recorded are given in Table 32.

TABLE 32

YIELDS OF DRY MATTER

Grass	Dry matter yield (kg/ha) May - November 1976	
	20 kg N/ha	100 kg N/ha
B. miliformis	3925	3397
B. ruzizensis	5235	6119
B. mutica	2799	3220
B. brizantha cv Tenganaika	4851	5618
Pennisetum purpureum cv NB 21	5775	5098
Setaria anceps cv Kazungula	7800	7464
Paspalum plicatulum	6903	6231
Panicum maximum (Guinea B)	4468	5190
Panicum maximum (Guinea A)	5586	7293
Panicum maximum cv Green panic	2948	3200

Field Experiment No 99 — Intercropping trial, Smallholdings (L. B. Chandrasekera & U. K. D. Lewis)

In an extent of 1.2 ha planted with rubber at spacings of 2 x 8·2 m 0·6 ha interplanted with bananas and 0·4 ha were interplanted with pineapple in November 1976. This planting serves mainly as a demonstration plot for smallholders in the area.

Field Experiment No. 98 — Passion fruit trial — Dewalakande Estate (L. B. Chandrasekera & U. K. D. Lewis)

Approximately 1 acre of rubber planted at spacings of 2·4 x 9 m was interplanted with passion fruit in 1975, to serve as a demonstration plot for estates in the district. A crop of 831 kg of Passion fruit was harvested at the end of the first year in 1976 which gave a gross income of Rs. 821.00.

Rainguards : (R. Satchuthananthavale & G. de Mel)

In the field trial at Dartonfield, fitted with rubber rainguards, there were 36 additional tapping days for the year 1976 as compared with the control plots. This resulted in an additional crop of 363·2 lb for two tapping tasks.

Tissue culture : (R. Satchuthananthavale & C. Weerasinghe)

Callus cultures were established from explants of *Hevea* anthers, seedling stem sections and clonal stem sections. These cultures maintained good callus growth on continous sub-culturing except for callus established from clonal stem explants which showed a diminished rate of growth after the third sub-culture. Studies are being continued to improve the growth medium so that growth could be maintained on continous sub-culturing.

Physiology of disease resistance in Hevea : *(R. Satchuthananthavale)*

Thin layer chromatographic studies were carried out with diffusates from infected pods of clone RRIC 52, 45 and PB 86.

Study of growth substances in Hevea : *(A. C. I. Samaranayake in collaboration with R. Satchuthananthavale and assisted by C. Weerasinghe and L. S. Kariyawasam).*

Work was initiated on the study of growth substances which may interfere with callus formation in mature stem tissue as well as may be involved in the physiology of "Leaf buds" and "Scale buds".

Reduction of the period of immaturity : (A. C. I. Samaranayake, R. B. Gunaratne & W. T. Silva)

In an experiment on the use of advanced planting material, 100 stumped buddings were used to fill vacancies in a replanting carried out by the Estate Department. Budded stumps were grown in a nursery for 1½ years, and six weeks before uprooting, a trench was cut along one side of each plant, the tap root severed at a depth of 0.6 m, the lateral roots on the side of the trench pruned to about 0·2 m and the trench filled partially with soil. Ten days before planting, the budgrafts were pollarded at a height of about 2·5 m from the graft union just below a cluster of dormant buds. The cut ends were treated with a fungicide (Kankerdood) and the stems white washed with hydrated lime. After ten days when the buds of the topmost whorl were just starting to emerge, they were transplanted in the field. The establishment success of this trial was 92 per cent.

Preliminary preparations were made for setting down a trial comparing establishment and growth of (a) stumped buddings (b) Polythene container plants and (c) bare root budded stumps.

Growth variability in field plantings of budded stumps : (A. C. I. Samaranayake, R. B. Gunaratne & L. S. Kariyawasam)

The following treatments are being tested in a trial to reduce the growth variability observed in field plantings of budgrafts:

(1) Green-budded stumps planted in polybags and transplanted in the field with one mature whorl of leaves.

(2) Two green budded stumps planted bare root in each planting hole and the weaker plant eliminated later on.

(3) Two brown budded stumps planted bare root in each planting hole and the weaker plant eliminated later on.

(4) A single brown budded stump planted bare root in each planting hole.

(5) A single green budded stump planted bare root in each planting hole.

The experiment was planted during the May/June planting season in 1976 in a randomised design with 12 tree plots replicated six times. The percentage establishment and the height of scion six months after planting are summarised in Table 33.

TABLE 33

ESTABLISHMENT AND GROWTH OF BUDGRAFTS

Treatment No.	Percentage establishment	Height of scion cm
1	100	66·57
2	89	56·57
3	95	60·60
4	93	62·13
5	97	58·28

Seed selection : (*A. C. I. Samaranayake & R. B. Gunaratna*)

Illegitimate seed of clone RRIC 52 were grouped into two categories depending on their weight. (> 6g, 5 — 6g). Seeds weighing less than 5 g were discarded. Germination tests indicated a faster rate of germination of the heavier seeds. However, there was no significant difference in growth rate of seedlings of the two categories of seeds.

Seedling nurseries : (*A. C. I. Samaranayake, R. B. Gunaratne & W. T. Silva*)

In an experiment to study the effect of thinning out of poorer growers on the number of plants that reach buddable size in a stock seedling nursery, the following treatments were randomised among 27 plots :—

1. Removal of 50% of the plants

2. Removal of 25% of the plants

3. No removal of plants

The plants were removed in three rounds at 3 monthly intervals. The number of buddable plants at the end of one year for each treatment are given in Table 34.

TABLE 34

RESULTS OF THINNING OUT ON THE PERCENTAGE OF BUDDABLE PLANTS IN A NURSERY

Treatment	% buddable plants (>2 cm diameter)*	Mean diameter cm
1	31·4	2·303
2	31·1	1·988
3	31·4	1·748

* at 5 cm above ground level

There were no significant effects of thinning out on the percentage of plants that reach buddable size, although thinning out results is an improvement in growth of the seedlings.

(1) *Field evaluation of rhizobial strains. Nitrogen fixation in legume covers.* (*U. P. de S. Waidyanatha, L. S. S. Pathiratna & W. A. Ariyaratna*)

Four promising inoculant strains, nitrogen at 40 kg/ha and a control (no inoculation) as treatments were tested on Pueraria at 6 sites located in five soil series, *vis.* Parambe, Agalawatta, Homagama, Matale and Boralu, in a randomised block experiment with 6 replicates. Each plot consisted of a row of plants 2 m long. Acid-treated *Pueraria* seeds were smeared with rhizobia from agar cultures using gum Arabic as adhesive.

Plants were harvested 3½ months after sowing; dry weight of plants, nodule weight, % effective nodules and % leaf N were determined. Table 35 shows the results, obtained for one site, which are typical for all sites. Differences between treatments are not significant for any of the parameters suggesting that none of the inoculant strains improved N fixation under field conditions. Good nodulation, growth and % leaf N content in the uninoculated control itself suggest active fixation by indigenous rhizobia in local soils. Added nitrogen (40 kg/ha) did not depress nodulation.

TABLE 35

EFFECT OF FOUR RHIZOBIAL STRAINS ON GROWTH, NODULATION AND LEAF NITROGEN CONTENT OF *Pueraria* IN THE FIELD

Treatment (Rhizobial strain)	Plant dry wt (g/plot)	Nodule dry wt (g/plot)	Effective nodules (%)	Leaf nitrogen (%)
Rothamsted 3824 (CB 756)	200·3	1·61	69·0	3·06
,, 3877 (CB 1024)	212·5	1·41	49·0	3·24
Nitragin LX146	148·4	1·14	50·8	2·64
,, EL 29	231·3	1·64	48·0	3·52
No Inoculant	186·9	1·47	38·0	3·15
,, + 40 lb N/ac	292·8	1·11	39·5	4·24
	N.S.	N.S.	N.S.	N.S.

(2) *Comparison of indigenous rhizobial isolates with introduced strains on* Pueraria *(U. P. de S. Waidyanatha, L. S. S. Pathiratne & W. A. Ariyaratne)*

A sterile sand culture experiment in Leonard Assemblies was done in the greenhouse with rhizobial cultures from nodules collected from several localities and an alien strain, Rothamsted 3824. Randomly collected nodules of *Pueraria* from each locality were crushed together, mixed and cultured on YEM agar. Such cultures represented populations from different localities. Plants were grown at two pH levels, *viz.* 4·5 and 6·5.

The results (Table 36) show that shoot growth and nodulation with many of the indigenous rhizobia are comparable with the foreign inoculant strain Rothamsted 3824 (CB 756). With most strains, growth and nodulation were better at the higher pH. However, the acetylene reduction activity was highest for Rothamsted 3824. The growth of plants supplied with inorganic nitrogen (70 ppm) was unusually poor.

TABLE 36

DRY WT (g) OF SHOOTS AND NODULES PER JAR OF FOUR PLANTS AND NODULE ACTIVITY

Rhizobia	pH	Shoots	Nodules	μ moles C_2H_4/jar/h
R_1	4·5	2·88	0·165	3·004
	6·5	4·20	0·273	3·000
R_2	4·5	1·78	0·130	1·964
	6·5	1·08	0·080	1·489
R_3	4·5	2·54	0·151	2·548
	6·5	2·96	0·200	2·405
R_5	4·5	3·16	0·276	3·313
	6·5	3·50	0·262	3·907
R_6	4·5	2·44	0·155	2·762
	6·5	3·50	0·250	6·075
R_7	4·5	3·90	0·244	3·681
	6·5	3·76	0·243	2·928
Rothamsted 3824	4·5	2·54	0·250	4·963
	6·5	2·66	0·260	5·320
70 ppm N —	4·5	1·48	NIL	—
No inoculum	6·5	1·82	NIL	—
Control (No N — no inoculum)	4·5	0·24	NIL	—
	6·5	0·26	NIL	—

R_1 to R_7 — local rhizobia

(3) *Rhizobial inoculation of* Pueraria *in sterilized and unsterilized soil* : (*U. P. de S. Waidyanatha, L. S. S. Pathiratne & W. A. Ariyaratne*)

A pot experiment was done, comparing growth and nodulation of *Pueraria* inoculated with four strains of rhizobia in unsterilized and methylbromide-treated soils. The purpose was to ascertain whether competition from indigenous rhizobia and/or other soil micro-organisms are factors in the absence of response to inoculant strains in local soils.

Growth and nodulation of *Pueraria* were extremely poor in methylbromide-treated soil so that no useful information was obtained on the performance of inoculant strains in sterile soil. There was no response to inoculation in unsterilized soil.

(4) *Effect of inoculation of nitrogen, phosphorus, potassium and Dolomite on growth and nodulation of* Pueraria:
(*U. P. de S. Waidyanatha, W. A. Ariyaratne & L. S. S. Pathiratne*)

The above 5 factors were tested in a field experiment at Eladuwa Estate, using a 2^5 compounded factorial design with 2 replicates. Plots were 8 x 18 ft and seeds were sown in breadth-wise rows, 4ft apart. The treatments were :—

No Inoculant	— I_0
Inoculant (Rothamsted 3824)	— I_1
No nitrogen	— N_0
80 kg/ha Nitrogen as Urea	— N_1
No phosphorus	— P_0
80 kg/ha P_2O_5 as Saphos	— P_1
No potassium	— K_0
60 kg/ha potassium as MP	— K_1
No Dolomite	— D_0
100 kg/ha Dolomite	— D_1

Plants were uprooted 3 months after sowing the seeds and assessed for total growth and nodulation (Table 37). Inoculation or added nitrogen did not improve growth and this is strong evidence that indigenous soil populations of rhizobia effectively fixed nitrogen. Added nitrogen greatly depressed nodulation. Phosphorus had no effect on plant growth but strikingly increased nodule weight. Potassium depressed growth and nodulation, but this is unusual and needs clarification. Dolomite improved plant weight appreciably but not nodule weight.

TABLE 37

DRY WEIGHTS OF PLANTS AND NODULES AT 3 MONTHS

		I	N	P	K	D	Mean
Plant weights (kg/plot)	0	0·87	0·87	0·86	1·04	0·68	0·86
	1	0·88	0·88	0·89	0·71	1·08	0·89
Nodule weights (g/plot)	0	2·46	3·55	1·75	2·71	2·65	2·62
	1	2·44	1·35	3·15	2·19	2·25	2·28

(see text for treatments)

(5) *Effect of inoculation, boron, copper, zinc and molybdenum on growth and nodulation of* Pueraria : (*U. P. de S. Waidyanatha, W. A. Ariyaratne & L. S. S. Pathiratne*)

This field experiment was similar in design replication, plot size and other details to the foregoing one. The nutrients together with a basal dressing of P, K and Dolomite were added to the soil before seed sowing. Plants were harvested at 3 months of age and dry weights of plants and nodules were determined. The treatments were as follows :—

No inoculant	— I_0
Inoculant (Rothamsted 3824)	— I_1
No Boron	— B_0
2 kg Boron as Borax	— B_1
No Copper	— C_0
2 kg Copper as Copper sulphate	— C_1
No molybdenum	— M_0
0·2 kg molybdenum as Sodium molybadate	— M_1
No Zinc	— Zn_0
3·5 kg Zinc as Zinc sulphate	— Zn_1

TABLE 38

DRY WEIGHTS OF PLANTS AND NODULES AT 3 MONTHS

		I	B	C	M	E	Mean
Plant weights (kg/plot)	0	1·34	1·41	1·40	1·36	1·39	1·38
	1	1·42	1·36	1·37	1·40	1·37	1·38
Nodule weight (g/plot)	0	6·34	6·63	6·11	6·80	6·26	6·43
	1	5·77	5·48	6·01	5·32	5·86	5·69

(See text for treatments)

None of the treatments affected total growth but there is some indication that molybdenum and boron depressed nodule growth. This however needs clarification by further experimentation.

Field Experiment No. 92 — Padukka Group (*U. P. de S. Waidyanatha, L. S. S. Pathirana & S. Wijesinghe*)

The drought that prevailed during the December-March period completely killed *Calopogonium*; *Pueraria* was less affected. With the rains in April the covers were again completely re-established, which in the case of *Calopogonium* was from seeds produced profusely prior to death of plants. In *Pueraria* the new growth was mostly by vegetative propagation. The ability of *Calopogonium* to die during drought and re-establish from seed in wet weather should be a useful attribute for its use as a cover for areas with acute dry spells because competition for moisture between the cover and rubber will then be least when soil moisture stress is greatest.

The rubber plants have now recovered fully from the cockchafer grub damage which occurred in 1975 but recently suffered another set-back in growth from bandicoot damage; the bark of many plants was gnawed away around the collar. The latter damage was unfortunately confined only to legume plots which means that only some treatments have suffered.

The % leaf nitrogen (Table 39) and growth of covers do not indicate any benefit from rhizobial inoculation.

TABLE 39

THE RESPONSE OF COVER PLANTS TO INOCULATION WITH RHIZOBIA

	% leaf N of cover	Height (cm) of rubber plants
Pueraria inoculated	4·14	30·8
Pueraria not inoculated	4·13	32·0
Pueraria + 50 kg N/ha	4·23	33·0
Calopogonium inoculated	4·39	34·6
Calopogonium not inoculated	4·23	36·0
Calopogonium + 50 kg N/ha	4·23	35·3
Naturally established legumes	—	37·1
Naturals (without *Mikania*)	—	37·4

Growth of rubber plants appears to be better in the natural and naturally established legume plots than in the grown legume plots. This could well be due to the differential rodent damage observed with respect to these treatments as explained earlier. However there is also some indication that growth in the *Calopogonium* plots is marginally better than in the *Pueraria* plots.

(1) *Root infection and extra matrical spores* :
(U. P. de S. Waidyanatha & S. Ravindranath — Undergraduate Student)

Preliminary observations were made on infection of rubber roots by vascular arbuscular (VA) mycorrhiza. The extent of infection was greater in immature rubber with leguminous covers than with naturals. Extra matrical spores were isolated by the wet sieving and decanting method and these were more in soils under cover than naturals. Covers (*Pueraria*) themselves were heavily infected.

(2) *VA mycorrhiza and growth of* Stylosanthes guianensis *in sterile soil with two sources of phosphorus.*
(U. P. de S. Waidyanatha & N. Yogaratnam)

The treatments given below were tested in a randomized block design pot experiment with 5 replicates. Apatite or saphos phosphate was incorporated into methylbromide-treated soil at the rate of 0·5 mg equivalents/g soil and each pot with 4 plants was inoculated with 60 spores from a mixture of yellow vacuolate and laminate spores. Plants were harvested at 6 weeks of age.

Inoculation was not successful as seen from the results and very little mycorrhizal infection was observed.

TABLE 40

DRY WEIGHT (g) OF SHOOTS PER POT AND PHOSPHORUS CONTENT

	Shoot weight	% P
(1) Inoculation + Apatite	1·80	0·227
(2) Apatite only	1·78	0·310
(3) Inoculation + Saphos	1·96	0·318
(4) Saphos only	2·08	0·440
(5) Inoculation only	0·26	0·278
(6) Nil (control)	0·20	0·216

It is however very significant that growth of *Stylosanthes* was severely depressed in sterilized soil unless phosphate was added. Similar observations were made with *Pueraria* and other cover legumes which in their natural state are invariably infected with VA mycorrhizae. It therefore appears that mycorrhizal infection is an obligatory pre-requisite for phosphate uptake by some legume covers in the natural state, and stunted growth in sterile soil is possibly due to the lack of mycorrhiza which however can be overcome by addition of excess phosphate.

It also appears from the results that growth and P uptake were better with Saphos than apatite as the source of phosphate.

Index to Field Experiments

REVIEW OF THE GENETICS AND PLANT BREEDING DEPARTMENT

By

D. M. Fernando

SUMMARY

Genotype/environment studies on 10 modern clones, initiated in 1975 by the Geneticist were continued. RRIC 110 was found to match RRIC 101 on early high yields. RRIC 100 and 102 showed later high yields and RRIC 103 was found to be resistant to drought and to develop a spreading canopy in areas such as Bibile and Moneragala. One of the first smallholdings to plant the RRIC 100 series was tapped and RRIC 103 was found to yield over 800 kg/hectare dry rubber in its first year of tapping. Five clones of the RRIC 100 series were released to the IRCA, Africa.

DETAILED REVIEW

General

Statistically significant improvements in the first three and four years yield of the RRIC 100 series clones were observed. Significant increases in growth leading to a reduction in the immature period were also observed. An extensive acreage using RRIC 100 and RRIC 101 was replanted especially in those estates where experiments were located. Budwood of RRIC 100, 101, 102, 103, and 110 was shipped on request to the IRCA in the Ivory Coast. The utilization of improved genotypes as indicated by statistically significant improvements in yields and growth would require new thinking on tapping intensities, manuring and general planting practice. These aspects are being handled by the Botanical and other Research Departments. Planting material of the newer clones is still in very short supply in spite of issues of nearly five thousand yards of budwood of RRIC 100 and RRIC 101 from 1969 to 1971 from this Institute.

Staff

Dr. N. E M. Jayasekera, Gineticist, compiled the Annual Report of the Department for 1975 and supervised over-all research until the return of Mr. D. M. Fernando, Head of the Department in June, 1976, from a fellowship in Long Ashton Research Station, England. Mr. P. Samaranayake, Senior Technical Assistant, returned in November, 1976 from the International Agricultural Centre, Wageningen, Holland, after a course in Statistics and Genetics and three months work on a cytogenetical project at the Institute for Horticultural Plant Breeding, Wageningen. All other officers were on duty except Mr. H. B. H. de Silva, Senior Field Assistant, who was interdicted in November, pending inquiry. The Assistant Genecticist, Mr. C. M. B. Ratnayake continued post-graduate studies at East Malling Research Station.

Publications

Jayasekera, N. E. M. and Jinks, J. L. (1976) Effect of gene dispersion on estimates of components of generation means and variance. *Heredity* **36**, 31 — 40.

SENANAYAKE, Y. D. A., JAYASEKERA, N. E. M. AND SAMARANAYAKE, P. (1975). Growth of nursery rootstock seedlings of *Hevea brasiliensis*. Muell Arg. *cv.* Tjir 1 Part 2, *Q. Jl. Rubb. Res. Inst. Sri Lanka* 52, 29 — 37.

LIYANAGE, A. de S., FERNANDO, D. M. AND PERIES, O. S. (1976) — Disease screening programmes for leaf, panel and root diseases in Sri Lanka, contribution to the IRRDB Symposium held in Cisarua, Indonesia 8 — 9 November, 1976.

Conferences

The following two papers were presented at the Centenary International Rubber Conference, Colombo (Dec. 15 — 17, 1976).

1. Aspects of *Hevea* breeding and selection in Sri Lanka by D. M. Fernando.
2. Initial studies on the nature of genotype-environment interaction in some *Hevea* cultivars by N. E. M. Jayasekera, P. Samaranayake and K. B. Karunasekera.

Visits

The technical staff of the Department paid visits to experimental areas for observations and collection of data.

Extension

A course of instruction was prepared for officers of the Advisory Services.

RESEARCH INVESTIGATIONS

Mutation breeding (D. M. Fernando)

Only 10% success was obtained on transport of irradiated rubber plants from Long Ashton, England, to Sri Lanka. A few ' xantha ' type mutant buds have been found to grow from the surviving plants. Studies on detached cuticles are continuing.

Clone evaluation (D. M. Fernando)

The yield and growth potential of the RRIC 100 series clones was analysed and the results presented in a paper read at the Centenary International Rubber Conference held in Colombo. RRIC 110 was found to match RRIC 101 on early high yields. RRIC 103 was found very suitable for drier areas such as Moneragala and Bibile. RRIC 100 showed appreciable yields and a small canopy in the wet zone. RRIC 105 also showed high yields and a wind resistant type of branch adhesion in the wet zone. RRIC 102, RRIC 103, and clone 4011 showed satisfactory yields under adverse conditions in the Matale District.

Rootstock — Scion studies using diallel design (N. E. M. Jayasekera & K. B. Karunasekera).

Seeds from only four clones were available in sufficient quantities to initiate this experiment. Two of these clones, 815 and 1004, are not registered clones while

the other two, RRIC 52 and RRIC 100, are well established clones. Each clone had sixty plots with ten seedlings per plot. Plots were distributed at random and the experiment was repeated in two blocks. Three height measurements were recorded at six weekly intervals starting from the 6th week after planting in the nursery. These data will be used to study the relative magnitudes of : between seedlings (within clones) and between clones variation components. This will indicate the relative importance of rootstock selection within a clone and between clones.

Rootstock Variability Studies — Tjir 1 (*N. E. M. Jayasekera, Y. D. A. Senanayake & P. Samaranayake*)

Girth measurements of the scion were taken at six monthly intervals. Early height and girth measurement of the scion were correlated to nine rootstock characters measured before bud grafting. This was done independently, for fast and slow growing groups of rootstock seedlings. In the fast growing group, out of 63 correlations only three were significant at the 5% level while in the slow growing group of rootstocks, only 5 correlations out of 63 were significant. Therefore, these significant correlations could be regarded as random effects of sampling due to a large number of correlations. Hence one can conclude that the rootstock characters measured have no influence on early growth of the scion. Simple pairwise correlations were carried out in this analysis. One hundred and twenty five (125) plants were included in the fast growing group while there were one hundred and forty seven (147) in the slow growing group.

Genotype-environment interaction studies (*N. E. M. Jayasekera, P. Samaranayake & K. B. Karunasekara*).

In this experiment, two height measurements were taken at 132 days and 264 days after planting. The survival rate was also scored as a percentage of plants sprouted at the time of first height measurement.

Analysis of variance indicated a significant genotypic, environmental and genotype-environmental interaction components of variation. Results are given in Table 1.

TABLE 1

RESULTS OF THE ANALYSIS OF VARIANCE

Item	Mean square		
	1st Height	2nd Height	Survival rate
1. Clones (genotypes)	9176·70***	79856·50***	2065·00***
2. Locations (environments)	5579·41***	250767·25***	3079·92***
3. Clones × Locations	868·34*	7597·16*	599·93*

Probability levels :

*** = < 0·1% ** = 1·0 — 0·1% * = 1·0 — 5·0%

Further analysis of genotype-environment components was carried out to identify the clones with significant linear relationship with the environments. On this basis clones could be classified into three stability groups. The results were discussed in detail in a paper entitled "Initial studies on genotype-environment interactions of some *Hevea* cultivars" which was read at the Centenary International Rubber Conference. The studies were located in the following fields :

Experiment No.	*Description*	*District/site*
No. 39	1975 (N.E.) Genotype-environment interaction trial	— Moralioya Group
40	,, ,, ,, ,, ,, ,,	— Pimbura Group
41	,, ,, ,, ,, ,, ,,	— Hunuwella Group
42	,, ,, ,, ,, ,, ,,	— Golinda Group
43	,, ,, ,, ,, ,, ,,	— Bentota Group
45	,, ,, ,, ,, ,, ,,	— Moneragala Group
46	,, ,, ,, ,, ,, ,,	— Monrovia Group
47	,, ,, ,, ,, ,, ,,	— Bibile Group
48	1976 (January) ,, ,, ,, ,,	— Wariapola Group

Hand Pollination Programme (A. K. M. S. Senaratne)

Very dry weather in the earlier part of the year reduced the set and caused premature flower drop. The seedlings obtained were planted in a fully randomized design for further study. The results of the programme are given in Table 2.

TABLE 2

HAND POLLINATION PROGRAMME — 1976

Cross Made	Number of pollinations	Seedlings obtained
RRIC 103 × PB 86	1584	6
RRIC 103 × RRIC 52	338	3
RRIC 100 × PB 86	784	22
RRIC 100 × RRIC 52	1084	28
RRIC 100 × RRIC 101	312	57
RRIC 101 × RRIC 52	310	10
RRIC 101 × RRIC 88	164	—
RRIC 101 × PB 86	501	56
RRIC 101 × 82	40	2
RRIC 101 × RRIC 100	40	4
RRIC 101 × RRIC 101	40	—
RRIC 100 × 82	40	5
RRIC 100 × RRIC 100	40	—
RRIC 100 × RRIC 103	10	—
PB 86 × RRIC 101	509	10
PB 86 × RRIC 88	435	—
PB 86 × RRIC 103	1386	3
PB 86 × 82	135	3
PB 85 × PB 86	40	—
PB 86 × RRIC 100	40	—
82 × RRIC 101	196	21
11 × PB 86	53	13
82 × 82	40	3
82 × RRIC 100	40	2
1305 × PB 86	37	—
Total	8198	248

Disease Resistance

Oidium (*D. S. Gamage*)

1963 Experiment No. 6A — Matale

Two clones were test-tapped in this trial and the yields of RRIC 102 (Table 3) indicate suitability for these upland areas.

TABLE 3
EXPERIMENT NO. 6A — 1963 CLONE TRIAL — MATALE
(TAPPED S2/, d/2, 100%)

Clone	Trees tapped	Girth cm 1975	Girth cm 1976	Yield g/tree/tapping 1974	Yield g/tree/tapping 1975	Yield g/tree/tapping 1976
RRIC 102	45	55·0	55·6	43·8	40·0	29·6
PB 86	8	47·3	53·2	36·1	20·1	19·6

1965 Experiment No. 10 — Matale

Owing to severe drought conditions in the first half of the year, yields in this area were very depressed. Very sporadic tapping further increased error of test-tappings. As shown in Table 4, RRIC 103 and the RRIC 52 selfed clone 4011 showed the most promising yields in this area and could be recommended for larger scale planting along with RRIC 102.

TABLE 4
EXPERIMENT NO. 10 — 1965 CLONE TRIAL — MATALE
(TAPPED S/2, d/2, 100%)

Clone	Parentage	Trees tapped	Mean girth cm 1975	Mean girth cm 1976	Yield g/tree/tapping 1974	Yield g/tree/tapping 1975	Yield g/tree/tapping 1976
RRIC 103	RRIC 52 × PB 86	6	57·4	58·7	35·5	35·1	35·8
4011	RRIC 52 × RRIC 52	5	54·8	55·5	28·1	39·7	34·2
1108	RRIC 52 × RRIC 7	14	57·0	58·0	20·5	22·0	21·0
2462	RRIC 88 × FX 4098	32	56·8	58·3	24·8	26·7	20·0
RRIC 52	—	8	57·0	60·3	13·7	15·6	18·5
IAN 710	PB 86 × F 409	17	53·5	55·0	20·1	31·6	18·0
2427	RRIC 45 × FX 4098	27	53·0	54·0	24·6	33·8	17·6

South American Leaf Blight (*D. S. Gamage & G. D. Chandrasena*)

1965 Experiment No. 8 — Dartonfield

This experiment includes clone 2473 which was reported resistant to SALB from Trinidad and shows yields (Table 5) which are above presently established clones such as RRIM 623 and RRIC 45. Clone 2417 was also sent to Trinidad but showed susceptibility to attack.

TABLE 5

EXPERIMENT NO. 8 — 1965 CLONE TRIAL — DARTONFIELD
(TAPPED S/2, d/2, 100% FROM 1974)

Clone	Parentage	Trees tapped	Mean girth cm		Yield g/tree/tapping			Dry Trees
			1975	1976	1974	1975	1976	
2417	RRIC 45 × FX 4098	11	61·0	61·6	49·7	46·6	52·4	
RRIC 102	RRIC 52 × RRIC 7	7	63·6	65·2	51·7	50·4	51·5	
6306	RRIC 36 × FX 516	9	67·7	70·3	42·7	47·6	37·4	
2473	RRIC 45 × IAN 873	14	67·0	68·5	41·8	38·6	36·2	
6182	PB 28/59 × IAN 873	13	75·1	76·8	32·5	27·0	32·8	
1461	RRIC 52 × T 792	12	72·3	74·0	32·8	33·7	32·6	
2885	Ch 26 × RRIC 52	13	79·8	82·2	30·5	32·5	32·1	
IAN 710	PB 86 × F 409	12	63·3	65·4	22·6	24·7	26·3	
RRIC 45	RRIC 8 × Tjir 1	122	63·2	63·7	27·0	28·4	25·6	
5326	RRIC 51 × F 4542	9	70·1	72·2	—	27·0	24·2	
RRIM 623	PB 49 × Pil,B 84	12	66·5	67·1	26·2	27·6	23·0	
5352	RRIC 52 × IAN 710	14	79·5	81·5	—	24·6	22·6	

Clone Trial

1963 Experiment No. 6 — Kuruwita (W. A. C. Wijesinghe)

RRIC 109 showed satisfactory growth and yield (Table 6) but better foliage was seen in RRIC 105 and clone 4011.

TABLE 6

EXPERIMENT NO. 6 — 1963 CLONE TRIAL — KURUWITA
(TAPPED S/2, d/2, 100%)

Clone	Parentage	Trees tapped	Mean girth cm		Yield g/tree/tapping		
			1975	1976	1974	1975	1976
RRIC 109	Ch 26 x RRIC 36	6	81·6	84·0	58·4	54·9	83·2
3076	RRIC 45 x Wagga 6278	6	63·6	64·2	47·5	48·9	72·4
2994	RRIC 36 x Ch 26	8	77·7	79·8	34·3	51·7	66·8
RRIC 105	RRIC 52 x Tjir 1	5	81·7	82·9	64·0	78·9	54·5
RRIC 108	RRIC 36 x Ch 26	7	66·7	67·3	44·4	44·9	53·8
T. 132	RRIC 37 x Wagga 6278	8	68·0	69·9	60·7	53·9	53·6
4011	RRIC 52 x RRIC 52	7	72·9	74·1	63·6	57·1	47·6
PB 86	—	58	69·4	71·4	39·0	40·5	43·1

1964 Experiment No. 7 — Kuruwita (W. A. C. Wijesinghe)

RRIC 110 showed outstanding yields (Table 7) also supported by measurement in replicated plots in Experiment 21 (Table 17). Clone 266 has been found susceptible to wind damage. RRIC 102 maintained yields above PB 86 and showed excellent survival.

TABLE 7

EXPERIMENT NO. 7 — 1964 CLONE TRIAL — KURUWITA
(TAPPED S/2, d/2, 100%)

Clone	Parentage	Trees tapped	Mean girth cm		Yield g/tree/tapping		
			1975	1976	1974	1975	1976
RRIC 110	LCB 1320 x RRIC 7	12	73·6	77·7	73·5	74·3	64·9
266	Mil 3/2 x Tjir 1	19	80·9	84·5	53·4	65·6	58·5
RRIC 102	RRIC 52 x RRIC 7	74	69·2	70·0	62·3	59·9	46·5
1152	RRIC 45 x RRIC 13	14	73·3	75·7	45·6	43·3	38·1
PB 86		27	58·0	59·9	—	31·6	33·1

1966 Experiment No. 11 — Kuruwita (B. M. S. G. Peiris)

A number of trees have been removed in this experiment in order to establish a factory. RRIC 101 recovered yields (Table 8) to some extent but RRIC 103 showed the best increase in girth after tapping and parallel increase in yield with age.

TABLE 8

EXPERIMENT NO. 11 — 1966 CLONE TRIAL — KURUWITA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping		
		1975	1976	1974	1975	1976
RRIC 101	115	58·8	60·8	61·6	33·9	51·1
RRIC 103	114	68·5	72·1	61·9	56·9	68·5
RRIC 45	115	63·7	66·6	45·4	40·9	38·5

1965 Experiment No. 9 — Moneragala (D. S. Gamage)

Under conditions of severe drought the yield of RRIC 101 dropped (Table 9). RRIC 103 showed more resistance to adverse conditions in this district.

TABLE 9

EXPERIMENT NO. 9 — 1965 CLONE TRIAL — MONERAGALA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping			Dry trees
		1975	1976	1974	1975	1976	
IAN 710	25	51·2	52·8	15·5	18·1	29·4	
RRIC 103	16	64·1	65·6	19·1	26·4	26·1	
RRIC 45	29	56·3	57·9	16·5	17·1	23·1	
RRIC 104	15	62·5	65·0	20·0	32·6	22·3	
1305	15	57·6	59·1	22·6	34·5	22·3	1
1487	11	59·0	60·0	28·7	27·2	21·6	
RRIC 102	19	57·0	58·5	20·0	30·0	21·3	
RRIC 101	16	55·1	56·2	30·9	32·3	17·7	

1966 Experiment No. 13 — Moneragala (D. S. Gamage)

In this replicated large scale trial, RRIC 103 showed better foliage, yield and growth than the other clones including RRIM 623. The yield in comparison with RRIM 623 is shown in Table 10.

TABLE 10

EXPERIMENT NO. 13 — 1966 CLONE TRIAL — MONERAGALA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976
RRIC 103	256	65·0	21·1
RRIM 623	167	57·2	13·4

1966 Experiment No. 12 — Nivitigalakele (H. B. H. de Silva)

RRIC 103 showed significantly better yields in this experiment (Table 11). The better yields compensated for the loss of 39 trees in 1975, owing to wind-damage at the crest of a hill.

TABLE 11

EXPERIMENT NO. 12 — 1966 CLONE TRIAL — NIVITIGALAKELE
(TAPPED : S/2, d/3, 67%)

Clone	Trees tapped	Yield g/tree/tapping		
		1974	1975	1976
RRIC 103	186	74·2	70·6	54·8
1004	175	42·7	43·5	33·7
RRIC 45	149	50·0	30·2	30·8

1967 Experiment No. 14 — Nivitigalakele (H. B. H. de Silva)

RRIC 102 showed more stability under drier conditions in the early part of 1976 (Table 11A) : some susceptibility to *Gloeosporium* leaf-fall was also shown by RRIC 102 though the effect on yields was not pronounced.

TABLE 11A

EXPERIMENT NO. 14 — 1967 CLONE TRIAL — NIVITIGALAKELE
(TAPPED : S/2, d/3, 67%)

Clone	Trees tapped	Yield g/tree/tapping		
		1974	1975	1976
RRIC 102	294	55·9	54·6	37·4
RRIC 101	319	70·3	53·4	32·0
RRIM 623	146	32·9	41·2	21·4
815	377	26·5	20·3	20·0

1967 Experiment No. 16 — Neboda (A. K. M. S. Senaratne)

RRIC 103 and RRIC 102 showed satisfactory yields and growth (Table 12).

TABLE 12

EXPERIMENT NO. 16 — 1967 CLONE TRIAL — GIKIYANAKANDA, NEBODA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping			Dry Trees
		1975	1976	1974	1975	1976	
RRIC 103	409	66·3	69·3	36·4	43·7	42·5	11
RRIC 102	243	61·8	64·1	33·9	41·6	40·6	11
RRIM 623	282	60·5	61·6	31·9	34·6	37·5	7
1004	317	63·5	66·7	21·8	31·5	32·9	6

1967 Experiment No. 17 — Peenkande (W. D. Armon)

As shown in earlier small scale trials, RRIC 100 showed better yields than RRIC 101 (Table 13) after the first three or four years of tapping. Owing to outstanding vigour, and subsequent increased length of cut, clone 815 has also commenced to show a later increase in yields. In this experiment a continuity of management through land reform has ensured adequate inputs such as fertilizer and the increased yields, in comparison with other experimental areas, serves to show the ample returns from adequate maintenance.

TABLE 13

EXPERIMENT NO. 17 — 1967 CLONE TRIAL — PEENKANDE
(TAPPED : S/2, d/3, 67% UPTO SEPTEMBER, 1975 S/2, d/2, 100% THEREAFTER)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping		
		1975	1976	1974	1975	1976
RRIC 100	543	63·0	67·1	48·8	57·7	55·6
815	489	73·5	79·1	46·9	53·4	48·6
RRIC 101	412	57·8	60 0	58 9	66·8	48·2
1004	297	61·3	67 0	34·9	52·2	47·1
RRIM 623	393	59·6	62·9	44·8	54·0	44·0
RRIC 45	286	56·3	58·0	33·3	45·9	33·3

1967 Experiment No. 20 — Bibile (H. B. H. de Silva)

The adoption of 100% intensity tapping at opening in 1975 resulted in an increase in dry trees in the higher yielding clones. In the majority of cases the dry trees could be brought back into tapping in one year. With clones yielding over 1000 kg/ha/year (Table 14) in the first three years, it appears necessary to reduce intensity to 67% either by tapping a half-spiral every third day or by reducing the length of the tapping cut.

TABLE 14

EXPERIMENT NO. 20 — 1967 CLONE TRIAL — BIBILE
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Yield g/tree/tapping		kg/ha	Dry trees
		1975	1976	1976	
RRIC 101	318	33·6	33·7	1581	29
1305	284	25·4	29·7	1338	16
RRIC 100	260	18·2	21·3	626	2
IAN 710	214	16·2	20·3	686	3
RRIC 103	213	19·2	19·0	891	4
RRIC 45	288	18·8	17·1	663	17

1967 Experiment No. 19 — Hedigalla (W. D. Armon)

The control of weeds in this wet zone area was effective with RRIC 103 although early yields (Table 15) were higher in RRIC 101. With the heavy rainfall experienced, no dry trees have occurred to date in this area although 100% intensity was used.

TABLE 15

EXPERIMENT NO. 19 — 1967 CLONE TRIAL — HEDIGALLA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm	Yield g/tree/tapping	
		1976	1976	1976
RRIC 101	98	57·6	47·3	36·4
RRIC 103	217	65·4	31·4	30·0
RRIC 45	195	54·4	29·4	24·4

1967 Experiment No. 15 — Kuruwita — B. M. S. G. Peiris

In this small scale trial (Table 16), it appears quite possible to upgrade yields of SALB resistant parents such as IAN 873. Clones such as 6182 have already been tapped for 5 years in the 1965 clone trial at Dartonfield and it would be advisable to diversify planting material with clones incorporating these different parents.

TABLE 16

EXPERIMENT NO. 15 — 1967 CLONE TRIAL — KURUWITA
(TAPPED : S/2, d/3, 67%)

Clone	Parentage	Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976
10570	RRIC 45 × PB 28/59	19	68·7	51·7
6182	PB 28/59 × IAN 873	19	74·3	38·9
8811	LCB 1320 × RRIC 52	4	64·6	39·6
5682	FX 25 × Ch 26	23	66·6	28·3
8794	RRIC 52 × IAN 6167	8	66·5	27·7
10727	RRIC 52 × PB 86	18	64·6	27·6
7281	IAB 873 × RRIC 52	14	67·2	27·1
RRIM 623	PB 49 × PilB 84	36	62·3	22·5

1968 Experiment No. 21 — Kuruwita (B. M. S. G. Peiris)

In this trial with three randomized 10 tree plots of each clone RRIC 110 was confirmed as a very high yielding clone in the initial years of tapping. Clones 6182 and 6306, which are also planted in the 1965 clone trial at Dartonfield, showed appreciable yields in this experiment. (Table 17)

TABLE 17

EXPERIMENT NO. 21 — 1968 CLONE TRIAL — KURUWITA
(TAPPED : S/2, d/3, 67%)

Clone	Parentage	Mean Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976
RRIC 110	LCB 1320 × RRIC 7	20	68·9	61·2
RRIC 102	RRIC 52 × RRIC 7	20	61·8	48·9
6182	PB 28/59 × IAN 873	17	69·4	37·9
6306	RRIC 36 × FX 516	19	56·4	37·6
6 — 704	IAN 710 × Ch 26	16	66·6	35·4
7263	FX 3482 × RRIC 52	20	64·0	32·5
RRIC 104	RRIC 52 × Tjir 1	24	69·9	35·2
RRIM 623	PB 49 × PilB 84	13	57·3	32·1
5 — 90	IAN 710 × RRIC 45	16	74·8	31·4
6 — 541	RRIC 36 × RRIC 36	15	60·6	28·6

1968 Experiment No. 22 — Kelani Valley (W. A. C. Wijesinghe)

In this experiment with 3 or 4 replicates of 300 trees each of each clone RRIC 103 showed a better yield (Table 18) and the best percentage of trees tapped per hectare.

TABLE 18

EXPERIMENT NO. 22 — 1968 CLONE TRIAL — KELANI VALLEY (PANNAGULA ESTATE) (TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Yield g/tree/tapping		
		1974	1975	1976
RRIC 103	822	26·6	32·1	34·3
C 695	697	24·4	30·3	31·9
1173	699	28·8	27·7	29·6
RRIC 45	790	25·3	26·9	28·9
82	829	21·0	21·7	25·4

1968 Experiment 23 — Hedigalla (W. D. Armon)

In this experiment an attempt was made to compare RRIC 101 and RRIC 103 in the wet zone (Table 19). RRIC 101 is significantly better yield-wise but RRIC 103 shows better growth. Together the two clones would combine early profits and later stable high yields.

TABLE 19

EXPERIMENT NO. 23 — 1968 CLONE TRIAL — HEDIGALLA (TAPPED : S/2, /d2, 100%)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping	
		1975	1976	1975	1976
RRIC 101	220	56·5	56·7	49·1	40·8
RRIC 103	279	59·6	61·1	27·9	29·5
RRIC 45	221	52·9	52·2	25·6	23·8

1968 Experiment 25A. Supply Planting — Sirikandura — Matugama (D. S. Deddu-wakumara)

In 1968 (NE) a 1967 RRIM 623 planting at Sirikandura Estate was supplied with vigorous experimental material after vacancies caused by *Rigidoporus lignosus*. As expected it was found that these supplies could be brought into tapping at the same time as the earlier planting (Table 20). The very favourable yields of these supply clones indicates that such vigorous material could successfully withstand competition even from quick-growing clones such as RRIM 623.

TABLE 20

EXPERIMENT NO. 25A — 1968 SUPPLY PLANTING — SIRIKANDURA, MATUGAMA
(TAPPED : S/2, d/2, 100%)

Clone	Parentage	Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976
RRIC 102	RRIC 52 × RRIC 7	5	62·6	67·7
RRIC 101	Ch 26 × RRIC 7	5	60·7	57·6
RRIC 103	RRIC 52 × PB 86	5	66·1	53·9
1458	LCB 1320 × RRIC 7	5	60·1	52·9
5613	FX 25 × Ch 26	5	58·1	36·7
9639	PB 86 × RRIC 52	5	74·5	26·2
10019	IAN 6487 × RRIC 52	5	59·3	25·9
RRIM 623	PB 89 × Pil B 84	10	60·6	25·8
10054	IAN 6587 × RRIC 52	5	60·0	23·2
6449	RRIC 52 × PB 86	5	62·3	20·7

1969 Experiment No. 26 — Sirikandura (N. E. M. Jayasekera)

Replicated plots of RRIC 101 showed the best yields in this trial (Table 21).

TABLE 21

(EXPERIMENT NO. 26) — 1969 CLONE TRIAL — SIRIKANDURA
(TAPPED : S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm		Yield g/tree/tapping	
		1975	1976	1975	1976
RRIC 101	122	52·5	54·1	33·0	31·0
RRIC 102	150	54·0	56·4	28·1	26·1
RRIC 103	155	53·0	56·2	20·5	22·1
RRIC 45	68	48·4	51·6	21·7	27·0

1969 Experiment No. 29 — Kuruwita (B. M. S. G. Peiris)

In this experiment Ch 26 was investigated in combination with other clones as a source of early, possibly sustained, high yields and better vigour than RRIC 101 As shown in Table 22, it is possible that a few clones could be selected for further test or small-scale planting but another 2 or 3 years yield figures would be necessary for evaluation.

TABLE 22

(EXPERIMENT NO. 28) 1969 CLONE TRIAL — KURUWITA
(TAPPED : S/2, d/3, 67%)

Clone	Parentage	Trees tapped	Mean girth cm	Yield g/tree/ tapping
			1976	1976
7 — 1029	Ch 26 × 1458	14	57·2	48·2
7 — 1185	RRIC 102 × RRIC 89	16	54·4	43·1
7 — 1078	Ch 26 × 815	11	56·4	41·7
7 — 1415	RRIC 89 × Ch 26	19	55·1	37·0
7 — 1201	RRIC 102 × Ch 26	18	57·7	36·4
7 — 1413	RRIC 89 × Ch 26	18	57·0	34·0
7 — 1238	Ch 26 × RRIC 100	21	65·4	34·0
7 — 1218	RRIC 102 × Ch 26	20	59·4	30·2
7 — 1176	Ch 26 × 815	21	61·6	30·0
RRIC 45	RRIC 8 × Tjirl	8	54·9	28·7
6 — 507	RRIC 103 × Ch 26	15	60·7	28·3
7 — 1077	Ch 27 × 815	9	62·9	22·9

1969 Experiment No. 29 — Eladuwa (A. K. M. S. Senaratne)

In this experiment with 31 single tree replicates of each clone adjacent to a common control (RRIC 45) RRIC 101 showed significantly better yields (Table 23).

TABLE 23

(EXPERIMENT NO. 29) 1969 CLONE TRIAL — ELADUWA
(TAPPED : S/2, d/3, 67%)

Clone	Trees tapped	Mean girth cm	Yield g/tree/tapping
		1976	1976
RRIC 101	24	57·3	51·1
1305	27	58·4	29·6
82	27	53·8	28·0
RRIC 100	27	49·7	26·4
1458	27	50·8	25·2
RRIC 103	28	57·5	23·3
RRIC 45	140	49·0	21·8

Experiment No. 30 Hedigalla (W. D. Armon)

In this experiment RRIC 101 yields were the best but RRIC 103 showed the best foliage and accompanying weed control. There were some losses due to *Rigidoporus* and the canopy of RRIC 103 was the most effective in spreading over vacancies.

TABLE 24

(EXPERIMENT NO. 30) 1969 CLONE TRIAL — HEDIGALLA
(TAPPED S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976
RRIC 101	441	56·8	46·7
RRIC 100	223	55·1	29·2
RRIC 103	411	61·2	24·5
RRIC 102	152	53·0	19·9
RRIC 45	152	48·7	16·8

1970 — Smallholding Assessment — Ratnapura (W. A. C. Wijesinghe)

A smallholding replanted in 1970 with RRIC 100 and RRIC 103 was test-tapped during 1976 (Table 25). RRIC 103 was found to show the best growth and subsequent yield on a kg/ha basis. Growth was equivalent to the same clones planted in larger estates. The ability to bring this clearing into tapping earlier, owing to the rapid growth, was greatly appreciated by the owner.

TABLE 25

SMALLHOLDING ASSESSMENT — RATNAPURA (1970 PLANTING)
(TAPPED S/2, d/2, 100%)

Clone	Trees tapped	Mean girth cm 1976	Yield g/tree/tapping 1976	kg/ha 1976
RRIC 100	198	45·2	29·9	639
RRIC 103	320	47·7	25·6	872

Index to field experiments :

Field Experiment	*Description*	*District/site*
6	1963 clone trial	Kuruwita
6A	1963 ,, ,,	Matale
7	1964 ,, ,,	Kuruwita
8	1965 Sm. sc. cl. trial	Dartonfield
9	1965 Clone trial	Moneragala
10	,, ,, ,,	Matale
11	1966 ,, ,,	Kuruwita
12	,, ,, ,,	Nivitigalakele
13	,, ,, ,,	Moneragala
14	1967 ,, ,,	Nivitigalakele
15	,, Sm. sc. cl. trial	Kuruwita
16	,, Clone trial	Gikiyanakanda
17	,, ,, ,,	Peenkande
19	,, ,, ,,	Hedigalla
20	,, ,, ,,	Bibile
21	1968 Sm. sc. cl. trial	Kuruwita
22	,, Clone trial	Pannagula
23	,, ,, ,,	Hedigalla
24	,, ,, ,,	Bibile
25	,, ,, ,,	Wariapola
25A	,, supply planting	Sirikandura
26	1969 clone trial	,,
28	,, Sm. sc. cl. trial	Kuruwita
29	,, cl. trial	Eladuwa
30	,, ,, ,,	Hedigalla
34A	Stock/scion experiment	Nivitigalakele
35	1972 Seedling experiment	,,
39 — 48	Genotype/environment experiment	9 sites
49	1976 diallel stock/scion	Nivitigalakele

REVIEW OF THE PLANT PATHOLOGY DEPARTMENT

BY

A. de S. LIYANAGE

SUMMARY

The weather conditions were generally unfavourable for the spread of leaf and panel diseases and hence the incidence of *Oidium*, *Phytophthora* and *Gloeosporium* leaf diseases and Bark Rot was negligible during the period under review. White Root disease caused by *Rigidoporus lignosus* appears to be a serious problem in mature and immature plantations and Black Root disease has been recorded from another estate during 1976.

The optimum temperature for germination of conidia of *O. heveae*, under laboratory conditions, was found to be between 25 — 30°C.

The wintering pattern, host phenology and the incidence of secondary leaf fall due to *Oidium* were recorded on four cultivars. Rod traps were successfully used to trap *Oidium* spores.

Several cultures of *Phytophthora* were screened prior to selecting a few isolates to study the nomenclature of the fungus. A useful technique was developed to examine the structural details of the fungus.

Biochemical investigations on resistance to *Phytophthora* spp., revealed that there were differences in the phenolic compounds present in different cultivars. It was also observed that some of these compounds inhibited spore germination.

It has been found that mycelium of *Phytophthora* spp. was detected only when free hand sections of fresh material were examined and not with wax embedded sections. The hyphae were almost exclusively intra cellular.

The optimum temperature for growth and sporulation of isolates of *Gloeosporium alborubrum* ranged between 25 — 30°C. However, some isolates behaved differently. Generally, optimum growth was recorded at pH 6 but higher pH levels were favourable for the production of spores.

The critical period for panel infection was shown to extend upto 3 days after causing an injury to the bark, when the panel scrap was removed. However, the percentage infection was lowered without the removal of panel scrap, still the panel remained susceptible for 3 days.

The rate of spread of *Phytophthora* spp. was recorded at monthly intervals, on artificially inoculated panels.

It was shown that there was no difference in the number of latex vessel rings in virgin and callused bark.

A significantly high phenolic content was noted in healthy bark of PB 86 than in bark infected with *Phytophthora* spp.

There were no significant differences between several proprietary and other formulations on bark renewal.

The use of preserved latex as an adjuvant with fungicides has given promising results in controlling bark rot.

Clonal susceptibility to *Oidium*, *Phytophthora* and *Gloeosporium* leaf diseases Bark Rot and White Root disease was determined under laboratory and field conditions. Most of the high yielding eastern clones were susceptible to *Oidium* and *Gloeosporium* but clones of F and FX and IAN origin were resistant. It was shown that screening of clones for Bark Rot could be done at an early stage. Varying degrees of resistance were noted for Bark Rot. A seedling technique has been successfully developed to evaluate clones against infection by *R. lignosus*.

Effect of temperature, pH, light and dark and relative humidity on the growth of several isolates of *R. lignosus* revealed that there were marked difference in the rate of growth, morphology and pathogenicity. The growth pattern in different soil types also appeared to be different.

Studies on the rate and pattern of spread and control of White Root disease were initiated in different agro-climatic zones.

Mulching with decayed straw has given good results in detecting the trees infected with *R. lignosus*, in mature and immature clearings.

The effect of different pre-planting, planting and post-planting treatments on the growth of rubber trees and the incidence of *R. lignosus* were examined.

It was shown that addition of sulphur reduced the pH appreciably until 5 weeks after addition of sulphur upto a depth of 30 cm. The total fungal population of the surface soil was greater than at lower depths.

It was shown in a pot trial that covers and *Colacasia* spp. reduced the incidence of White Root disease.

The influence of covers on the rate of decay of rubber wood was examined.

Fungal succession on *Hevea* timber showed that *Trichoderma* spp. to be the most common fungus. *Daldenia concentrica*, Jelly fungus and *Schizophyllum* spp. were other types frequently identified on decaying logs.

Several basidiomycetes were isolated from fructifications found on decaying rubber wood.

Sporophore development and the pattern of basidiospore release were also studied. A bimodal spore release pattern was observed with *R. lignosus* with peaks between 0400 h and 0800 h and 1900 and 2100 h. Spores were abundant during 0400 to 0800 h.

DETAILED REVIEW

Staff

The Department continued to function under the supervision of the Director, Dr. O. S. Peries until the appointment of Dr. A. de S. Liyanage as the Head of the Department on the 6th February, 1976. The Head of the Department and

Mr. G. W. Liyanage, Assistant Plant Pathologist were on duty throughout the year. Dr. (Mrs.) V. Satchuthananthavale resigned the post of Plant Pathologist, with effect from 10th May, 1976.

Mrs. N. I. S. Liyanage, Experimental Officer, the Senior Technical Assistant, Mr. Z. E. Irugalbandara, and Messrs D. M. Dantanarayana, L. Halangoda, S. S. Jayasooriya, W. Amaratunga, S. Wettasingha and A. Dharmaratna, Technical Assistants, were on duty throughout the year. Messrs B. Fernando and N. Fernando assumed duties as Technical Assistants on the 3rd August and 5th August respectively.

Visits

The following visists were paid by the Department staff during the period under review.

Experimental	—	248
Advisory	—	12
Miscellaneous	—	34
Total		294

Conference, Meetings and Seminars

Dr. A. de S. Liyanage attended the following :—

1. The second meeting of the ANRPC Technical Committee on South American Leaf Blight held at Cisarua, Indonesia from 3 — 5 November, 1976.

2. A training seminar on Agricultural Research Management organised by the Post-graduate Institute of Agriculture, University of Sri Lanka, with support from the South East Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA), Philippines held at the Agrarian Research & Training Institute, Colombo from 28 — 29 June 1976.

3. Meeting to draw up the syllabus in Plant Pathology for the M.Sc. course in Agricultural Biology.

4. Administrative Committee Meetings — 1

5. Formulary Committee Meetings — 1

6. Smallholders Conferences — 1

7. Co-operative training classes — 1

Mr. G. W. Liyanage attended the following :—

1. Co-operative training classes — 1

The Head of the Department, Assistant Plant Pathologist, Experimental Officer, Senior Technical Assistant and the Technical Assistants attended the International Centenary Rubber Conference held at the BMICH in Colombo from the 15th — 17th December, 1976.

Lectures and Refresher Courses

1. O. S. Peries, A. de S. Liyanage and G. W. Liyanage presented their programme of work for 1977, to the Institute Staff.

2. A de S. Liyanage and G. W. Liyanage conducted a refresher course on the identification and control of diseases affecting rubber to Divisional Advisory Officers and Rubber Instructors.

3. G. W. Liyanage delivered a lecture entitled 'Studies on the infection of Hops by *Fusarium sambucinum*' to the Institute Staff. This talk was based on the work done by him for the degree of Master of Philosophy at the University of London.

Publications

The following papers were prepared for publication by the staff of the department, during 1976.

O. S. Peries — Review of the Plant Pathology Department for 1975.

*A. de S. Liyanage and D. J. Royle — Overwintering of *sphaerotheca humuli*, the cause of hop powdery mildew. *Ann. appl. Biol.* (1976), **83**, 381 - 394.

A. de S. Liyanage, D. M. Fernando and O. S. Peries — Disease screening programmes for leaf, panel and root diseases in Sri Lanka. *Contribution to the IRRDB Symposium held in Cisarua, Indonesia, 8 - 9 November, 1976.*

A. de S. Liyanage, M. Nadarajah, G. W. Liyanage and D. M. Dantanarayana — Investigations on new fungicidal systems for the control of Bark Rot on *Hevea brasiliensis*. *Contribution to the International Centenary Rubber Conference, 1976.*

A. de S. Liyanage — Influence of some factors on the pattern of wintering and on the incidence of *Oidium* leaf fall in clone PB 86. *Jl. Rubb. Res. Inst. Sri Lanka* Vol. 53, (in press).

A. de S. Liyanage — Control of White Root disease caused by *Rigidoporus lignosus*. *RRISL Bulletin* Vol. 11 (in press).

A. de S. Liyanage — Diseases of economic importance affecting Rubber in Sri Lanka (in Sinhala) *Vidya* **10,** (**10**) 31 - 40 1976.

G. W. Liyanage, A. de S. Liyanage, O. S. Peries and L. Halangoda — Studies on the variability and pathogenicity of *Rigidoporus lignosus*. *Contribution to the International Centenary Rubber Conference*, 1976.

*D. J. Royle and G. W. Liyanage — infection of planting materials by the Hop canker organism, *Fusarium sambucinum*. *Rep. Dept. Hop. Res.*, Wye College, 1976.

*Based on the work carried out for the post-graduate degree.

General

The incidence of *Oidium* leaf-fall was mild throughout the rubber growing districts, during the 1976 refoliation season. The wintering occurred early and was generally uniform, especially in PB 86. The weather conditions during the refoliation period were not conducive for the propagation of the causal fungus *Oidium heveae* ; consequently, the control of the disease did not present a problem.

Although there was a heavy pod set, *Phytophthora* leaf-fall and Bark Rot were negligible in all rubber growing areas. The intensity and distribution of rainfall during the South-West monsoon period was far below average, when green mature pods were present on the trees. There were a number of hot sunny days interspersed between a few wet days during the monsoon season. This type of weather is inimical to the development and spread of the fungus. When weather conditions became suitable for *Phytophthora* infection, a majority of the pods had fallen or dried due to the hot sunny weather that prevailed during the interim period.

The incidence of *Gloeosporium* leaf disease was low throughout the period under review. However, occasional outbreaks were reported in young clearings, in certain estates during the wetter months of the year.

The occurrence of Pink disease caused by *Corticium salmonicolour* was not reported from any estate during the course of 1976.

The White Root disease caused by *Rigidoporus lignosus* continues to be the major hazard in both mature and immature clearings, in most of the wetter rubber growing Districts. This could be mainly attributed to the non-removal of all infected root debris harbouring the fungus at the time of uprooting for replanting, failure to detect the infection in early stages of growth and inadequacy of proper control measures.

Black Root disease caused by *Xylaria* spp., was recorded from another estate in the Kegalle District during 1976. Unlike the White Root disease, it appears to be confined to the drier rubber growing districts.

LABORATORY INVESTIGATIONS

Diseased specimens

The following diseases were identified on specimens sent to the Institute during 1976.

Identity of the disease	*Number of specimens*
(a) Fungi	
Rigidoporus lignosus	2
Gloeosporium alborubrum	1
Oidium heveae	1
(b) Other causes	
Bark cracking	1
Total	5

BIOLOGY OF FUNGI

Oidium heveae

Spore germination — Leaf disks were inoculated and glass slides were dusted with 24 h old inoculum. Spore germination was studied at various relative humidities and temperatures by removing leaf disks and glass slides at different intervals.

The results summarised in Table 1 indicate that the optimum temperature range for germination of conidia of *Oidium heveae*, was between 25 — 30°C. This confirms the previous findings of Peries, 1963. The germination of the fungus, however was not affected by the relative humidity. Spores germinated well under both high and low humidity conditions.

The germ tube growth, recorded 24 h after commencement of the experiment, followed a similar pattern with maximum growth being recorded at 25 — 30°C at all humidities tested.

Assessment of spore germination and colony growth on leaf disks of PB 86 are continuing. (A. de S. Liyanage & D. M. Dantanarayana).

Phytophthora spp.

Clarification of nomenclature : Thirty three isolates of *Phytophthora* in stock, which have survived were grown on Lima Bean Agar (LBA), prior to selecting the cultures for a detailed study on the nomenclature of the fungus. The sexuality of most of the isolates was already known and hence only the following were used for pairing with type cultures No. 60 & 62. Culture No. 361, 362, 365, 367, 379, 391, 395, 398(b), 399 & 401 were used. All the cultures failed to produce oospores when paired with culture No. 60 but oospores were produced in abundance when paired with culture No. 62, confirming that they belong to Group I. Observations were also made on the sporulation of these isolates as well as some others from Group II. (O. S. Peries & D. M. Dantanarayana).

TABLE 1 — GERMINATION OF CONIDIA OF O. HEVEAE UNDER DIFFERENT TEMPERATURES & RELATIVE HUMIDITIES

hours after inoculation	temperature °C	Germination (%) Relative humidity (%) 100	97—98	89—94	84—87	75—76	49—55	32—34
5	15	34·0	8·5	2·0	6·5	3·5	9·0	14·5
	20	55·5	46·0	27·5	18·0	20·0	19·5	19·5
	25	65·5	55·0	33·5	31·0	30·5	51·0	56·5
	30	62·5	60·5	32·5	60·0	49·0	39·0	71·5
	35	25·0	34·5	8·0	6·5	24·5	16·0	30·5
	40	0	0·5	0	6·0	0	0	4·0
10	15	34·5	12·5	10·5	24·5	13·0	28·0	15·5
	20	67·5	53·5	33·0	32·5	49·5	58·0	61·5
	25	69·0	70·0	46·5	73·0	63·5	71·5	67·5
	30	58·5	84·0	61·0	51·5	56·0	64·0	71·0
	35	37·0	31·5	14·5	24·5	35·5	23·5	50·5
	40	0	5·5	2·0	5·5	2·0	0	1·0
15	15	54·5	20·5	21·5	19·0	10·0	27·0	20·0
	20	67·0	76·5	49·5	53·5	32·0	72·5	52·5
	25	82·5	79·5	60·0	78·0	76·5	78·5	76·0
	30	54·5	82·0	65·5	56·0	57·0	79·0	83·0
	35	31·5	26·5	34·5	47·5	30·5	50·0	60·0
	40	0	1·5	1·0	3·0	0·5	2·0	2·5
24	15	64·0	47·0	60·5	49·5	19·0	38·0	42·0
	20	72·0	68·0	70·0	73·5	63·0	73·5	61·0
	25	83·5	81·5	75·0	76·0	69·0	91·5	78·5
	30	57·5	78·5	55·5	50·0	56·5	84·5	81·0
	35	24·0	35·3	26·5	47·5	35·5	28·0	70·5
	40	0	4·0	0·5	0·5	0·5	0·5	0·5

Technique for measurements of organelles in situ — Certain difficulties were encountered in making critical and accurate measurements of the various organelles of *Phytophthora* spp. Therefore, an attempt was made to develop a suitable technique for the observation and measurements of mycelium, sporangia, sporangiophores and study the nature of their attachment and other details, as they occur in culture, by growing the fungus on glass-slides, dipped in Lima Bean Agar. This technique appears to be satisfactory. (O. S. Peries & D. M. Dantanarayana).

Determination of chromosome number — An attempt was made to count the number of chromosomes of some selected isolates of *Phytophthora* spp., to examine whether it could be used as a criterion for the separation of different species. However, lack of proper microscopic facilities greatly hampered the progress of these studies, (O. S. Peries & N. I. S. Liyanage).

Biochemical basis of resistance — Preliminary studies on the biochemical aspects of resistance to *Phytophthora* spp., were carried out. Green mature pod cavities of clones RRIC 52 and RRIM 513 were inoculated with a standard zoospore suspension and the diffusates obtained were analysed for phenolic compounds by paper chromatography. Ten spots were detected in RRIC 52, of which seven were detected under UV light and three showed a positive reaction to p-nitraniline. The Rf, values of all these spots in clone RRIC 52 are shown in Table 2. Amongst the spots obtained was a very bright blue spot which was found in diffusates of the clones tested. This spot did not answer the p-nitraniline test. Six, UV positive spots were observed in clone RRIM 513, and it also gave six spots with p-nitraniline reagent.

Bioassay of eluted spots using zoospores of *Phytophthora* revealed some inhibitory effect on spore germination.

Attempts were also made to study the UV absorption pattern of eluted compounds. (A. de S. Liyanage, O. S. Peries & N. I. S. Liyanage in collaboration with P. A. J. Yapa).

TABLE 2 — CHROMATOGRAPHIC ANALYSIS OF PHENOLICS IN THE CLONE RRIC 52

Spot No.	Rf*	p-nitraniline	Ninhydrin	UV
1	70	—	—	+
2	49	—	—	+
3	37	—	+	+
4	26	—	+	+
5	18	—	—	+
6	12	—	+	+
7	5	—	—	+
8	79	+	—	—
9	65	+	—	—
10	58	+	—	—

*Solvent system : Iso-Propanol-n-Butanol-Tetra Butanol-Ammonia-water.

Gloeosporium alborubrum

Effect of temperature on the growth and sporulation — Twelve isolates were collected from different rubber growing areas to study the variability and pathogenicity of *Gloeosporium alborubrum.*

The growth of different *Gloeosporium* isolates are shown in Table 3. The results indicate that the optimum temperature for the growth of all isolates range between 25 — 30°C. The reduction in growth of the fungus at 20°C was more marked than at 35°C, suggesting that the fungus is able to stand higher temperatures. There are differences in the pattern of growth of different isolates. While some were fast growing, a few showed a slow growth rate. This behaviour was found to be independent of the temperature conditions under which they were incubated.

Assessment of sporulation, 8 days after inoculation is shown in Table 4. This indicates that the isolates which supported good growth did not necessarily produce spores in abundance. Some of the slow growing isolates produced more spores than most of the fast growing isolates. It was observed that maximum sporulation generally occurred at 30°C, except in a few instances. Isolate obtained from Bibile showed heavy sporulation even at 35°C, showing its high adaptibility to thrive under dry conditions. Also, the isolate obtained from Moralioya produced hardly any spores, at all temperatures. (A. de S. Liyanage & S. S. Jayasooriya).

Effect of pH on the growth and sporulation—Generally all isolates tested tolerated a higher pH level for growth, with the optimum growth being recorded at pH 6. Poor growth was recorded at pH 5. (Table 5).

Results shown in (Table 6) indicate that at least five isolates showed maximum sporulation at pH 9 while the others showed maximum sporulation between pH 6 —7. (A. de S. Liyanage & S. S. Jayasooriya).

Effect of relative humidity on the growth and sporulation — Results shown in Table 7 reveal that the rate of growth was not affected by the presence of free water which helped to maintain RH near saturation conditions. The isolates which were shown to be slow growing continued to do so even at 100% relative humidity.

It was shown (Table 8) that the intensity of sporulation in some isolates was markedly reduced at 100% RH. This may be due to the reduction of temperature brought about by the presence of free water. (A. de S. Liyanage & S. S. Jayasooriya).

TABLE 3 — EFFECT OF TEMPERATURE ON THE GROWTH OF DIFFERENT ISOLATES OF *GLOEOSPORIUM*

Isolate No.	Estate	District	Temperature °C																											
			15°						20°						25°						30°						35°			
			days after inoculation																											
			1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1	Moralioya	Kelani Valley	6·2	6·2	9·0	10·6	14·6	19·6	6·6	14·3	23·5	31·3	40·1	54·8	11·3	24·3	37·2	48·2	63·0	78·7	19·3	28·3	40·1	51·7	64·0	80·7	8·3	12·7	18·1	23·6	31·1	36·0
2	Urumutta	Matara	6·0	6·2	8·5	9·6	16·2	24·1	6·0	13·3	23·1	29·8	40·1	54·3	9·8	24·3	38·1	48·1	63·2	81·5	14·1	30·7	42·3	54·3	68·7	85·0	8·5	12·8	20·1	26·7	33·7	39·5
3	Nakiadeniya	Galle	6·0	6·7	11·1	12·0	16·3	22·1	6·6	15·2	27·0	32·7	45·5	58·3	8·6	25·3	38·3	51·0	68 5	82·0	19·2	29·5	41·8	54·6	66·2	82·3	10·3	10·3	13·2	18·5	24·5	35·6
4	Pelmadulla	Ratnapura	6·1	6·0	10·3	13·3	19·6	26·6	6·1	14·8	25·2	32·6	46·1	58·5	10·1	25·7	39·1	47·5	63·6	81·5	13·1	27·1	39·7	50·1	62·3	83·7	8·2	12·3	18·5	24·1	32·5	39·5
5	Peenkanda	Ratnapura	6·0	6·2	10·8	12·8	18·8	24·5	6·1	14·3	24·5	32·6	44·5	58·7	11·0	26·3	42·1	54·7	72·0	85·0	15·2	30·8	45·8	59·5	76·0	85·0	7·3	10·7	17·0	22·2	29·6	34·3
6	Golinda	Kegalle	6·5	7·3	9·1	10·2	12·8	16·0	7·3	11·0	17·0	22·8	34·1	44·5	11·0	20·8	40·1	42·0	56·8	70·6	12·0	23·1	33·8	42·5	53·2	61·0	10·1	12·3	16·5	21·3	24·0	26·0
7	Padukka	Colombo	6·3	6·2	7·6	9·2	11·2	14·0	6·3	9·0	13·0	16·0	18·8	21·1	9·2	12·7	18·1	21·2	27·1	28·1	9·1	14·3	20·2	24·5	28·2	30·8	6·0	6·1	8·6	9·8	11·5	12·1
8	Wariyapola	Matale	6·2	6·2	10·1	12·2	16·3	24·5	6·0	12·7	22·3	30·5	40·0	53·7	8·2	21·7	35·2	46·3	64·0	79·5	10·1	25·8	38·1	49·8	66·0	78·8	7·1	10·7	15·5	20·6	26·5	31·5
9	Gampola	Kandy	6·0	6·0	7·6	8·6	11·7	19·0	6·0	11·3	17·1	18·6	23·7	34·5	8·2	17·2	26·0	31·3	43·0	43·5	14·3	26·2	37·7	49·2	65·5	78·3	6·2	8·7	11·7	16·5	21·2	24·7
10	Bibile	Badulla	6·0	6·0	6·3	6·7	7·8	15·6	6·0	9·8	18·7	24·1	34·5	45·6	8·3	20·7	33·3	44·1	59·3	73·2	10·5	25·0	37·6	49·2	64·5	74·2	8·1	10·1	15·1	17·8	24·1	26·5
11	Monaragalla	Badulla	6·0	6·2	7·3	8·6	11·5	19·0	6·2	10·3	19·5	26·2	40·2	51·5	7·1	18·7	32·7	45·5	63·6	79·7	9·6	24·2	38·0	50·2	68·0	79·7	7·7	15·1	23·6	29·7	37·7	44·8
12	Dartonfield	Kalutara	6·0	6 0	6·1	7·0	9·6	13·2	6·0	8·7	13·1	17·8	25·0	34·2	7·7	15·3	23·2	31·7	42·7	55·0	8·1	15·8	23·0	30·8	36·8	41·8	6·0	6·0	6·0	6·5	7·2	7·8

TABLE 4 — ASSESSMENT OF SPORES OF DIFFERENT ISOLATES OF GLOEOSPORIUM (X 10^4)

Isolate No.	Estate	District	Temperature (C°) 15°	20°	25°	30°	35°
1	Moralioya	Kelani Valley	0·63	1·13	1·25	0·63	1·25
2	Urumutta	Matara	2·88	4·25	28·75	17·75	2·63
3	Nakiadeniya	Galle	1·50	3·50	3·88	43·88	1·50
4	Pelmadulla	Ratnapura	0·25	1·25	3·38	6·13	1·38
5	Peenkanda	Ratnapura	0·00	2·13	9·75	5·75	3·13
6	Golinda	Kegalle	1·88	3·25	15·38	71·75	12·13
7	Padukka	Colombo	4·25	4·25	12·13	25·88	0·13
8	Wariyapola	Matale	0·38	1·25	1·88	7·38	3·13
9	Gampola	Kandy	1·13	0·00	0·88	3·88	2·25
10	Bibile	Badulla	1·13	2·75	4·75	28·63	25·50
11	Monaragala	Badulla	0·25	1·63	5·50	17·63	3·63
12	Dartonfield	Kalutara	0·88	6·63	8·75	25·50	5·00

TABLE 5 — EFFECT OF pH ON THE GR

Isolate No.	Estate	District	pH[5]					pH[6]		
			3	4	5	6	7	3	4	5
1	Moralioya	Kelani Valley	44·3	58·6	72·0	77·6	79·6	46·5	62·3	78·8
2	Urumutta	Matara	27·3	34·5	49·0	76·6	83·1	43·3	59·8	76·0
3	Nakiadeniya	Galle	26·3	27·0	25·1	31·1	37·0	37·1	49·1	62·0
4	Pelmadulla	Ratnapura	41·8	53·1	60·5	61·6	64·6	46·8	62·3	77·6
5	Peenkanda	Ratnapura	38·1	48·5	61·5	75·1	82·1	47·5	63·1	76·5
6	Golinda	Kegalle	36·1	39·8	44·6	49·6	52·8	36·6	48·6	62·6
7	Padukka	Colombo	25·6	29·6	32·6	42·0	55·0	29·0	37·6	47·0
8	Wariapola	Matale	28·8	30·3	39·3	58·1	66·1	29·6	43·8	60·1
9	Gampola	Kandy	36·5	50·6	63·6	79·6	85·0	41·3	54·8	68·8
10	Bibile	Badulla	40·0	52·0	64·5	75·1	79·1	45·0	54·6	69·8
11	Monaragala	Badulla	42·8	59·0	75·3	83·5	85·0	41·1	61·8	77·6
12	Dartonfield	Kalutara	27·8	35·8	43·0	47·7	48·7	28·0	36·8	45·5

TABLE 6 — EFFECT OF pH ON SPORULATION OF DIFFERENT ISOLATES OF *GLOEOSPORIUM* (x 10^4)

Isolate No.	Estate	District	pH 5	pH 6	pH 7	pH 8	pH 9
1	Moralioya	Kelani Valley	0·44	0·66	0·38	0·82	0·58
2	Urumutta	Matara	8·25	32·25	54·43	66·44	78·62
3	Nakiadeniya	Galle	6·5	71·83	70·5	39·5	48·75
4	Pelmadulla	Ratnapura	0·63	4·33	24·43	11·94	8·13
5	Peenkanda	Ratnapura	0·33	2·13	4·08	3·56	4·0
6	Golinda	Kegalle	21·31	72·93	88·83	76·13	113·7
7	Padukka	Colombo	6·38	15·93	26·25	22·38	27·44
8	Wariyapola	Matale	0·69	0·38	0·92	1·25	0·75
9	Gampola	Kandy	0·75	1·31	0·94	0·57	2·33
10	Bibile	Badulla	1·33	17·5	34·62	36·13	133·25
11	Monaragala	Badulla	2·63	5·38	4·31	7·88	17·33
12	Dartonfield	Kalutara	4·66	22·31	10·13	10·44	11·94

[4]Each figure is a mean of 3 replicates.

TABLE 7 — EFFECT OF 100% RH ON THE GROWTH OF DIFFERENT ISOLATES OF *GLOEOSPORIUM*

Isolate No.	Estate	District	days after inoculation			
			1	2	3	4
1	Moralioya	Kelani Valley	13·6	28·7	44·1	85·0
2	Urumutta	Matara	14·2	31·3	46·0	85·0
3	Nakiadeniya	Galle	13·2	31·3	47·9	84·0
4	Pelmadulla	Ratnapura	11·2	27·8	44·3	80·5
5	Peenkanda	Ratnapura	12·9	31·4	48·0	78·5
6	Golinda	Kegalle	8·8	19·6	30·4	60·5
7	Padukka	Colombo	8·6	12·3	18·8	27·4
8	Wariyapola	Matale	12·5	28·3	43·6	84·3
9	Gampola	Kandy	11·3	25·8	39·3	72·5
10	Bibile	Badulla	12·4	28·1	42·4	57·0
11	Monaragala	Badulla	11·8	27·6	45·2	85·0
12	Dartonfield	Kalutara	8·1	17·8	27·5	53·7

TABLE 8 — EFFECT OF 100% RH ON THE SPORULATION OF DIFFERENT ISOLATES OF *GLOEOSPORIUM* ($\times 10^4$)

Isolate No.	Estate	District	Sporulation
1	Moralioya	Kelani Valley	0
2	Urumutta	Matara	27·96
3	Nakiadeniya	Galle	18·0
4	Pelmadulla	Ratnapura	0·8
5	Peenkanda	Ratnapura	3·4
6	Golinda	Kegalle	30·2
7	Padukka	Colombo	11·5
8	Wariyapola	Matale	4·4
9	Gampola	Kandy	4·3
10	Bibile	Badulla	2·8
11	Monaragala	Badulla	2·2
12	Dartonfield	Kalutara	6·2

Rigidoporus lignosus

Collection of isolates — Eleven isolates of the fungus, (10 from rubber and 1 from cocoa) were obtained from infected roots collected from seven rubber growing districts, as listed in Table 9. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

TABLE 9 — SOURCE AND ORIGIN OF DIFFERENT ISOLATES OF *R. lignosus*

Isolate No.	Estate	District	Source
A	Dartonfield	Kalutara	Rubber
B	Dartonfield	Kalutara	,,
C	Urumutta	Matara	,,
D	Stokesland	Galle	,,
E	Bentota	Galle	,,
F	Peenkanda	Ratnapura	,,
G	Mahaoya	Kelani Valley	,,
H	Woodend	Kelani Valley	,,
J	Muwankanda	Kurunegala	,,
K	Wariyapola	Matale	,,
L	Wariyapola	Matale	Cacao

Effect of temperature on the growth — Maximum growth of all the isolates was recorded at 30°C. The growth of the fungus was poor at 15°C and was almost static at 40°C. Isolate H tolerated both high and low temperature conditions. (Table 10).

TABLE 10 — MEAN RADIAL GROWTH (mm) OF *R. lignosus* ON MALT AGAR AT DIFFERENT TEMPERATURES, 3 DAYS AFTER INOCULATION

Temperature °C	Isolate A	B	C	D	E	F	G	H	J	K	L
15	12·5	8·6	7·1	8·4	11·1	9·2	8·6	43·2	6·1	9·5	7·2
20	96·0	126·2	117·0	104·5	115·5	67·2	144·0	207·5	94·7	101·5	89·0
25	151·7	161·9	170·5	156·5	195·5	131·0	152·5	294·5	181·5	191·0	181·5
30	181·5	215·5	211·0	186·0	216·0	181·5	247·5	292·5	207·0	226·0	213·0
35	97·4	118·0	171·5	127·5	123·5	94·5	141·5	206·2	117·0	150·7	156·0
40	2·0	3·5	4·7	5·7	6·0	4·5	5·5	7·5	3·5	3·7	4·0

Analysis of variance on the growth of the fungus 3 days after inoculation, revealed that all isolates differed in their response to temperature. The interaction of the isolates was significant at higher temperatures but not at lower temperatures. This shows that the isolates are sensitive to high temperatures.

Table 11 gives the parabolic equation relating growth of each isolate to increase in temperature. The temperature at which maximum growth was attained, was calculated and found to be almost identical for all isolates.

TABLE 11 — CALCULATED TEMPERATURE OPTIMA AND LINEAR GROWTH (mm) OF DIFFERENT ISOLATES OF *R. lignosus*

Isolate	Optimum temperature °C	linear growth
A	27·4	41·5
B	27·5	48·4
C	27·9	51·3
D	27·7	44·5
E	27·5	51·2
F	27·8	37·8
G	27·6	52·2
H	27·2	76·5
J	27·6	48·0
K	27·8	52·6
L	27·9	50·2

Regression equation of $y = a + bx + cx^2$

The amount of growth at this temperature was widely different between isolates, maximum and minimum growth were found in isolate H and F respectively.

Most of the isolates produced thick rhizomorphs at lower temperatures, except isolate H which did not produce any rhizomorphs. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

Effect of pH on the growth — The growth was tested at pH values ranging from 3 to 11. Mean growth 3 days after inoculation is given in Table 12.

TABLE 12 — MEAN COLONY DIAMETER (mm) OF DIFFERENT ISOLATES OF *R. lignosus* ON MALT AGAR, 3 DAYS AFTER INOCULATION

	Isolate										
pH	A	B	C	D	E	F	G	H	J	K	L
3	0	0	0	0	0	0	0	0	0	0	0
4	6·1	11·1	10·2	9·0	7·8	5·7	11·5	45·2	4·8	11·0	9·1
5	24·6	28·7	35·7	31·8	30·2	24·6	34·2	64·8	25·1	30·0	26·5
6	35·0	35·2	41·8	39·3	41·5	31·2	46·7	64·3	37·1	43·2	39·5
7	47·0	49·2	50·5	51·8	50·5	40·2	56·7	65·0	46·0	54·2	46·1
8	55·1	57·6	54·2	54·2	53·6	45·3	56·1	67·5	51·3	61·0	53·1
9	52·6	63·0	57·7	66·8	57·1	49·6	64·0	61·3	54·3	60·7	56·1
10	57·1	61·7	56·5	68·5	56·5	41·8	64·0	49·6	54·0	60·3	50·3
11	58·2	55·8	54·7	65·6	53·0	44·7	57·7	27·6	44·6	55·0	52·5

pH 3 was found to be lethal for growth of all isolates. Even at pH 4 poor growth was recorded for all isolates except isolate H. However, it did not tolerate higher pH values unlike other isolates. Both linear and quadratic effects of pH on fungal growth were significant. This indicated an increase in growth with an increase in pH. However, at higher pH values a diminishing pattern of growth was noted.

It was shown that linear into linear component of interaction between isolates and pH was significant. This shows that growth of various isolates at low pH was different, but the tendency for the growth to fall away with increase in pH is alike in all isolates. Therefore, regression equation $y = a + bx - x^2$ was fitted to each isolate and linear regression coefficient was used to determine the pattern of tolerance to pH by the *Rigidoporus* isolates. (Table 13).

TABLE 13 — THE PATTERN OF TOLERANCE TO pH BY ELEVEN ISOLATES OF *R. lignosus* BASED ON LINEAR REGRESSION COEFFICIENT (LRC)

	Isolate										
	H	K	G	E	C	J	B	L	D	A	F
LRC	49·1	30·8	30·7	28·6	27·9	27·8	26·3	26·0	24·5	23·1	22·7

Isolate H was able to withstand low pH levels while isolate F was the most sensitive.

The ability of different isolates to form rhizomorphs at various pH levels are shown in Table 14.

TABLE 14 — PRODUCTION OF RHIZOMORPHS BY DIFFERENT ISOLATES OF *R. lignosus* AT VARIOUS pH LEVELS, 30 DAYS AFTER INOCULATION

Isolate	pH							
	4	5	6	7	8	9	10	11
A	2	3	4	4	4	4	4	3
B	1	3	4	4	4	4	4	2
C	3	4	4	4	4	4	4	4
D	2	3	4	1	1	1	1	1
E	1	4	4	4	4	4	2	2
F	4	4	4	4	4	4	4	4
G	2	2	4	4	4	4	4	2
H	5	5	5	5	5	5	5	5
J	2	3	5	5	5	4	4	3
K	1	2	2	2	2	2	2	2
L	1	2	2	2	2	2	2	2

Scale : 1 = Very distinct ; 2 = Distinct ; 3 = Diffuse ; 4 = Thin ; 5 = Nil

Rhizomorph production was more pronounced at both low and high pH levels suggesting that they are formed under sub-optimal conditions. However, isolate H did not produce any rhizomorphs at any pH tested. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

Effect of light and dark on growth — All isolates grew significantly better in the dark than when exposed to continuous light, except isolate H which grew well under both conditions (Table 15). These observations were further confirmed by the significant negative correlation coefficient (r = 0·653). (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

TABLE 15 — EFFECT OF EXPOSURE TO CONTINUOUS LIGHT AND DARK CONDITIONS ON THE GROWTH (mm) OF ELEVEN ISOLATES OF *R. lignosus*, 3 DAYS AFTER INOCULATION

Isolate	Mean colony diameter dark	light	Difference	Significance
H	68·7	66·4	2·3	NS
J	34·2	29·8	4·4	*
E	39·2	32·7	6·5	*
D	38·6	34·1	4·5	*
C	38·4	30·9	7·5	*
A	37·8	28·7	9·1	*
B	36·4	26·4	10·0	*
L	32·6	21·6	11·0	*
K	32·2	20·6	11·6	*
G	40·4	28·4	12·0	*
F	29·2	15·8	13·4	*
Mean	38·8	30·4		

NS = not significant

* significant at 5% level LSD = 0·041

Effect of relative humidity on growth — Effect of 50%, 75% and 100% relative humidities were tested on the growth of the fungus and the results are presented in Table 16. Growth measurements taken 3 days after commencement of the experiment, showed that the growth was not affected by these humidities. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

TABLE 16 — MEAN LINEAR GROWTH (mm) OF ELEVEN ISOLATES OF *R. lignosus* KEPT AT DIFFERENT RELATIVE HUMIDITIES, 3 DAYS AFTER INOCULATION

Isolate	Relative humidity (%) 100	75	50
A	37	38	37
B	45	42	44
C	44	39	42
D	38	38	35
E	45	40	40
F	—	—	—
G	43	45	41
H	65	68	68
J	36	36	37
K	40	38	39
L	39	39	38

Pathogenicity of the fungus on rubber roots — The ability of the fungus to grow in autoclaved and non-autoclaved healthy rubber root pieces was examined by using a modification of the technique used by Fox in 1966.

It was shown that the isolate behaviour was significantly different from one another when grown on autoclaved healthy rubber roots. (Table 17).

TABLE 17 — MEAN LINEAR GROWTH (mm) OF ELEVEN ISOLATES OF *R. lignosus* ON HEALTHY AUTOCLAVED RUBBER ROOTS, 3 DAYS AFTER INOCULATION

Isolate										
H	A	E	G	B	C	J	D	K	L	F
51·5	21·8	20·0	19·2	15·2	15·0	13·9	13·5	12·6	12·2	4·9

Any two means not underscored by the same line are significantly different at 5% level of confidence by the multiple range test.

Isolate H showed a significantly faster rate of growth than all other isolates except isolate F, which showed a very slow rate of growth.

The use of surface sterilized non-autoclaved rubber root pieces showed essentially the same pattern of infection. Isolate H and F respectively were the most

and least virulent isolates. The pattern of growth of the fungus shown in Table 18 was the same irrespective of the time of examination of the inoculated root pieces. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

TABLE 18 — MEAN LINEAR GROWTH (mm) OF ELEVEN ISOLATES OF *R. lignosus* ON HEALTHY HEVEA ROOTS, 7 & 14 DAYS AFTER INOCULATION

7 days after inoculation											
H	B	A	C	E	G	D	K	L	J	F	
31·8	8·3	7·6	7·5	7·4	7·2	6·3	6·2	6·1	5·2	3·2	
14 days after inoculation											
H											
53·8	24·5	23·8	23·4	21·1	20·9	20·2	20·0	18·9	18·7	8·4	

Any two means not underscored by the same line are significantly different at 5% level of confidence of multiple range test.

Spread of different isolates in seven soil types — The spread of the fungus under laboratory conditions was studied using a soil tube technique. The soils were adjusted to 50% moisture holding capacity.

The results shown in Table 19 indicate that all the isolates grew well in soils of Matale, Boralu and Homagama series. Although the mycelial strands of the fungus were thinner in these soils, the quantity of mycelium per unit volume was higher. Soils of Agalawatta and Ratnapura series also supported satisfactory growth but the quantity of mycelium produced was small. Further, the mycelial strands produced in these soils were thicker. Less growth was recorded in Parambe soil and virtually no growth was found in Deniya soil. *Trichoderma* spp., was found to be predominant in Parambe soils and it may have an antagonistic effect on the fungus. Owing to the greater porosity, the deniya soils had a poor water retention capacity. This resulted in the accumulation of water added to each tube, submerging the fungus. This may have starved the fungus of oxygen required for its growth. It was also shown that the pH of the soil has some influence on the growth of the fungus. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

TABLE 19 — MEAN LINEAR GROWTH (mm) OF ELEVEN ISOLATES OF *R. lignosus* IN SEVEN TYPES OF RUBBER SOILS, 5 DAYS AFTER INOCULATION

		Isolate										
Soil type	Soil pH	A	B	C	D	E	F	G	H	J	K	L
Agalawatta	3·9	23·0	16·4	19·6	10·2	23·0	5·4	7·4	15·6	11·4	14·4	24·6
Ratnapura	3·9	25·6	18·2	21·8	6·0	27·0	2·0	21·0	4·2	12·8	16·6	20·6
Parambe	4·1	16·4	13·4	9·8	7·4	18·6	9·2	10·2	5·4	8·4	18·4	14·8
Deniya	5·2	2·4	0	0	0·8	7·8	2·4	7·6	5·8	4·6	0	2·4
Matale	5·2	33·2	26·8	24·6	24·4	28·2	25·8	28·0	20·4	33·8	33·2	33·4
Boralu	4·4	32·8	35·0	24·6	20·2	35·2	17·2	31·4	33·0	31·8	26·8	31·4
Homagama	4·9	23·6	22·4	21·6	12·2	25·8	10·8	25·0	25·4	23·8	22·2	21·0

Statistical analysis revealed that there were significant differences between isolates and isolate × soil interaction. This shows that the isolates respond differently to different environments.

The use of a new statistical approach to evaluate the genotype-environment interaction enabled the grouping of isolates in relation to their adaptability. According to this analysis, the isolates showing a regression coefficient higher than 1·0 are unstable and those showing a regression coefficient of less than 1·0 have a high degree of adaptability to this environment, as shown in Table 20.

TABLE 20 — THE GROUPING OF ISOLATES OF *R. lignosus* ON THE BASIS OF REGRESSION COEFFICIENTS

Isolate	Regression coefficient	Grouping	
J	1·2176	> 1·0	Very sensitive to changes in soil type
B	1·1674		
A	1·0958	= 1·0	generally adapted to all soil types
L	1·0820		
K	1·0752		
H	0·9917		
G	0·9768		
F	0·7702	< 1·0	not sensitive to changes in soil types.
D	0·8468		
E	0·8720		
C	0·9023		

Xylaria *spp.*

Isolation of causal organism of Black Root disease — Several isolates were obtained from Parambe, Golinda, Orange Grove State Plantation, Hatbawa and Urumutta Estates. These isolates were sent to CMI for identification but none of them were identified as *Xylaria* spp. even though some of them produced fructifications resembling those found in the field, under laboratory conditions. (A. de S. Liyanage & S. Wettasingha).

Miscellaneous

Phytophthora palmivora was successfully isolated from an infected coconut palm from Mutugala Estate, Dambadeniya. Several earlier attempts to isolate the fungus proved unsuccessful, as the material for isolation was obtained from an area close to the rotting apical region of the stem. However, the fungus was isolated successfully when pieces of infected material were obtained from about 60 cm away from the apex. The fungus was also baited using cocoa pods. The average spread of the lesion of the fungus on cocoa pods from 4 to 7 days was determined as 33·6 mm per day. (O. S. Peries, A. de S. Liyanage & D. M. Dantanarayana).

HOST-PARASITE RELATIONSHIPS

Oidium heveae

Histological basis of resistance — Copper brown leaf discs of RRIC 7, RRIC 52, RRIC 102, RRIC 103, LCB 870, PB 86, F 409 and F 4542 were removed and inoculated on the upper surface with conidia of *Oidium*. Samples were removed at

2, 5, 10, 24, 48 and 72 h after inoculation. Leaf discs were also removed for sectioning, to examine the post-penetration behaviour. Assessments are still continuing. (A. de S. Liyanage).

Effect of cuticle thickness on penetration — The effect of cuticle thickness of PB 86, RRIC 45, RRIC 52 and Tjir 1 was investigated to determine the relationship that exists between cuticle thickness and infection by *Oidium*. Leaves were tagged as they emerged from the bud and small pieces were removed at weekly intervals to prepare transverse sections. Some of the leaves that were tagged were affected by *Oidium*, causing laef-fall. This hampered the progress of this work. (O. S. Peries & N. I. S. Liyanage).

Phytophthora *spp.*

Histology of host penetration in petioles, stems and bark — Microscopic examination of free hand sections of petioles of PB 86, 8 days after inoculation with a zoospore suspension revealed the presence of fungal hyphae, resembling *Phytophthora* spp., in the meta-xylem, xylem parenchyma and in the pith. Hyphae were intra-cellular and not inter-cellular. The thickness of the hyphae varied between 3—6μm and in some cells right angle branching was evident. Hyphae were seen to extend along three xylem cells. A number of darkly stained cells were also noted. However, when artificially inoculated wax embedded sections were examined hyphae were not evident, even in sections obtained from petioles kept for 10 days after inoculation, but there was clear evidence of cell eruption at points of entry of zoospores. At these points epidermal cells were elongated considerably and they were about three times the length of normal epidermal cells.

Artificially inoculated tender stems of *Hevea*, on examination showed the presence of tyloses in xylem vessels. These too are formed as a response to injury or invasion by the pathogen. Evidence of any *Phytophthora* hyphae was not found.

Examination of sections obtained from naturally infected bark of PB86, revealed the presence of structures resembling *Phytophthora* hyphae. In the affected tissue, groups of large thick walled cells with granular contents were observed in the soft bark. In healthy tissues such cells were not observed. Sections of old lesions showed, bands of darkly stained cells in soft bark. This could be a layer of cells separating the infected tissue from the healthy tissue cut off by a newly formed cambium. (O. S. Peries & N. I. S. Liyanage).

Scanning Electron Microscopy of Leaf disks & petioles — Leaf disks and petioles inoculated with a zoospore suspension of *Phytophthora* spp. were removed at different intervals of time and fixed in glutaraldehyde and dehydrated through a series of mixtures of ethanol and iso-amyl acetate. These were sent to Long Ashton Research Station in Bristol, England for Scanning Electron Microscopy. (A. de S. Liyanage, O. S. Peries & N. I. S. Liyanage).

Anatomy of bark — The number of latex vessel rings in the virgin bark was compared with that of a thirteen year old callused bark and the renewed bark on the same tree. There were no significant differences in the number of latex vessel rings. However, the thickness of the hard bark was greater in the virgin bark, but the thickness of soft bark was comparable in all three cases. (O. S. Peries & N. I. S. Liyanage.)

TABLE 21 — SUSCEPTIBILITY OF LEAF PETIOLES TO *PHYTOPHTHORA* INFECTION

Clone	Mean lesion size (cm)	Clone	Mean lesion size (cm)	Clone	Mean lesion size (cm)	Clone	Mean lesion size (cm)
RRIC 59	7·2	LCB 1320	11·4	PR 107	12·5	RRIC 103	13·7
RRIC 94	9·1	PB 28/59	11·4	RRIC 50	12·6	RRIC 99	13·8
RRIC 9	9·4	PR 252	11·5	RRIM 701	12·6	RRIC 104	13·8
RRIC 42	9·4	IAN45/701	11·6	RRIC 62	12·7	RRIM 604	13·9
2417	9·4	6306	11·7	RRIC 76	12·7	RRIC 91	14·0
RRIC 17	9·7	RRIC 55	11·8	RRIC 107	12·7	RRIC 52	14·1
RRIC 22	9·7	RRIC 92	11·8	PR 255	12·7	RRIC 106	14·1
GL 1	9·7	IAN45/710	11·8	NAB 12	12·7	RRIM 526	14·1
RRIC 95	9·9	3221	11·8	RRIC 36	12·8	RRIM 628	14·1
F 409	9·9	RRIC 89	11·9	RRIC 64	12·8	PB 86	14·1
RRIC 32	10·0	RRIC 110	11·9	RRIC 102	12·8	AV 1349	14·1
RRIC 37	10·1	AV 1734	11·9	F 4542	12·8	RRIM 608	14·3
RRIC 69	10·2	RRIC 40	12·0	F 351	12·9	RRIC 48	14·6
WR 101	10·3	RRIM 609	12·0	RRIC 7	13·0	RRIC 87	14·6
RRIC 57	10·4	PR 253	12·0	RRIC 41	13·0	RRIC 88	14·6
RRIC 100	10·4	RRIC 65	12·1	RRIC 46	13·0	2427	14·8
IAN 45/873	10·5	RRIM 603	12·1	2418	13·0	RRIM 605	15·1
NAB 15	10·6	RRIM 620	12·1	RRIC 33	13·1	IRCI 2	15·2
RRIC 63	10·8	PB 5/51	12·1	Tj 1	13·1	RRIC 54	15·4
RRIC 68	10·8	CH 32	12·1	RRIC 38	13·2	AV 1734	15·4
IRCI 7	10·8	RRIC 31	12·2	RRIC 39	13·2	RRIC 75	15·5
RRIC 3	10·9	RRIC 105	12·2	WG 6278	13·2	NAB 17	15·5
RRIC 4	10·9	MK 3/2	12·2	AV 1328	13·2	RRIC 5	15·8
RRIC 67	11·0	RRIM 602	12·2	RRIC 6	13·3	RRIC 86	15·8
RRIC 82	11·0	RRIM 623	12·2	IRCI 10	13·3	AV 385	15·8
RRIC 90	11·0	RRIC 101	12·3	PR 251	13·4	RRIC 45	15·9
RRIC 70	11·2	RRIC 109	12·3	RRIC 60	13·5	RRIM 600	15·9
RRIC 49	11·3	RRIC 66	12·4	IRCI 6	13·5	RRIC 108	16·2
IRCI 1	11·3	RRIC 13	12·5	FX 714	13·5	RRIC 55	16·6
IRCI 9	11·3	RRIM 607	12·5	2473	13·5	1305	16·8
RRIC 47	11·4	RRIM 707	12·5	GT 1	13·6	RRIM 621	17·0

Phenolic content of rubber pods—The total phenolic content of healthy green mature pods of the clones RRIC 40, RRIC 52, RRIC 100 and RRIC 101 was determined; of these clones RRIC 101 and RRIC 100 had the highest phenolic content. (A. de S. Liyanage, O. S. Peries, N. I. S. Liyanage in collaboration with P. A. J. Yapa.)

Phenolic content of healthy and infected bark — The total phenolic content of healthy and infected bark of PB 86 was determined. A significantly high phenolic content was noted in healthy bark tissues. (A. de. S. Liyanage, O. S. Peries, N. I. S. Liyanage in collaboration with P. A. J. Yapa).

Susceptibility of Hevea *petioles to* Phytophthora *infection* — Two methods were assessed. In the first, absorbant cotton wool strips (about 10 mm × 4 mm) were placed on the petioles after dipping in a zoospore suspension standardized to have 100,000 zoospores per ml. This method gave satisfactory results. However, a rot that was setting in from both ends of the petioles could not be arrested despite the immersion of both ends in molten wax. In the second method using Chee's technique, it was possible to inoculate a larger number. The results shown in Table 21 are arranged in the increasing order of susceptibility. This experiment was repeated on five occasions and there was a wide variability in the pattern of infection. This experiment would be repeated to inoculate a large number of petioles of each clone. (A. de S. Liyanage, S. Wettasingha & A. Dharmaratna).

CONTROL

Oidium heveae

Screening fungicides — The fungicides, Bayleton, Benlate, and Nimrod were tested at two concentrations *viz.* 0·1% and 0·05% to determine their effect on spore germination. Two methods were examined. (1) In the first method fungicides were sprayed until a thin film was formed on the glass slides and later spores were dusted before incubation. (2) In the second method, spores were dusted on clean glass slides before the application of fungicides. The results are shown in Table 22.

TABLE 22 — EFFECT OF FUNGICIDES ON SPORE GERMINATION OF *O. heveae*

Fungicide	Germination (%)*			
	Concentration *a.i.*			
	1		2	
	0·05%	0·1%	0·05%	0·1%
Bayleton	0	0	0	1·3
Benlate	1	0	0	0·7
Nimrod	0	0	0	0·3
Control	11·3		21·6	

* Mean of 3 replicates — 100 spores were counted for each replicate.

All the fungicides tested were found to be effective under laboratory conditions However, the number of conidia germinated in the control were low showing that the viability of spores was poor. These studies would be repeated before carrying out small scale field trials.

Phytophthora *spp.*

Investigations on new fungicidal systems — Several dithiocarbamates containing metal ions, chemicals such as zinc oxide and formaldehyde and fungicides recommended by the Institute were used. Antimucin and Actidione were used singly or in combination, *in vitro* trials. The fungicides were separately incorporated into Lima Bean Agar or Rubber Serum Agar in the presence or absence of latex, to give dilutions of 0·0025%, 0·02% and 0·1% of the fungicide, based on their active ingredient.

It was shown that most fungicides had little or no toxic effect at 25 ppm. At higher concentrations all the fungicides except zinc oxide and Zineb gave satisfactory results, showing that zinc based chemicals are ineffective against *Phytophthora* spp. Diffusibility studies showed that a mixture of Thiram and formaldehyde to be the most effective of all the fungicides tested except when mixed with bark extracts. When contact fungicidal properties were assessed, a result similar to that shown for linear growth was obtained.

However, in the presence of rubber serum, all the fungicides except Antimucin and Actidione were ineffective at 25 ppm. At 200 ppm all fungicides except Ziram were effective. However, a mixture of Thiram and zinc oxide, Thiram and formaldehyde and formaldehyde alone, gave unsatisfactory results in contact fungicidal tests.

The use of natural rubber latex was also examined. Field latex was found to be unsatisfactory. Ammoniated (1·2%) latex also permitted growth of the fungus at 25 ppm. At 200 ppm Actidione and Antimucin gave satisfactory results. Although the latter showed persistent fungicidal properties the former was found to be ineffective after 168 h after inoculation. (A. de S. Liyanage, G. W. Liyanage, D. M. Dantanarayana in collaboration with M. Nadarajah).

Field Investigations

BIOLOGY

Oidium heveae

Clonal susceptibility — Sixty plants each of 124 clones grown in the nursery at Dartonfield were assessed to determine the susceptibility to *Oidium* leaf disease.

The results tabulated in order of increasing resistance in Table 23, indicate that the clones could be grouped into three categories, based on the Ducan's multiple range test. This is the first assessment and it is possible that certain clones would have escaped natural infection because some of the leaves could have been mature at the time when inoculum was available.

The clones of F. FX and IAN origin appear to have a high degree of resistance to *Oidium* and these could be effectively used to incorporate *Oidium* resistance to new clones.

TABLE 23 — SUSCEPTIBILITY OF DIFFERENT CLONES TO *OIDIUM*

Clone	Mean	Clone	Mean	Clone	Mean
RRIC 67	16·57	NAB 15	10·42	RRIC 57	6·24
RRIM 603	16·49	Glen 1	10·35	RRIC 60	6·22
RRIM 621	15·30	GT 1	10·09	RRIC 63	6·21
PR 253	15·05	2417	10·04	RRIC 64	6·21
RRIC 59	14·73	Tj 1	10·01	RRIC 65	6·17
RRIC 107	14·23	RRIC 22	9·87	RRIC 88	6·14
RRIM 620	13·99	RRIC 33	9·56	RRIC 102	6·14
RRIC 6	13·21	RRIC 38	9·35	RRIC 103	6·09
RRIC 7	13·15	RRIC 42	9·31	RRIC 110	6·04
RRIC 86	12·74	RRIC 47	9·23	MICM 3/2	6·03
RRIC 99	12·66	RRIC 48	9·16	RRIM 623	5·85
RRIM 701	12·52	RRIC 54	9·14	PR 107	5·84
AV 1735	12·39	RRIC 62	9·07	PR 255	5·73
IRCI 6	12·06	RRIC 66	8·91	IRCI 2	5·72
1305	11·73	RRIC 76	8·87	LCB 1320	5·63
IRCI 7	11·69	RRIC 87	8·80	NAB 12	5·62
RRIC 3	11·48	RRIC 92	8·78	NAB 17	5·55
RRIC 17	11·41	RRIC 101	8·68	WR 101	5·13
RRIC 31	11·34	RRIC 104	8·64	2427	5·11
RRIC 82	11·21	Wagga 6278	8·62	6306	5·04
RRIC 90	11·06	RRIM 604	8·61	RRIC 32	4·92
RRIC 105	11·01	RRIM 607	8·61	RRIC 49	4·90
RRIM 600	10·92	PR 252	8·57	RRIC 52	4·81
RRIM 628	10·91	IRCI 1	8·50	RRIC 85	4·77
RRIM 707	10·81	F 4542	8·35	RRIC 108	4·75
AV 1734	10·61	IRCI 9	8·34	PB 28/59	4·28
PR 251	10·56	RRIC 9	8·31	F 351	4·27
		RRIC 37	8·29	F 409	3·92
		RRIC 40	8·19	FX 714	3·82
		RRIC 45	8·17	2418	3·82
		RRIC 46	8·16	2473	3·69
		RRIC 55	8·07	CH 32	3·47
		RRIC 69	8·05	AV 1349	3·04
		RRIC 75	7·84	IAN 717	2·91
		RRIC 100	7·83	IAN 710	1·17
		RRIC 106	7·66		
		RRIC 109	7·60		
		RRIM 526	7·56		
		RRIM 602	7·53		
		RRIM 608	7·35		
		RRIM 609	7·30		
		PB 86	7·22		
		PB 5/51	7·21		
		AV 385	7·19		
		AV 1328	7·18		
		IRCI 10	6·81		
		IAN 873	6·79		
		3221	6·72		
		RRIC 5	6·66		
		RRIC 13	6·54		
		RRIC 36	6·52		
		RRIC 39	6·41		
		RRIC 41	6·40		
		RRIC 50	6·31		

TABLE 24 — SUSCEPTIBILITY OF DIFFERENT CLONES TO *GLOEOSPORIUM*

Clone	Mean	Clone	Mean	Clone	Mean	Clone	Mean
Tj 1	8·06	RRIC 62	5·53	RRIC 32	3·17	RRIC 5	1·64
		RRIC 102	5·23	RRIC 33	3·11	RRIC 37	1·64
		IRCI 10	5·21	RRIC 38	3·09	RRIC 41	1·60
		FX 6306	4·38	RRIC 39	3·09	RRIC 48	1·60
		RRIM 608	4·32	RRIC 40	3·08	RRIC 50	1·58
		AVROS 1349	4·31	RRIC 45	3·08	RRIC 52	1·57
		AVROS 1735	4·27	RRIC 46	2·99	RRIC 55	1·56
		IRCI 1	4·15	RRIC 49	2·95	RRIC 60	1·53
		IRCI 6	4·10	RRIC 54	2·94	RRIC 64	1·52
		IRCI 7	3·95	RRIC 57	2·91	RRIC 69	1·50
		NAB 12	3·93	RRIC 63	2·91	RRIC 75	1·47
		NAB 17	3·87	RRIC 65	2·88	RRIC 85	1·47
		RRIC 67	3·85	RRIC 66	2·86	RRIC 87	1·44
		RRIC 86	3·79	RRIC 76	2·86	RRIC 100	1·37
		RRIC 108	3·78	RRIC 82	2·84	RRIC 105	1·36
		RRIC 109	3·78	RRIC 88	2·80	RRIC 110	1·34
		RRIC 7	3·72	RRIC 90	2·78	RRIM 602	1·34
		RRIC 22	3·71	RRIC 92	2·77	RRIM 605	1·32
		RRIC 36	3·67	RRIC 99	2·77	RRIM 707	1·31
		RRIC 42	3·66	RRIC 101	2·73	AVROS 385	1·23
		RRIC 47	3·60	RRIC 103	2·72	PR 255	1·23
		RRIC 59	3·50	RRIC 104	2·68	IRCI 9	1·23
		RRIC 3	3·33	RRIC 106	2·63	LCB 1320	1·22
		RRIC 6	3·29	RRIC 107	2·59	IAN 873	1·07
		RRIC 9	3·28	MK 3/2	2·57	F 351	0·65
		RRIC 13	3·25	Wagga 6278	2·54	F 409	0·64
		RRIC 17	3·24	RRIM 526	2·53	F 4542	0·58
		RRIC 31	3·22	RRIM 600	2·53		
				RRIM 603	2·52		
				RRIM 604	2·51		
				RRIM 607	2·49		
				RRIM 609	2·48		
				RRIM 620	2·47		
				RRIM 621	2·44		
				RRIM 623	2·43		
				RRIM 628	2·43		
				RRIM 701	2·40		
				PB 86	2·33		
				PB 5/51	2·28		
				PB 28/59	2·25		
				AVROS 1328	2·20		
				AVROS 1734	2·18		
				PR 107	2·15		
				PR 251	2·02		
				PR 252	2·01		
				PR 253	1·96		
				IRCI 2	1·96		
				NAB 15	1·91		
				CH 32	1·90		
				Glen 1	1·88		
				GT 1	1·85		
				WR 101	1·85		
				IAN 710	1·84		
				IAN 717	1·81		
				714	1·80		
				1305	1·76		
				2417	1·76		
				2418	1·75		
				2427	1·74		
				3221	1·72		

Gloeosporium alborubrum

Clonal susceptibility — Field observations were carried out to determine the susceptibility of 124 clones to *Gloeosporium* leaf disease. The results are tabulated in Table 24. in order of increasing resistance.

The results show that the clones could be grouped into four categories according to the nature of susceptibility.

The clones that showed the highest degree of resistance were Ford selections.

The critical period for panel infection with and without removal of panel scrap — It was shown (Table 25) that a tapping cut remains susceptible to bark rot infection for 3 days, when artificially inoculated after the removal of panel scrap; on the 4th day after inoculation the infection percentage, dropped to zero. However, when the inoculum strip was placed without the removal of scrap 100% infection was recorded only upto 24 h after causing injury to the bark. Thereafter, the percentage infection was reduced to 40% at the end of 3 days and by the 4th day none of the trees inoculated took infection. (A. de S. Liyanage, G. W. Liyanage, O. S. Peries, N. I. S. Liyanage & D. M. Dantanarayana).

TABLE 25 — EFFECT OF REMOVAL AND RETENTION OF PANEL SCRAP ON THE INCIDENCE OF BARK ROT

hours after tapping	% infection	
	without scrap	with scrap
3	100	100
9	100	100
24	100	100
48	100	80
72	100	40
96	0	0

Bark renewal of different clones — Five clones, PB 86, RRIC 7, RRIC 45, RRIC 52 and RRIM 513 were selected to study the callusing ability. A circular area of bark 9 cm diameter was removed in the virgin bark of 5 trees of each of the above clones. Results so far obtained (Table 26) indicate that the bark of clones RRIC 52 and RRIM 513 calluses faster and evenly than PB 86, RRIC 7 and RRIC 45. (O. S. Peries & N. I. S. Liyanage).

TABLE 26 — RATE OF BARK RENEWAL IN VARIOUS CLONES

Clone	Average length of renewed bark along the length of the trunk ∧ (cm) ∨	Average length of renewed bark along the breadth of the trunk <—> (cm)
RRIC 52	0·80	0·68
RRIM 513	0·73	0·63
RRIC 45	0·64	0·23
PB 86	0·67	0·18
RRIC 7	0·70	0·25

Effect of panel fungicides and other formulations on bark renewal of PB 86 — In this experiment where injured bark was treated with various formulations such as Shell TB 192, Kankerdood, Santar, Candarsan and a mixture of cow dung, ant hill earth, copper sulphate and sulphur were applied to wounds of PB 86, to study the rate of callusing. All the formulations applied on the panel showed a better callusing ability than the control. However, there was no marked difference between treatments. Also the results of the five replicates were inconsistent, although the trees were of the same age. (O. S. Peries & N. I. S. Liyanage).

Bark moisture determinations — Preliminary studies were carried out to determine the bark moisture content of five clones grown at Dartonfield. The results shown in Table 27 indicate that there is no marked difference between moisture content and susceptibitity to Bark Rot (O. S. Peries, A. de S. Liyanage & Z. E. Irugalbandara).

TABLE 27 — BARK MOISTURE CONTENT OF FIVE CLONES

Clone	Moisture content	Susceptibility to Bark Rot
RRIC 7	1·2	unknown
RRIC 45	1·4	highly susceptible
RRIC 52	1·2	resistant
RRIC 88	1·5	unknown
PB 86	1·4	moderately susceptible

Rate of spread of Phytophthora infection — Ten PB 86 trees were inoculated on 30th November, 1975 at the tapping cut and about 2 metres from the ground using the strip and disc inoculation techniques respectively, to examine the influence of weather on the rate of spread of the fungus. The results are tabulated in Table 28. It was observed that the rate of spread is greater when the inoculation is carried out above the tapping panel. Monthly inoculations will be carried out and also bark plugs will be removed at the time of inoculation, 2 weeks later and at the end of 4 weeks to determine the moisture content of the bark. (A. de S. Liyanage, O. S. Peries & D. M. Dantanarayana).

TABLE 28 — RATE OF SPREAD (cm) OF THE FUNGUS IN PB 86

Date of sampling	Tapping panel				Above the tapping panel			
	Mean maximum lesion length	Mean minimum lesion length	Mean lesion length	Range lesion length	Mean upper lesion length	Mean lower lesion length	Mean (lesion length) upper	Mean (lesion length) lower
30 Nov. 1975	40·3	15·6	25·3	3·0—124·0	81·5	51·5	25·0—270·0	20·0—117·0

Infection in relation to different stages of growth of the rubber tree — An experiment was initiated to examine the relationship that exists between Nursery, Budwood and Mature rubber trees to bark rot infection. 10 plants each of the clones PB 86, RRIC 45, RRIC 52 were inoculated with a zoospore suspension using the disc inoculation technique. There were 3 replicates. The resulting lesions were measured at the end of 4 weeks and are shown in Table 29.

TABLE 29 — EFFECT OF THE STAGE OF DEVELOPMENT OF THE TREE ON LESION DEVELOPMENT*

Stage of the growth of trees	Lesion length (cm)			Lesion area (cm^2)		
	Clone			Clone		
	PB 86	RRIC 45	RRIC 52	PB 86	RRIC 45	RRIC 52
Nursery	2·29	2·44	1·98	3·39	4·87	3·93
Budwood nursery	4·44	3·46	2·56	6·86	7·31	4·45
Mature	8·69	11·54	2·50	8·49	10·74	2·18

* Mean of 30 trees

These studies show that the lesion development in plants in the nursery and in the budwood nursery follow the same pattern as in the mature trees, suggesting that early screening could be carried out. This should help to eliminate the clones that are susceptible to Bark Rot infection; at the nursery stage (A de S. Liyanage, O. S. Peries, N. I. S. Liyanage & D. M. Dantanarayana).

Evaluation of clonal resistance to Bark Rot — Twenty plants each of 124-clones in the nursery at Dartonfield were inoculated by the disc inoculation technique to determine the nature of susceptibility of different clones to *Phytophthora* spp. The lesions were measured 4 weeks after inoculation. The results summarised in Table 30 indicate the degree of susceptibility of different clones, arranged in the order of increasing resistance.

These results show that some of the local clones are very resistant to the disease and these clones could be used in a hybridization programme to breed clones resistant to Bark Rot. (A. de S. Liyanage, A. Dharmaratna & S. Wettasingha in collaboration with D. M. Fernando).

Pathogenicity of different isolates — Budwood nurseries were established in 8 estates in different agro-climatic zones. Twenty plants each of 14 different clones were planted. (A. de S. Liyanage, S. Wettasingha & A. Dharmaratna).

Effect of Bark Rot on the yield — The tapping panel of PB 86 trees were artificially inoculated with a zoospore suspension using the strip inoculation technique. The infection was allowed to develop for 3 weeks before the lesion measurements

TABLE 30 — SUSCEPTIBILITY OF DIFFERENT CLONES TO BARK ROT INFECTION

Clone	Mean Lesion Length (cm)	Clone	Mean Lesion Length (cm)	Clone	Mean Lesion Length (cm)	Clone	Mean Lesion Length (cm)
IRCI 7	17·91	RRIC 41	8·42	RRIC 45	6·59	IRCI 9	4·78
F 351	15·83	IAN 717	7·96	RRIC 109	6·57	AV 1735	4·77
PR 255	12·83	CH 32	7·95	RRIC 33	6·57	6306	4·73
RRIC 68	12·51	RRIC 59	7·94	RRIC 17	6·47	2418	4·71
RRIC 55	12·28	RRIC 3	7·92	RRIC 88	6·46	RRIM 526	4·58
RRIC 69	12·07	RRIC 32	7·88	RRIM 628	6·29	RRIC 85	4·53
RRIC 50	11·82	RRIC 22	7·83	RRIC 92	6·26	RRIC 38	4·49
RRIC 48	11·65	RRIC 101	7·74	RRIC 64	6·22	RRIM 707	4·47
AV 1349	11·44	IRCI 2	7·55	RRIM 605	6·20	RRIC 106	4·40
RRIC 42	10·76	RRIC 36	7·47	RRIC 9	6·19	RRIC 107	4·40
RRIC 46	10·58	IRCI 1	7·42	RRIC 40	6·13	RRIM 607	4·38
2417	10·37	RRIC 103	7·41	1305	6·00	RRIC 94	4·34
RRIC 63	10·36	RRIM 602	7·41	PR 107	5·99	GI 1	4·30
RRIM 621	10·28	RRIC 65	7·39	IRCI 6	5·97	RRIC 5	4·28
MK 3/2	10·13	RRIC 47	7·35	RRIC 39	5·92	PB 28/59	4·26
RRIC 108	10·00	NAB 17	7·18	AV 1328	5·84	AV 1734	4·25
PB 86	9·96	F 409	7·18	NAB 15	5·77	RRIC 6	4·19
RRIC 4	9·95	RRIC 104	7·16	IRCI 10	5·60	RRIM 609	4·18
RRIC 13	9·18	PR 253	7·11	RRIC 57	5·54	IAN 873	4·15
RRIM 600	9·68	RRIC 110	7·09	RRIC 37	5·48	AV 385	4·05
RRIC 82	9·49	RRIC 7	7·00	RRIC 100	5·37	LCB 1320	3·78
RRIM 623	9·26	GT 1	6·99	2473	5·37	RRIC 102	3·78
RRIC 95	9·20	2427	6·94	WR 101	5·31	RRIC 99	3·67
RRIM 607	8·99	F 4542	6·90	RRIC 70	5·30	RRIC 60	3·44
PR 252	8·96	RRIC 76	6·90	RRIC 91	5·28	RRIC 67	3·44
RRIC 66	8·90	IAN 710	6·88	3221	5·19	RRIC 105	3·23
RRIC 90	8·70	RRIM 603	6·84	RRIM 701	5·07	RRIC 52	3·17
PR 251	8·68	RRIC 87	6·72	RRIC 75	5·04	Wg 6278	3·13
RRIC 54	8·67	RRIC 62	6·64	PB 5/51	4·93	FX 714	3·02
RRIC 49	8·61	NAB 12	6·60	RRIC 86	4·89	RRIC 31	2·92
RRIC 89	8·56	RRIM 620	6·59	RRIM 608	4·89	Tjir 1	2·81

were made by removing the renewed bark. The infected tissues below the tapping cut were not removed. Yield assessments were made using the cup coagulation method on every tapping day. This experiment is still continuing. (A. de S. Liyanage, O. S. Peries, N. I. S. Liyanage & D. M. Dantanarayana).

Effect of fungicides incorporated in base latex formulations on the yield of rubber— Thiram and Antimucin singly and in combination were mixed with different types of base latex formulations. These were applied on the tapping panels of 70 trees for 16 days spread over a period of 43 days. In general, these results show that the yield was slightly affected, when fungicides were continuously applied. (Table 31). There was a marked reduction in yield when Antimucin was applied mixed with the base latex formulations, which already contained Antimucin given as a pre-treatment. However, this effect was not shown when Antimucin was mixed with Thiram. Application of Antimucin mixed with water also reduced the yield, though not significantly. (A. de S. Liyanage, G. W. Liyanage and D. M. Dantanarayana in collaboration with M. Nadarajah).

TABLE 31 — THE EFFECT OF FUNGICIDES ON THE YIELD OF RUBBER

Fungicide	Mean yield g/tree/tapping	
	Pre-treatment	Post-treatment
Thiram 0·1% + A	42·6	39·3
Thiram 0·1% + B	39·3	33·3
Thiram 0·1% + C	30·7	29·4
Thiram 0·1% + D	22·1	24·1
Antimucin 0·1% + A	28·4	26·0
Antimucin 0·1% + B	28·6	27·2
Antimucin 0·1% + C	30·6	27·1
Antimucin 0·1% + D	42·9	36·4
Thiram & Antimucin 0·1% + A	23·8	23·8
Thiram & Antimucin 0·1% + B	53·7	51·7
Thiram & Antimucin 0·1% + C	33·5	31·4
Thiram & Antimucin 0·1% + D	41·5	41·7
Antimucin 0·1% and water	35·6	27·8
Water (control)	44·7	42·5

TABLE 32

CUMULATIVE YIELD BETWEEN DIFFERENT DAYS

	1—14	2—14	3—14	4—14	5—14	6—14	7—14	8—14	9—14	10—14	11—14	12—14	13—14	14
Correlation coefficient (r)	0·9630	0·9666	0·9621	0·9505	0·9686	0·9677	0·9648	0·9639	0·9614	0·9609	0·9553	0·9600	0·9642	0·9667

Correlation of yield data — There was no information available on the period for which yield assessments should be made before evaluating the effects of different treatments. In the absence of such information pre-treatment yield data were collected for 19 days, using the cup coagulation method spread over a period of 43 days. From the above data correlation coefficients were calculated between the yield obtained as shown in Table 32. The total yield for different durations ranging from 1 — 14 days was compared with the total yield of another duration amounting to five days which was considered to represent the experimental yield.

These results show that the correlation coefficients (r) are of a very high (significant) level whether it be single days yield or a total yield for a 14 day period. In essence it is clear that daily yields show a very high degree of repeatability. (A. de S. Liyanage).

Pattern of infection of different isolates of R. lignosus *on rubber seedlings* — The pathogenicity of eleven isolates of *R. lignosus* was examined using the rubber seedling technique developed by Liyanage (unpublished). The inoculum was standardized and 45 seedlings of each clone PB 86, Tjir 1 and RRIC 52 were used. The results, are summarised in Table 33.

TABLE 33 — PERCENTAGE SEEDLING OF *Hevea* DEAD DUE TO INFECTION, 4 MONTHS AFTER INOCULATION WITH ELEVEN ISOLATES OF *R. lignosus*

Cultivar	Isolate										
	A	B	C	D	E	F	G	H	J	K	L
	Mortality (%)										
PB 86	0	4·4	0	2·2	2·2	6·6	6·6	26·4	0	0	0
Tjir 1	0	0	0	6·6	2·2	0	4·4	15·4	2·2	0	2·2
RRIC 52	0	0	0	0	0	0	0	2·2	0	0	0

H isolate showed the highest rate of mortality and it affected seedlings of all the clones tested. Thus, it could be concluded that the isolate H is more virulent than other isolates.

Another interesting feature that was observed was that the H isolate produced a very soft rot of the root system. This is quite different to the rot produced by other isolates where the roots remained firm despite a heavy attack. (G. W. Liyanage, A. de S. Liyanage, O. S. Peries & L. Halangoda).

Evaluation of clonal resistance of rootstocks — Forty five seedlings of 19 different clones including *Hevea spruceana* were examined for rootstock resistance to *R. lignosus*. The results obtained about 4 months after inoculation with an virulent isolate are shown in Table 34.

TABLE 34 — PERCENTAGE SEEDLING DEAD DUE TO *R. lignosus*

Clone	% seedlings dead
RRIC 9	0
RRIC 11	2·2
RRIC 36	6·7
RRIC 40	0
RRIC 41	8·8
RRIC 43	2·2
RRIC 52	0
RRIC 100	8·8
RRIC 103	15·5
Wägga 6278	4·4
RRIM 623	0
RRIM 701	0
PB 86	4·4
PB 5/51	0
LCB 1320	0
GT 1	2·2
WR 101	0
Tjir 1	6·7
H. spruceana	0

The results so far obtained indicate that rootstocks of certain clones appear to be susceptible while others offer a certain degree of resistance. This experiment is continuing.

Seedlings of five clones were planted in the field arranged in 4 sub-sets to evaluate rootstock resistance to *Rigidoporus* at different intervals after inoculation. (A. de S Liyanage, G. W. Liyanage, O. S. Peries, N. I. S. Liyanage & W. Amaratunga).

Effect of vigour on resistance to R. lignosus — RRIC 52 seedlings were planted at Nivitigalakele to evaluate the effect of clonal vigour on the resistance of rootstocks to *R. lignosus*. Each seed used in the experiment was weighed and the date of germination was recorded. The height and girth measurements were kept at monthly intervals on all the plants used in this experiment. (A. de S. Liyanage in collaboration with N. E. M. Jayasekera).

Oidium heveae

Pattern of wintering and incidence of Oidium — The pattern of wintering and incidence of secondary leaf fall (SLF) due to *Oidium* were made on PB 86, RRIC 7, RRIC 45 and RRIC 52 at Dartonfield. The results shown in Table 35 indicate that wintering commenced, during the first week of December and continued until the beginning of the third week of February. There was hardly any difference on the time of completion of defoliation between clones.

There were two defoliations due to *Oidium* secondary leaf-fall. The first occurred towards the end of the 3rd week of February or first week of March and a smaller peak was recorded during the latter part of April. This pattern was observed in all clones except RRIC 52 where secondary leaf-fall due to *Oidium* reached a maximum on April 16. A second defoliation was not observed in this clone. (A de S. Liyanage).

TABLE 35 — PATTERN OF WINTERING AND INCIDENCE OF *OIDIUM* SLF

Clone	Date of Commencement of defoliation	Date of Completion of defoliation	Date of commencement of SLF	Date of Completion of SLF	Date of maximum SLF	
					1st peak	2nd peak
PB 86	8 Dec. 1975	12 Feb.	1 Feb.	22 May	21 Feb.	28 April
RRIC 45	8 Dec. 1975	18 Feb.	13 Feb.	24 May	3 March	28 April
RRIC 7	8 Dec. 1975	19 Feb.	15 Feb.	23 May	27 Feb.	19 April
RRIC 52	8 Dec. 1975	13 Feb.	17 Feb.	16 April	1 March	—

Phenology of different clones — Forty shoots of each of PB 86, RRIC 7, RRIC 45 and RRIC 52 were tagged before the commencement of wintering. A record of the onset of yellowing, leaf-fall, bud break, development of the shoots (assessed on the basis of ten stages of development of the bud) was kept. These results await analysis (A. de S. Liyanage).

Trapping of Oidium *spores* — *Oidium* spores were trapped successfully using rod traps, in which the trapping surface was a piece of sellotape. The rod traps were used from the 26 January 1976, and examination of the trapping surface indicated that there were *Oidium* spores in the air and they were in abundance from the second week of February and the maximum spore catch was obtained on the 23 February 1976. One of the most important advantages of this system is that the conidia germinated on the trapping surface when the weather conditions were favourable to conidial germination. This will not only help to get an idea of the proportion of conidia that remain viable but also will help to throw light on the number of new colonies that are likely to be formed. (A. de S. Liyanage).

Phytophthora *spp.*

Pod development in Hevea — Several flowers of PB 86, RRIC 45 and RRIC 52 were labelled during the early part of the year, but these were affected by *Oidium*, causing premature flower drop. However, about 20 pods at ' Button stage ' (8 cm

circumference, 2·5 cm diameter) were selected for a preliminary study. These were labelled and their growth studied weekly by measuring the circumferences at the broadest region of the pod. The data obtained (Table 36) indicate that rapid growth of the pod takes place in the first three weeks from the ' button stage ' after which the growth was slow. The size of the pod also diminishes slightly as it approaches maturity, perhaps due to loss of moisture. (O. S. Peries & N. I. S. Liyanage).

TABLE 36 — POD DEVELOPMENT IN *Hevea* POD CIRCUMFERENCE (cm)

6/5/76	13/5/76	20/5/76	28/5/76	4/6/76	10/6/76	22/6/76
8·0	13·6	19·5	21·8	21·7	21·7	—
8·5	9·1	12·5	16·1	16·0	16·0	16·0
9·1	12·4	16·8	19·8	20·2	20·2	—
9·5	16·1	21·0	22·0	22·0	22·0	—
—	9·5	16·1	21·0	22·0	22·0	22·0
—	10·4	13·0	16·9	17·5	17·5	17·5
—	10·6	13·5	19·5	20·5	20·3	20·3
—	11·4	16·5	17·3	17·3	17·1	17·2
—	11·4	14·0	16·4	17·1	17·0	17·0
—	11·3	14·7	17·0	17·3	17·3	17·3
—	11·7	14·6	17·8	17·6	17·5	17·4
—	13·0	15·7	17·2	17·4	17·6	17·6
—	13·8	16·8	17·3	17·3	17·1	17·1

Rigidoporus lignosus

Development of sporophores—A preliminary study on the development of fruiting bodies was undertaken in the field. Small button shaped sporophores (fruit body initials) were generally found at the collar region and also on exposed diseased lateral roots, shortly after the onset of wet weather conditions. Most of them formed either a fan or an oval shaped structure. The growing edge of the sporophore was always milky white in colour and its width is dependent on the size of the sporophore. The upper surface was light yellow when young and turned to brownish-orange when mature. The lower spore bearing areas were always orange in colour. The spore bearing tissue differentiated about a week after the appearance of button shaped fruit bodies. These developed normally into bracket shaped sporophore, and the formation of several tiers of brackets on the affected area was not uncommon. Sporophores were firmly attached to the host by a layer of flat tissues which were growing downwards, but stalks were formed when they arose from small lateral

roots or from small crevices. The appearance and the survival of the sporophores were strongly influenced by the wet weather conditions. Two days of exposure to direct sunlight were adequate to inactivate small (4 cm) sporophores. The sporophores were highly susceptible to borer damage during dry weather periods. A selected number of sporophore initials were measured along their width and diameter. The mean growth of the selected sporophores for a period of one month was 26 mm and 18 mm along the width and diameter respectively. (G. W. Liyanage).

Pattern of spore release — Studies were carried out to determine the presence of basidiospores on *Rigidoporus* sporophores, which were obtained from decaying infected rubber stumps in Dartonfield estate. Various sizes of sporophores were brought to the laboratory and kept under humid conditions. Spores were trapped using glass slides at 24 h intervals. It was observed that sporophores ceased to release basidiospores after 24 h and they became dry and brittle after 48 h.

However, under field conditions intact sporophores continued to release spores upto 6 days, when the observations were terminated. The mean number of basidiospores per microscopic field (X 400) was taken at hourly intervals, for 3 days. A bimodal spore release pattern was noted, with peaks between 0400 h to 0800 h and 1900 h to 2100 h (Table 37). The spore catch was more in the former indicating that the high relative humidity and absence of light have influenced the release of spores in abundance. Continuous dry weather that prevailed during February and March resulted in complete drying of most of the sporophores followed by borer damage. These studies could not be continued. (G. W. Liyanage).

TABLE 37 — MEAN NUMBER OF BASIDIOSPORES PER MICROSCOPIC FIELD (X 400) TAKEN AT HOURLY INTERVALS FOR 3 DAYS

Time h	Mean number of spores
0100	23·3
0200	7·0
0300	8·2
0400	22·0
0500	142·6
0600	188·6
0700	288·4
0800	160·0
0900	26·8
1000	16·6
1100	11·5
1200	1·2
1300	2·5
1400	0
1500	5
1600	4·1
1700	0
1800	1·2
1900	46·6
2000	27·8
2100	63·2
2200	1·3
2300	10·7
2400	23·6

Rate and the pattern of spread of the White Root disease in mature clearings — Several *Rigidoporus* infected patches were demarcated in eleven estates in different agro-climatic zones to study the rate and pattern of spread of the disease in mature clearings. A census of the number of *Rigidoporus* infected trees, healthy trees, in an affected patch was taken. A second census was taken 3 months later. The results are shown in Table 38.

TABLE 38 — RATE OF SPREAD OF WHITE ROOT DISEASE IN DIFFERENT ESTATES

	Estate	District	Sites	Total No. of trees	Infection 1st census	Infection 2nd census	%Infection 1st census	%Infection 2nd infection	% Increase
1.	Muwankanda	Kurunegala	14	785	66	122	8·4	23·9	15·5
2.	Peenkanda	Ratnapura	11	436	8	3	1·8	2·5	0·7
3.	Doloswela	Ratnapura	12	762	80	56	10·4	17·8	7·4
4.	Moralioya	Kelani valley	14	1001	94	33	8·5	11·5	3·0
5.	Urumutta	Matara	10	883	69	—	7·8	—	
6.	Glassel	Kelani valley	12	699	85	—	12·1	—	
7.	Ambadeniya	Kegalle	13	881	80	—	9·0	—	
8.	Golinda	Kegalle	12	635	113	—	17·7	—	
9.	Galewatta	Kalutara	10	386	24	—	6·2	—	
10.	Dartonfield	Kalutara	17	965	61	—	7·2	—	
11.	Kiriwanaketiya	Kalutara	12	892	117	—	13·1	—	
12.	Padukka	Colombo	12	875	85	—	9·7	—	
13.	Stokesland	Galle							

CONTROL

Phytophthora *spp.*

Effect of fungicides on the establishment and spread of Phytophthora spp. — Three hundred PB 86 trees were selected from the 1959 clearing at Galewatta estate. Two fungicides, Thiram and Antimucin were used singly and in combination using four base latex formulations. These were compared with Antimucin mixed in water and a water control. Fungicides were applied for a number of days prior to inoculation with the strip inoculation techniques. In some trees inoculum was placed after the removal of panel scrap and in others without the removal of panel scrap. In one treatment fungicides were applied continuously until 3 weeks after inoculation commencing from 9 days after inoculation.

The results summarised in Table 39 show that the number of trees infected by the fungus was reduced when Antimucin incorporated in a base latex formulation was applied just prior to inoculation. Antimucin as a water miscible formulation was found to be effective provided there is no rain. Thiram and a mixture of Thiram and Antimucin appeared to be inferior to Antimucin. When base latex formulations which contained Antimucin were applied, the lesion development was

restricted. Thiram and a mixture of Thiram and Antimucin in base latex formulations also reduced the rate of spread of the fungus. The development of the fungus was minimised, when fungicides were applied on every tapping day. (A. de S. Liyanage, G. W. Liyanage & D. M. Dantanarayana in collaboration with M. Nadarajah).

TABLE 39 — EFFECT OF FUNGICIDES ON THE PREVENTION AND CONTROL OF BARK ROT

Fungicide	Trees infected				Mean maximum lesion length above the tapping cut (mm)			
	1	2	3	4	1	2	3	4
Thiram 0·1% + A	100	80	100	100	41	40	108	80
,, ,, + B	100	80	100	100	48	37	138	95
,, ,, + C	100	80	80	100	40	43	49	97
,, ,, + D	100	60	100	60	52	32	93	94
Antimucin + A	100	40	100	60	43	24	71	48
,, + B	100	60	80	40	58	32	47	26
,, + C	100	60	80	80	58	21	60	47
,, + D	100	60	80	20	39	25	70	33
Thiram & Antimucin + A	100	60	60	80	63	42	127	88
,, ,, + B	100	80	100	100	59	43	86	93
,, ,, + C	100	80	80	80	79	64	77	72
,, ,, + D	100	80	100	100	97	30	61	70
Antimucin 0·1% in water	100	60	100	0	73	64	40	0
Water control	100	80	80	90	56	70	93	99

Each figure is a mean of 5 replicates except the water control where it is a mean of ten replicates.

Rigidoporus lignosus

Detection of White Root disease — The following methods were used to detect *Rigidoporus* in 3 sites in a mature stand of rubber in Dartonfield.

1. Mulching — a mulch of straw and weeds were placed at the base of the tree.
2. Staking — rubber wood stakes were driven to the soil.
3. Covers — *Desmodium* and *Crotolaria* seeds were sown.

The above treatments were randomly distributed in each site around healthy, collar affected, and wind damaged trees in vacant patches.

Apparently healthy plants which were affected by *Rigidoporus* upto the collar region could be detected successfully with a mulch of decayed straw or weeds placed around the collar of the tree. Infection showed up in ten days and in severe cases

as early as a week. When the mulch was removed, white cottony mycelia could be seen at the collar region. This was noticed in the young plants as well, although the growth was somewhat sparse. The mulch has to be partially or fully decomposed at the time of using, as fresh weeds or straw did not promote the growth of mycelial strands even when the trees were affected at the collar region. This may be due to the heat evolved by the mulch during the early stages of decomposition which prevents the growth of the causal fungus. Periods of wet weather helped early detection.

Detection was also done by planting rubber wood stakes at various positions in the field. In the mature and immature stands the experiment was conducted in patches having a high incidence of *Rigidoporus*. The majority of stakes showed signs of *Rigidoporus* infection as early as ten days. Even when stakes were planted around apparently healthy trees infection showed up on the stakes. Such instances may actually be due to the presence of the fungus, *Rigidoporus lignosus* or due to, that of fungi resembling *Rigidoporus*. This may be a limitation of this technique, therefore it would be investigated further.

Detection of *Rigidoporus* infected trees by growing leguminous covers such as *Crotolaria* and *Desmodium* at the base of the trees could not be considered as a practical and a useful method. In the mature stand, interference by tappers during tapping made it difficult for establishing a cover around the base of the plant. Also, the cover plants had to be left for quite sometime until their root system came in contact with an infected root. The plants that grew for 2 — 3 months did not show any signs of infection with *Rigidoporus* in the mature and in young plantations. (O. S. Peries, N. I. S. Liyanage, B. Fernando, L. Halangoda & N. Fernando).

Effect of different pre-planting, planting and post planting treatments on the incidence of Rigidoporus — The height and girth measurements and rate of mortality were recorded.

	Pre-planting treatment	Planting treatment	Post planting treatment
1.	Stumps, uprooted and burnt	Without sulphur	Legumes
2.	Stumps, uprooted and stacked	With sulphur (114 g/planting hole)	Naturals
3.	Stumps left in the soil	Collar protectant applied	
		Sulphur added & collar protectant applied	

The effect of the above treatments on the growth of the rubber plants were analysed. It was shown that planting treatments affected the growth significantly, while there was no response to pre-planting treatments. Although the main effect of sulphur was not significant, it retarded the growth of plants in the first few months after planting. This effect disappeared, when the plants were about an year old. The application of a collar protectant, ' Fomac 2 ' at the time of planting increased the mortality rate and also it significantly affected the growth of the surviving plants. The interaction of sulphur and collar protectant is also significant. It was also observed that in the absence of sulphur, the application of Fomac decreased the growth significantly. However, in the presence of sulphur such an effect was not seen.

The covers had no significant influence in early stages of growth, nor does it interact with either the pre-planting or planting treatments. The cover X pre-planting X sulphur interaction shows a significant influence on growth, at about 3 — 4 months after planting. This was not consistent and hence could be ignored. The cover X pre-planting X collar protectant interaction showed a significant influence on the diameter though not on height of plants. When the diameter of trees of 3 month old plants were analysed it was shown that, in the absence of a collar protectant, trees under natural covers showed slightly better growth than those under legumes except when stumps were uprooted and burnt. In the presence of the collar protectant, trees under legumes grew poorly even when the stumps were uprooted and burnt. The incidence of *Rigidoporus* is still negligible. This experiment is still continuing and only the results of the first year's growth are discussed here. (A. de S. Liyanage & W. Amaratunga).

Effect of methods of clearing on the incidence of Rigidoporus — A replicated field experiment was laid out at Woodend Estate in 1976 and the following treatments were given :—

1. Stumps cut at ground level — apply 225 g of Borax for each stump.
2. Same as above — apply 225 g urea for each stump.
3. Apply 50% solution of 2, 4, 5 - T in desoline to the bark of stumps.
4. Stumps cut at ground level (control).
5. Stumps uprooted and burnt.

Growth measurements were recorded. This trial is continuing. (A. de S. Liyanage, G. W. Liyanage & W. Amaratunga).

Control of White Root disease in mature clearings — Rigidoporus infected patches were surveyed and mapped, in 12 estates in different agro-climatic zones and the following treatments were given to *Rigidoporus* affected plants and their healthy neighbours, to prevent the spread and control the disease.

1. Expose the root system, removal of all infected roots, scrape off mycelium from healthy roots, apply 'Fomac 2' (upto 15 cm from the bole) on the laterals and tap roots (30 cm) and cover with soil.
2. Same as (1) except the application of a collar protectant. Sprinkle 225 g sulphur on the soil around the plant.
3. Same as (1) and addition of sulphur as in (2).
4. Same as (1) without the application of Fomac 2.

This trial has just commenced (G. W. Liyanage, A. de S. Liyanage, L. Halangoda & N. Fernando).

Effect of Alocasia *and covers on the incidence of White Root disease* — At the end of six months the *Alocasia* plants were uprooted and a visual assessment was made on the extent of decay and survival of inoculum.

The above assessments were scored using a disease index. It was observed that some of the wood blocks were decayed completely. However, estimation of the infection by arithmetic inflation was justifiable as it was found that the correlation coefficient ($r = -0.1315$) between disease incidence of the surviving blocks (y) and corresponding extent of decay of the same surviving blocks (x) was not significant.

Analysis of variance showed the following (Table 40).

TABLE 40 — EFFECT OF COVER AND/OR *ALOCASIA* (HABARALA) ON THE INCIDENCE OF DISEASE (INOCULUM ESTIMATED ON A 4-BLOCK BASIS)

Covers	*Alocasia* spp. 0	Habarala 1	Habarala 2	Mean
Control (0)	2163	2203	1127	5493
Cover 1 (C_1)	1593	900	900	3393
Cover 2 (C_2)	1823	957	1005	3785
	5579	4060	3032	12671

(1) The presence of a cover significantly reduced the infection. There was no difference between the leguminous cover *Pueraria phaseoloides* and naturals.

(2) Presence of Habarala significantly reduced the infection. There was no difference between the 2 types of Habarala.

(3) The interaction (Cover X Habarala) was not significant indicating that the influence of cover is independent of Habarala and *vice versa* but showing that it is purely an additive effect.

Analysis of variance also showed that Habarala and/or cover did not influence the decay. (Table 41).

TABLE 41 — INFLUENCE OF HABARALA AND OR COVER ON DECAY

	Control (0)	Habarala I (H^1)	Habarala II (H_2)	Mean
Control (0)	670	770	870	2310
Cover 1 (C_1)	1060	665	1210	2935
Cover 2 (C_2)	880	915	1185	2980
	2610	2350	3265	8225
Mean	124	112	115	

If the correlation coefficient between x and y was significant it would then be inferred that there is a positive relationship between decay and incidence of disease. It suggests that a greater decay was brought about by high incidence of disease and *vice versa* for a negative relationship between x and y. A positive or a negative relationship would respectively, under estimate or over estimate the incidence of the disease and these were the main reasons for using the arithmetic inflation in analysing these results. (O. S. Peries & N. I. S. Liyanage).

Effect of addition of sulphur on the pH and soil microflora

The pH of soil samples taken from the surface soil (0) and at a depth of 15 & 30 cm of ten randomly selected points was recorded, prior to the application of sulphur and at different periods after the application of sulphur. (Table 42).

TABLE 42 — THE pH OF SOILS AT DIFFERENT DEPTHS AFTER TREATMENT WITH SULPHUR

		pH Sampling time after application of sulphur (days)				
Depth of sampling (cm)	pH Before application of sulphur	2	7	14	35	60
0	5·06	4·61	4·35	3·66	3·48	3·56
15	4·69	4·52	4·63	4·17	3·46	4·07
30	4·50	4·41	4·50	4·33	3·67	4·13

* Each figure is a mean of 10 samples.

The pH of the surface soil was the highest recorded (5·06) and that at 30 cm depth, had the lowest (4·50). Sulphur at the recommended dosage for control of *Rigidoporus* i.e. 123 g per square meter was added on the surface of the experimental area and lightly forked in. Soil pH was tested at 2, 7, 14, 35 and 60 days after the addition of sulphur. The pH continued to drop at all three depths until 35 days after the addition of sulphur. However, there was a slight increase in the pH at 15 cm and 30 cm depths, 7 days after sulphur was added to the surface. Sampling done 60 days after the addition of sulphur revealed that at all three depths there was an increase in the pH.

Total fungal population of the surface soil and those obtained at 15 and 30 cm depths was 132 and 101 and 32 respectively. *Penicillium* spp. and *Aspergillus* spp. were commonly isolated. *Trichoderma* spp. was found to predominate the surface soils, but at lower depths, their numbers were less. At 15 and 30 cm depths *Penicillium* and *Aspergillus* were abundantly present. There were some unidentified species too, most of them occurring at samples taken at a depth of 30 cm.

Fungal successions in Hevea *timber* — Various types of fungi appearing on decaying rubber wood placed under mature and replanted areas in Dartonfield were observed. At the end of five months *Trichoderma* spp. were commonly seen on all logs. *Daldenia concentrica* was observed only on logs with bark and Jelly fungi appeared only on the cut ends of logs and on logs in which bark was removed. *Schizophyllum communae* too appeared mostly on cut ends and on logs without bark

though it was also observed on logs with bark, to a lesser extent. Logs with bark allowed more fructifications to appear. With the onset of dry conditions most of the fructifications dried up. Bark cracking was very prominent and a severe termite attack was noted on the logs with bark, particularly those left in the replanted area.

The above experiment was repeated to determine the actual time at which different types of fungi appear on the logs. Commonly *Penicillium* spp., appeared within three days of placing the logs. Within the first two weeks *Penicillium* spp., *Fusarium* spp. and *Mucor* spp. continued to grow and patches of *Trichoderma* were also noted. *Trichoderma* was prominent over the 3rd and 4th weeks. However, all logs were not colonized extensively by these fungi due to the dry weather experienced during the early part of the year. (O. S. Peries & N. I. S. Liyanage).

Isolation of fungi causing decay of rubber wood — Ten fungal isolates of basidiomycetes were obtained from fructifications found on decaying rubber logs. (G. W. Liyanage).

Decay of rubber wood — Studies on the decay of rubber wood under leguminous covers, *Puereria* and *Centrocema* and naturals were initiated. Two sizes of blocks were used. The loss in dry weight, 3 months after the commencement of the experiment in shown in (Table 43).

TABLE 43 — INFLUENCE OF COVERS & NATURAL ON THE DECAY OF RUBBER WOOD

Cover	Block size	
	small	large
Puereria	7·9	29·2
Centrocema	7·9	29·8
Naturals	10·2	26·8

At 3 months, there was no significant influence of the covers on the decay of rubber wood. This experiment is continuing. (G. W. Liyanage & L. Halangoda).

Mycorrhizal association of rubber roots — Preliminary experiments were initiated to study the mycorrhizal association in rubber and cover plants. (G. W. Liyanage, A. de S. Liyanage in collaboration with N. Yogaratnam).

Economic evaluation of expenditure on disease control — A survey was carried out on 17 estates in Kalutara and Kegalle districts to determine the expenditure incurred for disease control from 1954 — 1974, taken at 5 yearly intervals. The results are being analysed. (A. de S. Liyanage, R. Wijewansa & S. S. Jayasooriya).

REVIEW OF THE SOILS CHEMISTRY DEPARTMENT

By

C. G. Silva

SUMMARY

Soils phosphorus studies have shown that the maintenance of a good ground cover and the placement of crushed rock phosphate in bands will increase the efficiency of uptake of phosphatic fertilizer by rubber. Incubation studies, pot experiments and a seedling nursery experiment have all shown that Apatite may be substituted for the imported Saphos. Incorporating rock phosphate into the soil has been found to ensure a uniform distribution of fertilizer in the soil. Micro nutrient studies have shown that there is a direct relationship between aluminium and phosphorus uptake by *Pueraria* plants. The area surveyed for soil and foliar analysis was double that of the previous year.

A fertilizer experiment in a Boralu soil has continued to show a significant response to potassium. An experiment with rubber grown in an area previously under tea has shown that in these areas fertilizer rates lower than the recommendation may be sufficient for normal growth. Experiments with grounds covers have shown that : (a) the legume *Mimosa invisa* is not an effective nitrogen fixer, (b) the practice of applying rock phosphate to cover is a good management practice, and (c) every attempt should be made to establish a suitable leguminous ground cover under immature rubber, in its absence about thrice the normal quantity of nitrogen fertilizer must be applied for comparable growth during immaturity.

DETAILED REVIEW

Staff

Mr. C. G. Silva, Soils Chemist, was on duty throughout the year. Dr. N. Yogaratnam was promoted as Soils Chemist in December. Mr. M. K. S. A. Samaraweera continued his post graduate studies in the United Kingdom. Messrs W. C. Dayaratne and F. P. W. Silva, Senior Technical Assistants, Messrs H. A. Seemon, A. M. A. Perera, B. P. M. Arsecularatne, L. J. Wickremasinghe and B. G. K. Jayawardene, Technical Assistants, and Messrs W. M. Abeysinghe, M. A. Mendis, A. D. M. Karunaratne, K. S. A. C. Peiris and J. Wijenayake, Field Assistants, were on duty throughout the year. Messrs S. P. A. R. de Silva, G. G. Weerawansa, T. A. C. S. Vasanthadeva and K. S. K. Wijeratne joined the Department as Technical Assistants during the third quarter.

Visits

The following visits were made for advisory, experimental and other purposes by the two Soils Chemists.

Advisory	— 8
Experimental	— 165
Miscellaneous	— 54

Meetings and Conferences

Mr. C. G. Silva presented a paper on the "Use of Eppawela Apatite for the nutrition of *Hevea*" at a joint Seminar of the Sri Lanka Association for the Advancement of Science and the Soil Science Society of Sri Lanka. Dr. N. Yogaratnam presented a paper entitled "The present state of use of nitrogenous fertilizer for rubber" at the annual symposium of the Soil Science Society of Sri Lanka. He also delivered a lecture entitled "Effects of nutrient sprays on fruit set, mineral composition and fruit quality of apple", which embodied the work done for his post-graduate studies, to the Staff of the Institute. Mr. C. G. Silva addressed the Kiriella Co-operative Land Reform Estates Supervisory Staff at a Meeting held at Matuwagala Estate, Kiriella. Dr. N. Yogaratnam presented a paper entitled "Management of covers under *Hevea* in Sri Lanka" and Mr. C. G. Silva a paper on "The efficient use of phosphatic fertilizer in relation to the phosphorus fixing capacities of the Rubber soils" at the Centenary International Rubber Conference. Dr. N. Yogaratnam attended the FAO/SIDA Workshop on "Organic materials as fertilizers in Asia", held in Bangkok and presented a Country Report (Sri Lanka) on the use of organic materials as fertilizers by the plantation sector in Sri Lanka. Mr. C. G. Silva attended meetings of the Fertilizer Working Group and of the Natural Resources Committee.

Publications

The following papers were prepared for publication in the Journal of Horticultural Sciences.

1. Effects of phosphate sprays on mineral composition and fruit storage quality of apple i. Mineral composition of leaves (N. Yogaratnam).
2. Effects of phosphate sprays on mineral composition and fruit storage quality of apple ii. Mineral composition of fruits and storage quality (N. Yogaratnam & R. O. Sharples).
3. Effects of foliar sprays containing nitrogen, magnesium, zinc, and boron on fruit set, mineral composition and fruit quality of apple. (N. Yogaratnam & D. W. P. Greenham).

RESEARCH INVESTIGATIONS

Phosphorus studies (*C. G. Silva, W. C. Dayaratne, L. J. Wickremasinghe & A. M. A. Perera*)

Studies on the phosphorus fixing capacities of the rubber soils have shown that soil pH and organic matter content are negatively correlated with P fixing capacities while the clay content and the available iron content are positively correlated. These results suggest that the efficient use of phosphatic fertilizer in the rubber growing soils may be achieved by the maintenance of a good ground cover and by the band placement of crushed rock phosphate.

Incubation studies, where the long term availability of P_2O_5 in fertilizer mixtures containing Eppawela Apatite, Saphos and Triple Super phosphate was compared, have shown that the availability of P_2O_5 after four months of incubation is as follows:-

	P_2O_5 ppm
Control	65
Saphos	414
Apatite	729
Triple Super	838

The pot experiment with *Hevea* seedlings, where the uptake of P from these different fertilizer sources was studied, has been harvested and the results are being analysed.

The IAEA sponsored internal co-ordinated project to evaluate the efficiency of Eppawela Apatite against Saphos phosphate using radio-active phosphorus has yielded inconclusive results probably because the Apatite and Saphos were not sufficiently long in the field. Another consignment of ^{32}P is expected, and that should assist in elucidating this problem.

The analysis of soil samples from an experimental area on a steep terrain, where the rubber trees have been planted on terraced contours, has shown that the distribution of phosphorus is uniform over the whole field. This is probably because the fertilizer was incorporated into the soil.

Nitrogen studies

The nitrogen regimes in a cover crop experimental area was investigated by a final year student of the faculty of Agriculture. The results will be published. The variation in soil nitrogen contents in an experimental area was studied before and after fertilizer application. The effect of the addition of fertilizer in changing the total nitrogen content is not significant in the interrow area. This shows that the added fertilizer is absorbed by the soil without any surface wash, probably because the fertilizer was incorporated into the soil. The leaf nutrient levels of this area have also been studied and the results are not yet available for reporting.

Studies on the mineralisation of nitrogen, initiated in collaboration with the University of Sri Lanka, have been completed but the results have not yet been analysed.

Potassium studies

The analysis of soil samples collected from the experimental area to evaluate the optimum placement of fertilizer, was completed.

Micronutrient studies

Studies on the influence of aluminium on the uptake of phosphorus by *Pueraria* plants in pots have shown that aluminium plays an important role in the phosphorus nutrition of the plant and that there is a direct relationship between phosphorus and aluminium uptake. This work is now ready for publication.

Mineralogy

This project could not be sarted during the year because certain sophisticated equipment such as an X-ray defraction apparatus and a differential thermal analyser are not available for the mineralogical analysis of soils. During the last quarter however negotiations were carried out with the Royal Tropical Institute, Netherlands to carry out this work as a joint collaborative project. It has now been agreed on principle to do this work in 1977 and the title of the project is " To characterise and classify the main rubber soils of Sri Lanka, to investigate their mode of formation with the aim to evaluate their contribution to the nutrition of *Hevea* and for correlating them with other soils in the tropics in order to facilitate transfer of knowledge and extrapolation of research results ".

Soil classification

The detailed classification of the soils of the Alutgama one inch map has progressed satisfactorily. About 50% of the area has been covered. Apart from the soil series so far recognised, a few more have been recognised in this area. The essential difference being that these new series are micaceous members of the ones already recognised.

Soil and leaf nutrient surveys

The total acreage of new areas which were surveyed was 12,480. The number of samples collected from experimental areas was 1495. The extent of analyses is as follows :—

Soil

Samples received	—	604
Total nitrogen	—	1531
Available phosphorus	—	820
Exchangeable potassium	—	1042
Exchangeable calcium	—	1042
Exchangeable magnesium	—	1042
Carbon	—	429

Leaf

Samples received	—	1441
Nitrogen	—	3505
Phosphorus	—	3939
Potassium	—	3616
Calcium	—	3616
Magnesium	—	3616
Micro nutrients	—	18

Agronomy

Nutrition of Hevea

A. *Effects of fertilizers on nutrient uptake and growth of immature rubber*

Four experiments were started to study the influence of fertilizers on nutrient uptake and growth of immature rubber.

Experiment, 76/1 : was started on Pembroke Estate in the Kalutara District using clone PB 86 growing on Boralu series soil. In this experiment 5 levels of NPK and Mg are being studied in a central composite second order design (N. Yogaratnam & K. S. A. C. Peiris).

Experiment, 76/3 : was started on Elpitiya Estate in the Galle District on Agalawatte series soil. In this experiment the effects of three levels on nitrogen and phosphorus are being studied on clones PB 86, RRIC 101, and RRIC 102 in a split plot design (N. Yogaratnam & A. D. M. Karunaratne).

Experiment, 76/4 : was started on Sorana Estate in the Kalutara District on Homagama series soil. Effects of three levels of nitrogen and potassium are being studied on clones PB 86, RRIC 100, 101 and 102, in a split plot design in this experiment (N. Yogaratnam & K. S. A. C. Peiris).

Experiment, 76/5 : compares the effects of three levels of potassium on clones PB 86, RRIC 101 and 102 during the immature phase. Provision has also been made in the experimental design to compare the effects of three tapping systems during the mature phase. This experiment is being carried out on Eladuwa Estate, in the Kalutara District on Boralu series soil (N. Yogaratnam & K. S. K. Wijeratne).

B. *Effects of fertilizers on nutrient uptake, growth and yield of mature rubber*

Response to fertilizers

Experiment, 61/1 : (No. 11, Kuruwita Sub-station) laid down to study the effects of two levels of nitrogen, phosphorus and potassium on growth and yield of PB 86 showed that application of potassium at the normally recommended rate increased growth and yield over that of the trees that did not receive any potassium. Nitrogen or phosphorus does not appear to have any effect either on growth or yield. It seems that rubber growing in Boralu series soils is likely to benefit by further additions of potassium fertilizers (N. Yogaratnam & K. S. A. C. Peiris).

Experiment, 61/2 : (No. 11, Kuruwita Sub-station) comparing three levels of nitrogen and phosphorus with uniform application of potassium and magnesium on PB 86, growing in Boralu series soil, did not show any significant effects on either growth or yield in 1976 (N. Yogaratnam & K. S. A. C. Peiris).

Experiment, 70/1 : (No. 22, Malaboda Estate) started in 1970 on a 1947 replanting of PB 86, to evaluate the relative importance of nitrogen, phosphorus and potassium on trees that are being tapped on renewed bark, did not indicate any treatment effects on either growth or yield of rubber. The results seem to suggest that the fertilizers applied during the periods before the experiment commenced have prolonged residual effects (N. Yogaratnam & M. Abeysinghe).

Experiment, 71/1 : (No. 27, Lowmont Estate) was started in 1971 to study the effects of three levels of nitrogen, phosphorus and potassium on growth, yield and bark regeneration. A 1964 replanting of RRIM 623 was used for this experiment. There were no significant treatment effects on either growth or yield (N. Yogaratnam & M. A. Mendis).

Experiment, 71/2 : (No. 28, Neuchatel Estate) was laid down in 1971 to study the effects of different levels of the fertilizer mixture R 463 + Mg on growth of clone PB 214, planted in areas previously under Tea. The girth measurements recorded in the sixth year of planting showed that application of fertilizers improved growth over that of the trees that did not receive any fertilizer . However, the growth of trees that received either half or the normally recommended rates, of fertilizer does not appear to be different from each other. This indicates that for rubber, planted in areas previously under Tea, fertilizers at rates lower than the normal recommendation may be sufficient for normal growth. This confirms the findings in the previous years (N. Yogaratnam & M. A. Mendis).

Five new experiments were started this year to study the fertilizer responses in mature rubber under different agro-climatic zones. Experiment 76/6, was started at St. George Estate (Annasigalla Division) in the Kalutara District, using clone

RRIC 45 from a 1969 replanting, growing on Boralu series soils. In this experiment four levels of nitrogen, phosphorus and potassium are being studied in a 4^3 factorial design. Pre-treatment assessments were made during this year (N. Yogaratnam & M. Abeysinghe).

Experiment, 76/8 : compares the effects of three levels of nitrogen, potassium, phosphorus and magnesium in a 3^4 factorial design. This experiment was laid down on Rayigam Estate, in the Kalutara District, using clone RRIC 45 from a 1967 replanting, growing on Agalawatte series soil. Treatments did not show any effect on either growth or yield during the five months of tapping (N. Yogaratnam & A. D. M. Karunaratne).

Experiment, 76/10 : effects of three levels of nitrogen and phosphorus and two levels of potassium and magnesium are being studied, in a $(3^2 \times 2^2)$ factorial design on clone PB 86 in a 1964 replanting at Hatbawe Estate in the Kegalle District. The soil in this experimental area belongs to the Parambe series. Pre-treatment assessments were completed (N. Yogaratnam & K. S. K. Wijeratne).

Experiment, 76/11 : started on Muwankande Estate, in the Kurunegala District compares the effects of three levels of nitrogen, phosphorus and potassium and two levels of magnesium on growth and yield of clone RRIM 623 in a 1967 replanting. The soil in this experimental area belongs to the Parambe series. Results obtained so far do not appear to show any treatment effect on either growth or yield (N. Yogaratnam & K. S. A. C. Peiris).

2. *Time of fertilizer application*

Two experiments were started to study the effect of different times of fertilizer (NP and K) application *viz.* (a) at defoliation (b) at refoliation and (c) after hardening of leaves, on nutrient uptake, growth and yield of mature rubber. One experiment (76/13) was laid down on Vincit Estate in the Kelani Valley District and the other (76/16) on Padukka Estate in the Colombo District. Both experiments were laid down on Boralu series soil using clone RRIM 623. Pre-treatment assessments were completed and the first fertilizer application will be done according to a 3^3 factorial design, at the time of defoliation (N. Yogaratnam, M. Abeysinghe & A. D. M. Karunaratne).

3. *Forms of fertilizers and methods of their application*

Experiment, 72/2 : (N. 29) started in 1972 to compare the effects of Urea and sulphate of ammonia as sources of nitrogen either broadcasted or pocketed, for mature rubber growing on Boralu series soil, was continued on five sites. As observed in the previous years there were no treatment effects on either growth or yield of rubber during this year, as well. Lack of significant responses to fertilizer nitrogen may be due to the fact that the nitrogen status of trees used in this experiment may be satisfactory for normal growth. No useful comparison between the effect of urea and that of ammonium sulphate is therefore possible (N. Yogaratnam & J. Wijenayake).

Experiment, 73/1 : started on a 1973 replanting of clone RRIC 101 in Dartonfield, compared the effects of Saphos phosphate and Eppawela Apatite as sources of phosphorus for immature rubber. Three was no significant effect of treatments on growth of rubber, possibly indicating the existence of some residual effects of phosphorus applied to the previous planting.

New Experiments : There new experiments were started this year.

Experiment 76/2, was laid down on Boralu series soil of Pembroke Estate in the Kalutara District. In this experiment PB 86 plants for a 1976 replanting was used to compare the effects of three forms each of nitrogen (*viz.* Urea, Sulphate of Ammonia and Ammonium Chloride), phosphorus (*viz.* Saphos phosphate, Eppawela Appatite and Super phosphate and magnesium) *viz.* Commercial Epsom Salt, Kieserite and Dolomite).

The second experiment, 76/12, was started on Parambe series soil of Glassel Estate, in the Kelani Valley District, on PB 86 in a 1961 replanting. The experimental treatments and design were the same as in Experiment 76/2. Pre-treatment assessments were completed (N. Yogaratnam, M. A. Mendis, & K. S. A. C. Peiris).

The third experiment, (76/17) was started on Eladuwa Estate, to study the effects of Saphos phosphate and Eppawela Apatite at different levels of P, on nutrient uptake and growth of immature PB 86. Pre-treatment assessments were completed and a single application of fertilizer was given (N. Yogaratnam & K. S. K. Wijeratne).

4. *Economics of fertilizer usage*

An experiment, 76/15, was started on Pembroke Estate using clone RRIM 623 from a 1966 replanting to compare the effects of the following treatments on growth and yield of rubber.

(a) No fertilizer in the 1st year (applied from 2nd year)

(b) No fertilizer in the 1st and 2nd years (applied from 3rd year)

(c) No fertilizer in the 1st, 2nd and 3rd years (applied thereafter)

(d) No fertilizer at all.

(e) Fertilizer every year.

Pre-treatment assessments were completed (N. Yogaratnam & M. A. Mendis).

5. *Discriminatory fertilizer applications*

Studies on standard and soil and foliar survey (discriminatory) methods of fertilizer application were started. An experiment (76/14) was laid down on Pembroke Estate using clone PB 86 from a 1967 replanting in which the effects of treatments (a) control — no fertilizer (b) soil and foliar survey — fertilizers and (c) standard fertilizers, were studied. There were no treatment effects on either growth or yield during this year (N. Yogaratnam & M. Abeysinghe).

6. *Fertilizer requirements of stimulated areas*

An experiment started in 1960 on a 1949 replanting of PB 86 at Eladuwa Estate, to study the effects of different levels of R 463 + Mg was continued, with the intention of super imposing Ethrel stimulant treatment in 1977. This has been planned in order to obtain some information on fertilizer/Ethrel interactions on yield of rubber. (N. Yogaratnam & M. Abeysinghe).

To sum-up, generally there has been no responses to added fertilizers in the new experiments that were started this year. It is known that the concentration of the respective nutrients in bark or wood tissue is higher in well manured trees, compared to trees inadequately manured as these tissues act as storage organs. There is a buildup of nutrients in bark and wood during leaf senescence and depletion at refoliation. Therefore a time lag varying from a few months to over three years may be observed between fertilizer application and response in yield, depending on the manuring history of the fields before the experiments commenced.

Cultural practices

Three experiments were started earlier (Annual Review 1975, p. 61 — 62) to : (1) to determine whether legumes are superior to naturals in promoting growth of young rubber trees,

(2) if so, whether application of extra nitrogen in areas with non-legume covers could improve growth during immaturity and yield during early maturity to make them comparable with growth in areas under legume covers,

(3) whether application of phosphate to covers and/or rubber is beneficial and,

(4) economic evaluation of some treatments in the current context of fertilizer prices and labour wages.

In experiment, 70/2, application of nitrogen showed a significant increase in growth of rubber ; the response being significantly linear (Table 1). The results of this experiment seem to suggest that the legume *Mimosa invisa*, tested in this experiment, may not be a very effective nitrogen fixer and that higher rates of fertilizer nitrogen to rubber may be useful in such instances.

TABLE 1

EXPERIMENT 70/2 : EFFECT OF LEVELS OF NITROGEN ON GROWTH OF IMMATURE RUBBER, NOVEMBER 1976

Treatments	Girth (cm)
N_1	45·7
N_2	47·5
N_3	48·2*
N_4	48·6*
LSD	2·06

With regard to the effects of phosphate, application of phosphate to cover has led to better girths, irrespective of the type of cover grown (Table 2). Phosphate to rubber only, also showed a similar tendency. Moreover, the application of phosphate to the covers has resulted in better girths than its application direct to the trees. These results confirm that applying rock phosphate to covers, is a good management practice.

TABLE 2

EXPERIMENT 70/2 : EFFECTS OF METHOD OF PHOSPHATE APPLICATION ON GROWTH OF RUBBER, NOVEMBER 1976

Treatments	Girth (cm)
P_o	45·5
P_r	46·7
P_c	49·8***
P_{rc}	50·1***
LSD	2·06

In experiment, 72/2, the growth of trees in the sown legume plots was much better than in the plots under naturals (Table 3). The trees in natural cover areas, with supplementary nitrogen to rubber ($N : n_1$), also showed a similar effect.

TABLE 3

EXPERIMENT 72/2 : EFFECT OF TREATMENTS ON GROWTH OF IMMATURE RUBBER, NOVEMBER 1976

Treatments	Girth (cm)
N : NS Control	24·9
L	39·0***
L : S	33·3***
$N : NSn_1$	29·2*
$N : NSn_2$	<20·00

The nitrogen content of the cover, leaves, green matter and litter was much greater and the C/N ratio of the litter lesser in the legumes than in naturals (Table 4).

TABLE 4

EXPERIMENT 72/2 : EFFECT OF TREATMENTS ON NITROGEN CONCENTRATION (%) AND C/N RATIO ; JANUARY 1976

Treatments	Cover leaves	Green matter	Litter	Litter ratio C/N
N : NS (Control)	1·60	1·03	1·65	22·26
L	2·22***	1·46***	2·26**	12·09***
L : S	1·98*	1·14	2·15***	13·39***
$N : Nn_1$	1·72	1·01	1·68	18·55
$N : Nn_2$	1·64	1·07	1·57	19·18
LSD	0·20	0·14	0·16	1·54

It has been established that materials with low C/N ratios would be expected to mineralise rapidly with their nutrients becoming rapidly available for uptake by *Hevea* or cover plants. As leguminous covers such as *Pueraria* and *Desmodium*, that were tested in this experiment, do not root deeply, the net effect would have been a rapid re-cycling of nitrogen from the upper soil layer.

The results of this experiment suggests that every attempt should be made to establish a suitable leguminous cover at replanting. If the establishment of legumes and their maintenance become difficult, extra nitrogen to rubber at rates three times the normal recommendation may improve growth, but even so this will not be comparable to growth in areas under legume covers.

In experiment, 70/3, on Hedigalla Estate, there were no treatment effects on growth of immature rubber (N. Yogaratnam, K. S. A. C. Peiris & A. D. M. Karunaratne).

REVIEW OF THE RUBBER CHEMISTRY DEPARTMENT

By

M. Nadarajah

SUMMARY

A considerable amount of the time of the officers was spent in preparing papers for the Centenary International Rubber Conference, Sri Lanka, 1976, and eleven papers were presented. Three papers were presented at the 32nd Annual Sessions of the Sri Lanka Association for the Advancement of Science in December 1976. Three papers have been accepted for presentation by the Indian Rubber Manufacturers' Research Association at their Conference to be held at Cochin, India, from 10th to 12th February, 1977.

A simple method of preparing a light coloured cyclised rubber, with para toluene sulphonic acid as the catalyst, has been developed using centrifuged latex as the raw material. This product appears to be of a high enough quality to warrant consideration of its commercial manufacture for export.

A market survey of the use of Sri Lanka crepe in overseas markets has shown the great potential of sole crepe and steps are being taken to step up the present production of sole crepe of 4,500 tons by another 4,000 tons annually in future. Sri Lanka is unique amongst natural rubber producing countries in the world in that more than one third of her production is as light coloured rubbers. The setting up of a rubber trade centre in the consuming countries will be necessary, if Sri Lanka is to at least maintain this position owing to strong promotional work being done by Malaysia for SMR 5L.

Assistance was given on the commercial use of bitumen latex mixes and Portland cement latex mixes for water proofing 9,000 sq. ft. of the top deck of the Bandaranaike International Airport.

Work has continued on the use of starch as a partitioning agent for the manufacture of rubber powder. Efforts have been made to commercially develop the post graduate research work on antioxidants done by Dr. M. R. N. Fernando and Dr. A. M. A. Amarapathy.

89 one hour lectures at undergraduate level and 70 one hour lectures at post graduate level were given by our staff at the Colombo and Katubedde Campuses and at the Vidyodaya Campus, respectively.

A crepe drying system using electrical heating elements and fans instead of firewood, boiler and radiators has been developed.

Epoxidised rubber seed oil with satisfactory oxirane oxygen content has been prepared, using hydroperoxide and glacial acetic acid as the reagent in the presence of resin catalyst.

Work was continued on making liquid rubber using solar energy and then compounding and curing it.

Biochemical work on the study of lipids in rubber, on enzyme deproteinization of natural rubber and on viscosity stabilised DPNR was continued.

Assistance was given to crepe and RSS factories having problems and also to rubber goods manufacturers. Routine specification tests were carried out on block rubber samples from Mawanella Block Rubber Factory and Cenat Factory, Paiyagala.

Assistance was given to the Mawanella Block Rubber Factory to commercially manufacture prevulcanised formaldehyde stabilised latex and deproteinized block natural rubber. The latter is being commercially used by Chemanex Ltd. to manufacture cyclised rubber masterbatch which is used as a replacement for imported high styrene resin. Assistance was also given to Elston Estate, Puwakpitiya, to manufacture cyclised rubber from deproteinised latex crepe and to use it for manufacturing road marking, enamel and floor paints.

Trials on the use of hydrochloric acid as a coagulant carried out over a period of three years have proved successful. It now remains to implement this commercially.

The technology of the production of powdered rubber, based on natural rubber using starch as a partitioning agent, has been worked out on a laboratory scale. It has been found that further addition of talc at 2% level on the rubber content is necessary, to prevent particle reagglomeration during drying.

The rubber products industry has been given a pep up by strengthening the advisory services and training of personnel.

A market survey carried out by one of our officers (Mr. S. W. Karunaratne) who was a member of the team appointed by the International Trade Centre (ITC) has shown that :

1. The pale crepe market is more or less saturated in Western and Eastern Europe.

2. There is further potential for the development of sole crepe.

3. That we should modernise and put up more block rubber factories.

4. Due to poor market promotion the image of Sri Lanka rubber is only vague and the report strongly recommends the setting up of a Trade Centre in Europe.

DETAILED REVIEW

Mr. S. W. Karunaratne, Chief Rubber Technologist, in a team of three persons, left in early June on a two months market survey in Europe for Sri Lanka Rubber and toured nine countries. Mr. L. M. K. Tillekeratne left on the 30th of September to represent the Rubber Research Institute at the ISO TC - 45 Conference, held in Barcelona, Spain. Messrs H. Narangoda and M. S. C. de Silva, Technical Assistants were released to join the Industrial Development Board. Messrs L. N. Samarawickrema and R. M. Kularatne, Technical Assistants were released to join the Ceylon Tyre Corporation and the Department of Agriculture, respectively. Mr. S.

M. C. D. Sebastian resigned from the services of the Institute. Messrs R. Surendrakumar, S. Kurera, P. D. Nimal, K. A. R. M. Perera, W. A. Lionel, and Misses T. Nirmala, C. L. Punchihewa and M. G. Manel joined the Rubber Chemistry Department as Technical Assistants. Mr. E. G. Mendis, Senior Technical Assistant was promoted to Assistant Development Officer, Rubber Chemistry Department. Mr. W. S. E. Fernando continued his post graduate studies at the University of Aston in Birmingham, United Kingdom. Mr. M. Nadarajah, Dr. P. A. J. Yapa, R. Tharmalingam, Dr. A. Coomarasamy, Dr. M. R. N. Fernando, Dr. A. M. A. Amarapathy and Mr. D. S. Muthukuda were on duty throughout the year.

Conferences

The following papers were presented at the Centenary International Rubber Conference Sri Lanka 1976 :—

1. Preparation and properties of DPNR and CV - DPNR by P. A. J. Yapa.
2. Preparation of powdered natural rubber by S. W. Karunaratne.
3. Recent developments in improvements in the manufacture of Sri Lanka crepe and RSS by M. Nadarajah.
4. Some improvements in crepe drying by R. Tharmalingam.
5. Modification of natural rubber by A. Coomarasamy.
6. Preparation of natural rubber latex with bound antioxidants by A. M. A. Amarapathy.
7. Solar energy for making liquid rubber by L. M. K. Tillekeratne.
8. Reaction of antioxidants with NR using thiol groups by M. R. N. Fernando.
9. Manufacture of crepe rubber by M. Nadarajah.
10. Technical merits of plantation crepe by S. W. Karunaratne.
11. Technical specifications for crepe rubber by L. M. K. Tillekeratne.

The following papers were presented at the 32nd Annual Sessions of the Sri Lanka Association for the Advancement of Science :—

1. The role of phenolics in discolouration of NR by P. A. J. Yapa.
2. Epoxidation of rubber seed oil by A. Coomarasamy.
3. Development of natural rubber latex : Portland cement mixes for engineering applications by M. Nadarajah.

Mr. M. Nadarajah presented a paper on " Rubber derivative in surface coatings " on 26-03-76 at a symposium on surface coatings organised by the Institute of Chemistry, Sri Lanka.

Mr. D. S. Muthukuda gave a talk on sheet manufacture at the Smallholders' Conference held on 25-06-76.

A report was submitted by Mr. R. Tharmalingam to M/s. C. W. Mackie & Company Ltd. on the performance of some of the remillers of scrap. Ways and means of improving the quality of crepe rubber from scrap at the remilling factories were suggested.

A talk on "Problems of drying rubber" was given by Mr. R. Tharmalingam, at the seminar on "Sun drying methodology" sponsored by the NSC and the Australian High Commission.

Mr. D. S. Muthukuda gave three days of lectures and demonstrations at the Refresher Course conducted at the Institute for the benefit of the Divisional Advisory Officers and the Rubber Instructors of the Institute.

A three day and two day course for small scale rubber industrialists organised by the Industrial Development Board in collaboration with the RRI was held at the RRI Colombo Office on 19-04-76, 20-04-76, 21-04-76 and on 26-05-76, 27-05-76 respectively.

Mr. L. M. K. Tillekeratne submitted two papers on "The production and quality control of SLR in Sri Lanka" and on "Insect infestation of TSR pallets" to the IRRDB meeting held in November in Indonesia this year.

Mr. S. W. Karunaratne addressed the small industrialists at the Industrial Development Board on two occasions.

Mr. W. D. Dharmasena gave two talks to small industrialists. He also gave eight lectures and demonstrations to the students of the vocational training class held at Ananda Sastralaya, Matugama, on the manufacture of latex based products.

Serving on Panels etc.

Mr. S. W. Karunaratne served as a Director of the State Rubber Manufacturing Corporation (SRMC) for a period of three years ending in October 1976. He attended altogether ten Board Meetings during the period January — October 1976.

Mr. S. W. Karunaratne served as a member of the Rubber Committee appointed by the Ministry of Plantation Industries. He functioned as the Chairman of the sub-committee on reclaimed rubber.

Mr. S. W. Karunaratne served as a member of the Rubber Committee appointed by the Ministry of Plantation Industries to work out targets for rubber to help proper planning for the welfare of the industry.

Mr. S. W. Karunaratne was a member of the Action Committee that made further recommendations for the rapid implementation of the proposals arising out of the market survey report (Van Gelder Report).

Training of RRISL Staff

Mr. W. D. Dharmasena underwent a course of training at Messrs Richard Pieris & Company Ltd. for a period of two weeks on the production of latex based products.

Training of personnel from the rubber industry at RRI

Mr. M. G. S. K. de Silva of Katubedde Campus was trained in laboratory methods for a period of two weeks.

Mr. Q. X. Gunaratne, Graduate Student from Colombo Campus, during his vacation work, assisted Mr. S. W. Karunaratne with the projects on the preparation of powdered rubber.

A short term training programme was arranged for ten small industrialists in the manufacture of dipped goods from latex by Mr. W. D. Dharmasena.

Exhibitions

Exhibitions were conducted at the following places :

1. Muslim Ladies College, Bambalapitiya (Duration five days).
2. Prince of Wales College, Moratuwa (Duration six days).

Mr. W. D. Dharmasena was incharge of the exhibitions.

Papers

The following papers were published during 1976.

1. Preparation of Natural Rubber Latex with bound antioxidants.—A. M. A. Amarapathy and G. Scott. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.
2. Rubber tree that develops the country (in Sinhala) — A. M. A. Amarapathy Newspaper Supplement, CIRC 1976, *Lankadeepa*, December 15, 1976.
3. Epoxidation of Rubber seed oil — A. Coomarasamy. Paper read at the 32nd Annual Sessions of the SLAAS, 09 December, 1976.
4. Modification of natural rubber — A. Coomarasamy and K. Silva. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.
5. Reaction of antioxidants with NR using thiol groups — M. R. N. Fernando, G. Scott and J. E. Stuckey. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.
6. Pale crepe — a specific grade of NR for specialised applications — S. W. Karunaratne. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.
7. Preparation of powdered natural rubber — S. W. Karunaratne and R. Tharmalingam. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.
8. Introduction of rubber (in Tamil) — S. Kasinathan, *Virakesari*, 16th December, 1976.

9. Rubber Industry — The foreign exchange earner — D. S. Muthukuda and J. A. Amaraweera (in Sinhala) *Dinamina*, 16th December, 1976.

10. Manufacture of crepe rubber — M. Nadarajah. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

11. Recent developments in improvements in the manufacture of Sri Lanka latex crepe and RSS. — M. Nadarajah, R. Tharmalingam, G. R. Chandrasiri, D. S. Muthukuda and E. G. Mendis, Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

12. Enzyme deproteinisation of NR latex — C.K. John, M. Nadarajah and B. L. Chan. Paper presented at the Centenary International Rubber Conference Sri Lanka, 1976.

13. Investigations on new fungicidal systems for control of Bark Rot in *Hevea brasiliensis* — A. de S. Liyanage, M. Nadarajah, G. W. Liyanage and D. M. Dantanarayana. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

14. We produce 150,000 tons a year, but use only 7,000 — M. Nadarajah, Newspaper Supplement, CIRC 1976, *The Sunday Times*, 12th December, 1976.

15. Development of natural rubber latex — Portland cement mixes for engineering applications — M. Nadarajah and Upali G. Fernando. Paper presented at the 32nd Annual Sessions of the SLAAS — 08th December, 1976.

16. Recent developments in new uses of natural rubber in Sri Lanka — M. Nadarajah and A. Coomarasamy. Paper submitted for the ninth Indian Rubber Conference — IRMRA, India, 1976.

17. Some improvements in crepe drying — R. Tharmalingam, C. Koelmeyer and W. T. Ponniah. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

18. Crepe rubber development unit — R. Tharmalingam — Newspaper Supplement, CIRC 1976, *Ceylon Daily News* — 15th December, 1976.

19. Technical specifications for crepe rubber — L. M. K. Tillekeratne. Paper presented at the Centenary International Rubber Conference in Sri Lanka, 1976.

20. Solar energy for making liquid rubber — L. M. K. Tillekeratne, R. M. Kularatne and M. S. C. de Silva. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

21. A turning point in rubber industry : block rubber (in Sinhala) L. M. K. Tillekeratne. *Rubber Puwath*, (Centenary Issue) Vol. 7 — 1976.

22. Insect infestation of TSR pallets — L. M. K. Tillekeratne — *RRISL Bulletin*, Vol. 11 — 1976.

23. Bright future for Block rubber — L. M. K. Tillekeratne — Newspaper Supplement CIRC, 1976. *The Sunday Times* — 12th December, 1976.

24. Preparation and properties of DPNR and viscosity stabilized DPNR — P. A. J. Yapa. Paper presented at the Centenary International Rubber Conference, Sri Lanka, 1976.

25. The role of phenolics in discolouration of NR — P. A. J. Yapa. Paper presented at the 32nd Annual Sessions of the SLAAS — 09th December, 1976.

26. Natural rubber and its versatility. P. A. J. Yapa. Newspaper Supplement, CIRC 1976, *Ceylon Daily Mirror* — 18th December, 1976.

27. Uses of NR latex — P. A. J. Yapa (in Sinhala). *Vidya* (Special issue on Rubber) Vol. 10, No. 10 — 1976.

28. Rubber plantation industry and our economy—P. A. J. Yapa. Newspaper Supplement, CIRC 1976, (in Sinhala) *Lankadeepa*, 18th December, 1976.

29. Manufacture of rubberised coir products using rubber latex — M. S. C. de Silva — *Karmantha* (English & Sinhala) — Vol. 3, No. 12 — 1976.

Lectures in Polymer Chemistry and Rubber Technology

The following officers delivered one hour lectures for the M.Sc. course at the Vidyodaya Campus. Mr. R. Tharmalingam (9), Dr. A. Coomarasamy (10), Dr. A. M. A. Amarapathy (27), Dr. M. R. N. Fernando (18), and Mr. L. M. K. Tillekeratne (6). The following officers delivered one hour lectures for the L.P.R.I. course at the Katubedde Campus. Mr. M. Nadarajah (46) and H. Narangoda (32). Dr. A. Coomarasamy gave 11 lectures in Polymer Chemistry for the University of Sri Lanka (Colombo Campus) B.Sc. special final year course.

Miss I. Ratnasooriya worked on her M.Sc. project on "Thiol based grafted antioxidants" under the supervision of Dr. M. R. N. Fernando. Mrs. R. Suranimala worked on her M.Sc. project on "Antioxidants" under the supervision of Dr. A. Coomarasamy.

RUBBER TECHNOLOGY

Portland cement — Natural rubber latex mixes (*M. Nadarajah*).

This work was done in collaboration with Dr. Upali G. Fernando of the State Engineering Corporation. The deficiency in properties when Portland cement is used in mixes with natural rubber latex is explained as being due to non-rubber substances, especially sugars, found in latex serum. These non-rubber substances could be reduced by centrifugation and further by dilution with water and recentrifugation.

A rubber/cement ratio of up to 0·035 for field latex, up to 0·10 for centrifuged latex and up to 0·20 for double centrifuged latex, in a cement sand mortar (1 : 1½) could be used without drastically impairing physical properties, but on the other hand obtaining some improved properties. The latices could be prevulcanised with vulcanising chemicals without serious reduction in strength when compared with the unvulcanised latices.

The incorporation of natural rubber latex in "Wirecon" boat building material was investigated and the results show that appreciable improvement in impact strength is obtained by the incorporation of the rubber latex.

Latex spreading
(A. M. A. Amarapathy, M. Nadarajah & M. G. Manel).

A satisfactory formulation for latex spreading was made using the formulation : prevulcanised formaldehyde stabilised field latex 300 g, formaldehyde stabilised field latex 75 g, Kaolin 68 g, and Titanium dioxide 34 g. The gloss was improved by using 10 g of PVA. If formaldehyde stabilised centrifuged latex at 37·5 g is used, a better product is obtained, and no PVA is needed to obtain the gloss.

Vulcanising systems for low temperature and sunlight curing of natural rubber compounds (M. Nadarajah, M. R. N. Fernando & K. A. R. M. Perera).

This work was done in collaboration with Mr. K. Subramaniam of the Katubedde Campus. The use of fast curing systems by using synergistic accelerator combinations is well known, but not much work has been done to extend this work to room temperature and sunlight curing systems, which would be useful in the tropics. Further, small scale rubber industrialists would prefer to have faster cure at a lower vulcanising temperature preferably 100°C and below.

Since vulcanisation would be expected to continue at room temperature, we have used semi efficient vulcanisation systems in our formulations, *i.e.* sulphur at levels of 1·5 phr, and high levels of accelerators 2 phr, and above. The curing process was followed by using the Monsanto Rheometer, where vulcanisation temperature was 100°C and above ; and the Wallace Plastimeter where room temperature or sunlight curing was used. The base white compound was : Rubber 100, Zinc Oxide 5, Stearic Acid 1, Mercapto benzothiazole (MBT) 1 and Sulphur 1·5 by weight. In the case of a black compound, 10 parts of FEF black was added. MBT was chosen as the accelerator as it gives a good plateau cure. The effect of six dithocarbamates with and without activation with the amines Butraldehyde-aniline or cyclohexyl ethyl amine was investigated.

It was found that a black compound developed a temperature of about 55°C when exposed to direct sunlight, whilst in a white compound the temperature rose only to 46°C. A pronounced synergistic action between thiazoles and dithiocarbamates was noted.

25 lb of a suitable black compound was prepared and sold to TAOS Yacht Company Ltd. to be used in sealing yacht decks. The compound was made as a two pack sunlight vulcanising sealing agent.

NR/SR Blends (A. M. A. Amarapathy & L. N. Samarawickrema)

The work on this project was completed. 36 formulations were used to evaluate the physical properties of vulcanisates of NR/Polybutadiene (BR) blends. This covers the range of 100% NR to 100% BR in 20% steps and each blend has 6 ISAF black loadings from 0 – 75 phr.

The physical properties such as hardness, tensile strength, ageing characteristics, resistance to engine oil, turpentine and brake oil, flexural strength and resilience were investigated. It was found that 80/20 NR/BR blends have the best properties. A paper on "Investigation into natural rubber — polybutadiene blends" has been written up for publication in the RRISL Journal.

Powdered NR (S. W. Karunaratne, R. Tharmalingam, Nimal Silva, G. D. Nimal & Q. X. Gunaratne)

Studies on the viscosity, stability and particle size of latex/xanthate systems were carried out.

Several batches of powdered NR were prepared from both field and concentrated latex after reducing the rubber content to 10%. Preparation of larger batches was made possible using the modified stirrer designed by one of us (R. Tharmalingam). With this device we were able to control the rate and efficiency of stirring during the addition of a conservating agent. Chlorination of the latex xanthate masterbatch, prior to coagulation by the addition of a chlorate and HCl, assisted in the prevention of reagglomeration during drying. Possibilities of microbial action are not ruled out and the samples are examined periodically for any microbial action.

One of us, Mr. Q. X. Gunaratne of the Colombo University assisted in the project while on vacation work for a period of one month.

Preparation of latex masterbatches (S. W. Karunaratne & H. Narangoda)

A 300 kg latex masterbatch (MB) of a shoe sole compound was prepared at the Mawanella Block Rubber Factory. After coagulation, the batch was crumbled using crumb rubber equipment and dried in the unidryer. It was not easy to control the coagulation when large filler loadings were added in the form of a slurry. This batch was made by Bata Shoe Company and the trials were satisfactory. High moisture content had to be taken care of by drying the masterbatch in an oven prior to further processing.

RUBBER CHEMISTRY

Preparation of chemical derivatves of natural rubber

Cyclised Rubber (A. Coomarasamy, M. Nadarajah, K. Silva & S. Kurera)

Large scale trials for the preparation of papain coagulated rubber for use in the manufacture of cyclised rubber were carried out at Mawanella Block Rubber Factory. The drying time of papain coagulated block rubber is much higher than the conventional block rubber; this defect was overcome by filling the dryer boxes to only half its capacity when papain coagulated rubber was used. Rubber treated with Nonidet T, prior to papain coagulation, showed higher rates of auto-cyclisation.

Chemanex Ltd. have indicated their interest in the commercial use of our Patents on cyclised rubber, mainly for use as a reinforcing filler. For this application the masterbatch must be prepared in an internal mixer or on a hot two roll mill at a temperature of over 90°C.

The Highways Department has indicated that they would like us to supply about 10,000 gal of road marking paints per year, on a commercial basis, for use in Sri Lanka. Elston Estate, Puwakpitiya, which is run by the RRI was found to be a suitable site to manufacture cyclised rubber for use in making road marking paints, as they have a spare two roll mill and suitable buildings to house this project.

Trials were conducted at Elston Estate in the preparation of papain coagulated rubber for cyclisation. Nitrogen values of 0·12 were obtained. The papain coagulated rubber, cyclised quite readily with 10% para toluene sulphonic acid after mixing in a 2 roll mill, available at the factory. Cyclisation was initiated by an IR bulb.

Satisfactory quality white paint was prepared by ball milling from washed cyclised rubber (450 g), Titanium dioxide pigment RSM 2 (650 g), Dibutylphthalate as plasticizer (2·5 g) and 1 : 1 mixture of Xylene and Mineral Turpentine (1,500 g) as solvent. Good floor paint was also made by incorporating Oruwala Iron oxide pigment into cyclised rubber varnish, using a mortar and pestle (50 g of cyclised rubber + 25 g of pigment and 100 g of solvent, xylene and mineral turpentine 1 : 1). The performance of local Titanium dioxide in paints was compared with the imported RSM 2 grade Titanium dioxide. It was found that local Titanium dioxide gives a greyish colour and a longer period of ball milling is necessary to obtain a satisfactory grade of paint. Elston Estate has fabricated a ball mill and are manufacturing paints on a pilot plant scale. A superior quality cyclised rubber was made using centrifuged latex and work is being done to improve the quality further, to produce a grade of cyclised rubber for export. Cyclised rubber was used satisfactorily to coat paper. This can be commercially implemented when the Embilipitiya Mills commence production.

Liquid Rubber (*L. M. K. Tillekeratne, P. A. J. Perera & M. S. C. de Silva*)

Work on this project is still in progress. Attempts will be made in future to reduce carboxyl end groups to alcoholic OH groups and then to couple the OH groups during vulcanisation reaction, using suitable coupling agents, thus elongating the molecules. This procedure was suggested by Professor Bailey of the University of Maryland, U.S.A.

Chlorinated Rubber (*A. M. A. Amarapathy*)

It has been possible to make a stable white product. The stability of chlorinated rubber was increased by using oxides of zinc, magnesium and lead ; but the product was insoluble in common solvents such as toluene, benzene, xylene etc. This may be due to some sort of crosslinking of rubber during the process of chlorination. Several attempts were made, to inhibit this crosslinking, but none was successful.

Synthesis of new types of antioxidants (*A. M. A. Amarapathy*)

The following quinoline type of compounds were prepared and their antioxidant activity was investigated using the technique of oxygen absorption and stress relaxation. The curing characteristics were studied using the Monsanto Rheometer :—

(1) 2 Methyl 4 hydroxy quinoline

(2) 4 Methyl 2 hydroxy quinoline

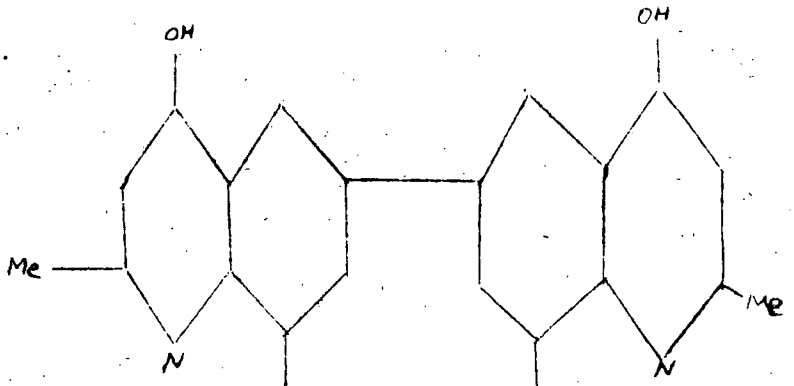
(3) 2, 8 di methyl 4 hydroxy quinoline

(4) 4, 8 di methyl 2 hydroxy quinoline

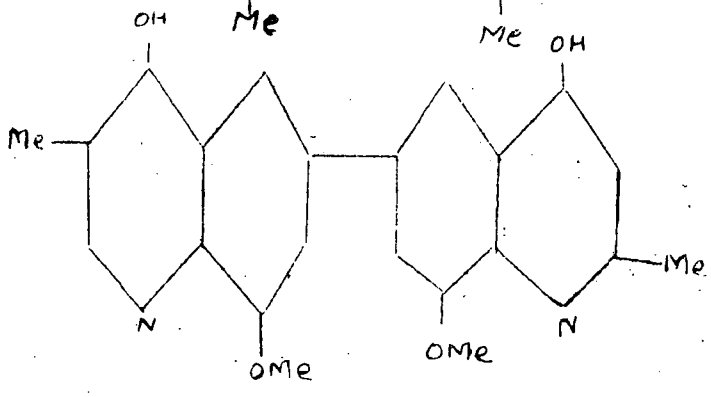
(5) 2, 6 di methyl 4 hydroxy quinoline

(6) 4, 6 di methyl 2 hydroxy quinoline

7).



8).



It was found that compound Nos. 6, 7 and 8 are good antioxidants. As these are freely soluble in water their application is restricted to those articles which do not come in contact with water. As far as the curing characteristics are concerned, there is no significant effect by the addition of these antioxidants.

Grafting of antioxidant (*A. M. A. Amarapathy*)

The work that had been carried out at Aston University was continued. Physical properties of grafted vulcanized rubber was studied and arrangements have been made to carry out grafting of antioxidants into natural rubber latex on a pilot scale.

Modification of Natural Rubber (*A. Coomarasamy, L. B. K. Silva, T. Kanthasamy & R. Surendrakumar*)

Modified rubbers were prepared by graft co-polymerization of vinyl monomers such as acrylamide, methyl methacrylate, vinyl pyridine and hydroxy ethyl methacrylate on to NR and by addition reactions of NR with compounds such as maleic anhydride and thioglycollic and these reactions were carried out in the presence of radical initiators such as cumene hydroperoxide, potassium persulphide and benzoyl peroxide. Possible uses of some of these modified rubbers were also investigated.

It has been found that 10% methyl methacrylate grafted NR latex and 10% acrylamide grafted NR latex could be used for impregnation of rayon tyre cords

satisfactorily, with less than 50% of the normal amount of expensive resorcinol formaldehyde resin required for use with ammonia stabilized latex. Preliminary studies have shown that acrylamide grafted latex could be used as a stock additive in paper manufacture to improve sizing of the paper. Acrylamide grafted NR exhibits a certain degree of mineral oil resistance as expected, but the degree of resistances is insufficient for practical purposes.

It has been found that the maleic anhydride modified rubbers could be used as adhesives with or without metal oxides such as magnesium oxide and calcium oxide as curing agents. In the absence of cross linking agents these modified rubbers exhibit pressure sensitive adhesive property.

New Antioxidants for NR (A. Coomarasamy & L. B. K. Silva)

N – (4 – Aniline phenyl) maleimide and (N - (3,5 Ditert butyl 4 – hydroxy phenyl) maleimide and N – N : Di – (4 – Diphenyl amino) fumaramide were synthesised and their antioxidant properties were compared with commercially available amine antioxidant Nonox ZA and phenolic antioxidant Topanol OC. The synthesized antioxidants seem to perform better at 100°C than the commercially available antioxidants used in this work. It has been found that the maleimide antioxidants could be bound to rubber in the presence of benzoyl peroxide. Further work on the binding reaction and polymerization of these antioxidants is in progress.

Epoxidation of Rubber Seed Oil (A. Coomarasamy & T. Kanthasamy)

Epoxidation of rubber seed oil could be effected by using hydrogen peroxide/ glacial acetic acid as the reagent in the presence of an acid catalyst. A catonic ion exchange resin catalysed process was found to be more efficient and to give a lighter coloured product compared to the mineral acid catalysed process. The presence of a small amount of solvent such as ethyl acetate was found to increase the efficiency of the reaction. Preliminary studies have shown that the epoxidised oil prepared from rubber seed oil in our laboratory has comparable stabilizing effect to the commercially available epoxidised soya bean oil. Further studies are in progress.

ADVISORY SERVICES TO PRODUCERS

Routine Advisory Work

The following advisory visits were done by Mr. D.S. Muthukuda, Assistant Development Officer.

	RSS manufacture	Pale Crepe manufacture	Sole Crepe manufacture	Latex weighing	Others	Total
1st Quarter	12	11	3	7	3	36
2nd Quarter	14	10	2	4	2	32
3rd Quarter	19	7	1	5	5	37
4th Quarter	11	12	2	4	7	36
TOTAL	56	40	8	20	17	141

Rubber Seed Oil (M. R. N. Fernando & M. Nadarajah)

The necessary advice was provided to the GA's Office, Kalutara to organise the collection of rubber seed. As milling facilities were not available in time, a miller was persuaded to pay for the seeds on the basis of the value of oil, at the rate of 15% oil on seed weight.

Bale coating experiments (L. M. K. Tillekeratne & P. V. A. G. Perera)

More experiments were carried out at the Torbay Stores and at various places in Sri Lanka on quick drying latex based bale coatings paints. In order to prevent mould growth on the coated bales, we have suggested that finished bales be covered with RSS sheets, coated with the bale coating mixture and dried completely before use.

Technological Advisory Services (A. M. A. Amarapathy & L. N. Samarawickrema)

A formulation was suggested after a series of trials at Messrs. D. Samson Industries Ltd. for making straps for slippers to improve the tear resistance.

A project report on establishing a latex based rubber goods industry was submitted by Mr. S. W. Karunaratne to Mr. D. C. L. Amarasinghe.

Assistance is being given to Messrs Jafferjee Brothers by Mr. S. W. Karunaratne and Dr. M. R. N. Fernando to set up a rubber goods industry to turn out cycle tyres, cycle tubes, microcellular sheets and rubber bands. A preliminary report was submitted.

Mr. S. W. Karunaratne and Mr. R. Tharmalingam assisted Mr. W. J. Balthazaar of East India and Ceylon Tea Companies Ltd. to draw up a process flow line to produce block rubber and to prepare a report to carry out feasibility studies to put up a factory.

Mr. S. W. Karunaratne prepared a feasibility report on Rubber Bands for the Ministry of Plantation Industries.

Mr. W. D. Dharmasena gave advice and instruction on the manufacture of latex based articles to 36 small scale industrialists.

Evaluation of compounds and quality control of products (S. W. Karunaratne, M. R. N. Fernando & P. P. Jayasinghe).

1. Test reports on — cycle tyre compounds, tyre gum compounds and microcellular soling compounds were given to Sinwas and to Associated Motorways Ltd.

2. Tests on brake washers were done for Diesel & Motor Engineering Ltd.

Advisory Visits

(a) Mr. S. W. Karunaratne carried out 25 advisory visits.

(b) Mr. W. D. Dharmasena made 27 visits to factories and schools and other organizations mainly in connection with demonstrations on the manufacture of latex based goods.

Room temperature curing system (*A. M. A. Amarapathy*)

A dough of a room temperature vulcanising compound was successfully used to repair a gasket of a fruit mixing machine of a Tourist Hotel.

Latex Stabilisation (*M. Nadarajah & D. S. Muthukuda*)

It was found that, for preserving latex for crepe manufacture, a minimum of 0·15% sodium hydroxide is necessary with 0.025% Tetra methyl thiuram disulphide/ zinc oxide and the latex can be kept in good condition for at least three days. It was however found that RPA 3 does not function efficiently in the presence of TMTD/ ZnO. Hence it is necessary to degrade the TMTD and this can be done by the action of sodium sulphite and also by lowering the pH. Sodium sulphite is added as a 5% solution at 5 g per kg of rubber and the pH of the latex is lowered below 7·0 but kept above 5·0 by addition of dilute acid before adding the RPA 3 and coagulating with acid. Using this procedure a satisfactory quality latex crepe was prepared.

Siting of small scale industrial unit on estates (*M. Nadarajah & A. Coomarasamy*)

In 1976, the Rubber Research Institute of Sri Lanka took an active interest in small scale rubber industries with a view to starting such small factories as extensions to existing raw rubber factories. The creation of a large number of small scale industrial units is preferable to the establishment of a few large scale industries, as this would provide more employment, thus affording some relief to the acute unemployment problem of this country. Further, Sri Lanka has about 150 raw rubber factories with the required power, water and workshop facilities and management skills. Small scale rubber based industries may be added on to them at minimum cost thus providing maximum employment for a given capital investment.

Products that are being commercially made are :

(1) Prevulcanised formaldehyde stabilised latex for use in paints and for water proofing concrete structures. This is being manufactured at Mawanella Block Rubber Factory.

(2) Manufacture of cyclised rubber at Elston Estate, Puwakpitiya, for sale. The cyclised rubber can be used in paints and as a reinforcing filler.

Development programme for Sri Lanka Raw Rubber (*M. Nadarajah & S. W. Karunaratne*)

A development programme for Sri Lanka raw rubber on the following lines has been suggested.

(a) RSS — Improvement in quality of RSS from smallholders and medium holders is possible by centralising manufacture in GPCC.

(b) Latex crepe from latex — Increased production annually of 2,000 tons is suggested. This could be done in existing crepe factories by working a second shift. The increase in foreign currency earnings at present prices would be Rs. 3 million. The extra cost of manufacture of latex crepe over RSS is 55 cts/kg but the premium for crepe is over Rs. 1·50.

(c) Centrifuged latex — The present production of centrifuged latex is 1,000 tons per annum. A De Laval 410 centrifuge will produce 600 tons/annum.

A machine is on order by the SRMC. Negotiations are in progress between SRMC and Ceyesta to operate the Ceyesta De Laval 410 machine to full capacity. If these two machines are in full production then the production in 1977 of centrifuged latex would be increased by 1,000 tons annually. It is recommended that an annual import of three De Laval centrifuges be permitted, which would increase centrifuged latex production by about 1,800 tons annually.

(d) Block rubber from latex which goes into RSS — The prospects of the manufacture of high quality block rubber namely 5 CV and 5L is limited in Sri Lanka as the clones mainly planted in Sri Lanka render CV production to specifications difficult and 5L production is not as profitable as latex crepe or sole crepe. Further, consumer preference is changing from honey coloured sole crepe to white sole crepe. The Mawanella Block Rubber Factory produces about 2,000 tons of SCR 5L annually.

(e) Scrap into Block rubber — There is a necessity to convert all scrap rubber into block rubber rather than into scrap crepe as done at present. Block rubber manufacture would (a) remove the dirt present in scrap more efficiently, (b) necessitate PRI as a specification which would involve chemical treatment of the scrap raising its quality, (c) permit facilities used at present in crepe factories to manufacture scrap crepe to be diverted to latex crepe and sole crepe production.

At a premium of Rs. 1/- per kilogram, the conversion of 1,000 tons of scrap into block rubber will give an increase in foreign exchange earnings of one million rupees.

(f) Sole Crepe — An increased production annually of 2,500 tons is suggested from latex. These could be done in latex crepe factories, by working an additional shift and with some locally fabricated equipment. The little foreign exchange needed for the fabrication of the machinery must be speedily given. The diversion of latex which goes into RSS into sole crepe at 2,500 tons/year will give at present prices, Rs. 15 million more in foreign exchange. The extra cost of manufacture of sole crepe over latex crepe is 55 cts/kg but the premium is over Rs. 4/- per kg for sole crepe over RSS.

The manufacture of 1,500 tons of industrial sole crepe annually is also suggested from latex crepe and SLR 5L. If a premium of Rs. 3/- per kg is obtained, the increase in foreign exchange earnings would be Rs. 4½ million.

(g) SLR 5 — About 30,000 tons of RSS 4 and 5 are produced annually at present in Sri Lanka. The Mawanella Block Rubber Factory is a 20 ton/day factory but manufactures only 6 tons of SLR 5L per day. If 2,500 tons of RSS 4 and 5 can be converted to SCR 5 at Mawanella Block Rubber Factory, an increase in foreign exchange earnings of over one million rupees per year can be obtained as the premium is over 40 cts/kg.

HCl Coagulation (*S. W. Karunaratne & K. A. Piyadasa*)

Further trials were conducted in Dartonfield and Nivitigalakele to assess if there were any practical difficulties in the handling of HCl.

This was tried out in one GPC with marked success. The only precaution necessary is to use a plastic can instead of a galvanised bucket to prepare the stock

solution of HCl. The cost saving by the use of HCl, which is a locally available raw material, could be quite substantial to warrant a serious study on the use of HCl as a coagulant on a larger scale. This work will be continued.

CREPE RUBBER DEVELOPMENT UNIT

Crepe Rubber Drying (R. Tharmalingam & K. P. N. de Silva)

An electrically heated system comprising of forced air heaters and a blower was installed in the Dartonfield Factory crepe drying tower in February 1976. The performance of this system was compared with the Boiler-Radiator system. Results obtained during the first ten months of operation show that the introduction of this Unit has remarkably increased the efficiency of the drying tower.

The use of electrically heated boilers in place of the wood fired boilers will be investigated in the next stage of this programme. An electrically heated boiler with nine — 2·6 KW heaters has been already fabricated and it will be installed in due course.

Preliminary studies on the drying characteristics of rubber in the form of laces for crepe manufacture under standard estate practice was investigated. The results were compared with published results on sheet rubber and granular rubber drying.

Subsidy and Advisory Visits (R. Tharmalingam & E. G. Mendis)

Visits undertaken during the year 1976 includes, factory modernisation, Rubber Control Subsidy and advisory visits. The details are given below.

Factory Modernisation	10
Rubber Control Subsidy	8
Advisory	7
Others	12
Total	37

Testing of Sole Crepe (E. G. Mendis)

Work was initiated on the laboratory testing of sole crepe from various factories for hardness and thickness variations. This work is based on the complaints made by the overseas buyers to the Market Survey Team which visited some of the consuming countries recently.

Block Rubber (R. Tharmalingam)

1. Carried out feasibility studies for putting up of a block rubber factory for M/s. Forbes & Walker Ltd.

2. Submitted a technical report to the Rubber Control Department in connection with the setting up of a block rubber factory by Mr. A. Perera, Homagama.

BIOCHEMISTRY

Investigations on new fungicides for Bark Rot control (M. Nadarajah)

This project was done in collaboration with Dr. A. de S. Liyanage and Messrs G. W. Liyanage and D. M. Dantanarayana of the Plant Pathology Department. Several dithiocarbamates containing metal ions (Ziram, Zineb, Vondezeb), Tetramethyl thiuram disulphide (TMTD), zinc oxide, formaldehyde and fungicides recommended for Bark Rot control, (Antimucin and Actidione) were used singly or in combination in *in vitro* trials, the concentration of the chemicals used being based on their active ingredients. Zinc oxide and Zineb were ineffective even at 1,000 ppm whilst TMTD, Ziram, Vondezeb and HCHO gave satisfactory results at 200 ppm., However, in the presence of rubber serum, Ziram and HCHO were ineffective Vondezeb and TMTD were effective at 250 ppm and Antimucin and Actidione at 25 ppm. The efficacy of fungicides are significantly impaired by frequent rains. Investigations were also undertaken to examine the possibility of increasing the efficiency of panel fungicides by incorporating them in rubber latex. Prevulcanised latex was not found to be suitable as an adjuvant under laboratory conditions. However, satisfactory results were obtained when fungicides were incorporated into high ammonia field latex and high and low ammonia centrifuged latex. Ammonia was also found to have fungicidal properties.

The use of preserved latex as an adjuvant with Antimucin and TMTD singly or in combination were investigated in field conditions and promising results were obtained. It thus appears that the efficiency of a water soluble fungicide such as Antimucin for Bark Rot control could be improved by using latex as an adjuvant.

Antimucin is a toxic chemical and it would be useful to investigate less toxic chemicals for Bark Rot control. Vondozeb (Manganese and Zinc ethylene bis dithiocarbamate) and TMTD are two, much less toxic chemicals which have shown considerable promise in laboratory investigations and are worthy of more detailed investigations under field conditions.

Coagulation of skim latex with papain (M. Nadarajah & P. A. J. Yapa)

The properties of 3-day old skim latex, to which papain and other chemicals were added at Vincit Estate, Waharaka, are given in Table 1.

TABLE 1

PROPERTIES OF PAPAIN TREATED SKIM RUBBER

Amount of chemicals in g. for one gallon of skim latex		Time for coagulation in days	Properties		Nitrogen %
Papain	Oxalic acid		P_o	PRI	
0	0	3	60	67	1·29
1·5	0·25	1	55	60	0·67
0·75	0·25	2	58	45	0·98

The results show that papain at 1·5 g and oxalic acid at 0·25 g per gallon of skim latex gives satisfactory PRI and nitrogen values for the skim rubber obtained.

Papain treatment of Hevea *latex to obtain superior quality rubber (M. Nadarajah)*

This work was done in collaboration with Mr. C. K. John and Dr. B. L. Chan of the Rubber Research Institute of Malaysia. The heat build up properties of papain treated block rubber was superior to acid coagulated block rubber. The heat generation at 120 minutes in a Goodrich flexometer was only 32·2°C compared to 47·8°C for the acid coagulated rubber. Apart from heat generation, the papain treated rubber gave better dynamic and permanent sets.

If the latex is matured for about 48 h with ammonia at about 0·15 % on the latex and Non ionic stabiliser (Nonidet P 40) at 0·5 on the drc and then coagulated with papain at 0·25% on the drc, a further improvement of heat build up and dynamic properties is to be expected. Since the latex can also be treated with Hydroxylamine, and since papain functions in the presence of hydroxylamine, the treatment of latex matured for about 48 h with hydroxylamine and papain would be expected to give a superior latex rubber for the tyre industry.

1. *Enzyme deproteinization of NR (P. A. J. Yapa)*

The work on this project was continued during the year. Investigations were carried out on two major lines, the preparation of deproteinized natural rubber (DPNR) and the preparation and properties of the viscosity stabilized version of DPNR.

(a) *Preparation of deproteinized natural rubber (P. A. J. Yapa & W. A. Lionel).*

A method for the preparation of DPNR from field latex was developed. The process involves the treatment of field latex with papain, followed by an alkali treatment of the rubber in crumb form. The crumbs are finally treated with a mixture of phosphoric acid and oxalic acid. Several other proteolytic enzymes, commercially available, such as Bacterial protease Novo (BPN) and superase were also used. Typical properties obtained from 15 different experimental preparations are given in Table 2.

TABLE 2

TYPICAL PROPERTIES OF DPNR PREPARED BY PAPAIN/ALKALINE HYDROLYSIS METHOD

Property	Typical values	Mean S. d.	Range
Dirt % wt	0·019	0·0039	0·011 — 0·035
Volatile matter % wt	0·28	0·0444	0·21 — 0·32
Nitrogen % wt	0·077	0·0194	0·056 — 0·105
Ash % wt	0·16	0·0648	0·100 — 0·226
PRI	73	8·0	60 — 83
P_o	40	6·9	32 — 55
Mooney Viscosity	69	8·34	50 — 88

The raw rubber properties and technological properties were found to be satisfactory. The heat build-up properties have not been studied yet.

Two factory scale trials were carried out at the Mawanella Block Rubber Factory to see whether this new method can be used for the production of block rubber. Apart from some difficulties encountered in drying, it was found to be satisfactory.

(b) *Preparation of viscosity stabilized DPNR (P. A. J. Yapa, W. A. Lionel & M. D. C. Seneviratne).*

A method was developed for the first time for the preparation of a viscosity stabilized version of DPNR from field latex. The method is similar to the one described for DPNR with the exception of addition of the carbonyl condensing reagent, hydroxylamine hydrochloride or hydroxylamine sulphate prior to enzyme treatment. BPN and superase can also be successfully used. Typical properties of viscosity stabilized – DPNR obtained from 15 different experimental preparations are given in Table 3.

TABLE 3

TYPICAL PROPERTIES OF CV-DPNR PREPARED BY PAPAIN/NH_2. OH HCl/ALKALINE HYDROLYSIS METHOD

Property	Typical value	Mean S. d.	Range
Dirt % wt	0·0135	0·0060	0·007 — 0·028
Volatile matter % wt	0·3384	0·079	0·18 — 0·45
Nitrogen % wt	0·0742	0·016	0·070 — 0·098
Ash % wt	0·0114	0·020	0·090 — 0·146
PRI	58·36	7·98	49·8 — 71·9
P_o	37·53	9·99	35 — 72
Mooney Viscosity (initial)	77·73	14·23	60 — 105
Mooney Viscosity (after storage hardening test)	78·06	13·54	62 — 107

The heat build-up properties of this rubber are to be investigated.

2. *Non rubber constituents in NR latex* (*P. A. J. Yapa & S. Kasinathan*)

A quantitative analysis of latex for neutral lipids and phospholipids was made to find out whether these have any relationship to the plugging index as suggested by some workers. Several trials were carried out with low and high yielding trees and the results are now being analysed. The neutral lipid content was found to increase towards the end of the latex flow. A technique for the extraction of neutral lipids and phospholipids from the latex phase was developed.

3. *Biochemical studies on disease resistance in* Hevea

Preliminary studies on biochemical aspects of disease resistance in *Hevea* were carried out during the year in collaboration with the Plant Pathology Department. Diffusates obtained from pods inoculated with *Phytophthora* spores were analysed for phenolic compounds by paper chromatography. Seven spots were observed in clone RRIC 52, on examination of the chromatograms under UV light, amongst them was a very bright blue spot which was found in diffusates of all the clones investigated. This spot did not answer the p – nitranilline test. Four spots were located with p-nitranilline in clone RRIC 52 and three of them were very distinct. Six UV-positive spots were observed in clone RRIM 513, which gave 6 spots with p-nitranilline reagent as well. Rf values of all these spots were recorded. The diffusates were also analysed for sugars and amino acids by using paper chromatography. Total phenolic content of pods of several selected clones was also determined. Of the clones examined, RRIC 101 had the highest phenolic content. Healthy and infected bark tissues were also analysed for total phenolic content. Significantly higher phenolic content was noticed in infected tissues. Attempts were also made to study the UV absorption patterns, of eluted compounds. Bioassay tests were carried out with eluted spots and *Phytophthora* spores and some inhibitory action was shown by a number of spots. These studies are being continued.

Centrifuge Unit

The requests made by various organizations for various latex preparations were met by the Centrifuge Unit of the Institute at Dartonfield, throughout the year. The demand for HCHO — NaOH stabilized latex became heavy towards the end of year, due to its introduction into bale coating purposes.

TABLE 4

SUPPLY OF LATEX BY THE CENTRIFUGE UNIT DURING THE YEAR 1976/GALLONS

	Ratmalana Labs./ Research purposes	Other Institutions
Centrifuged latex	112	1
NaOH - HCHO stabilized latex	288	1151
Prevulcanized latex	11	1
Grafted latex	4	—
Ammoniated field latex	38	154
NaOH — Ammonia stabilized latex	—	10
Total	453	1318

Mr. G. W. Goonasena assisted the Department of Buildings in the flooring of the VIP Lounge at Bandaranaike International Airport, Katunayake, with NaOH — HCHO stabilized latex cement mixtures. Similar assistance was given by him to several other organizations during the year.

SPECIFICATIONS

Technical Specifications (L. M. K. Tillekeratne)

Certificates were issued for 4773 samples from Mawanella for SLR 5L and SLR 5 grades. Production of SLR from low grade RSS sheets was commenced at Mawanella factory during the last quarter of this year. They were of good quality and were given only SLR 10 grade during the investigation period, although they come within the SLR 5 specifications. They will be given SLR 5 grade if their dirt values are consistent and if the mean + 3 standard deviation value is within the SLR 5 limit during this observation period. 1392 samples were analysed from the Cenat Factory, Paiyagala. All samples were not given SLR certificates, because some of them were out of specifications due to high VM values.

Analysis (L. M. K. Tillekeratne)

During this year under the survey of the quality of pale crepe, 318 crepe samples were analysed, 38 latex samples, four water samples and 14 acid samples were also analysed. In addition to the normal analyses, rubber chemicals, compounded rubber and rubber-black masterbatches were also analysed during this year on request from the various organisations in Sri Lanka.

Factory Visits (L. M. K. Tillekeratne)

A few visits were made to the Cenat Factory, Paiyagala and also to the Block Rubber Factory at Mawanella. After these visits we resampled rubber lots rejected due to high VM and regraded them as SLR rubbers if they satisfied the specification tests. We also managed to rectify many incorrect procedures followed by the block rubber producers.

REVIEW OF THE STATISTICAL SECTION

BY
G. A. J. P. R. GOONASEKERA

SUMMARY

The staff position remained unchanged. A research paper was presented at the Centenary Rubber Conference. Analysis of investigations on applications of multi-variate statistical methods was carried out at two Computer Centres. Meteorological work was continued uninterrupted.

DETAILED REVIEW

Staff

The Assistant Statistician, Mr. G. A. J. P. R. Gunasekera and the Technical Assistant, Mr. L. T. Peiris were on duty throughout the year.

Conference

A paper titled "The effect of weather on young *Hevea* growth" was read at the Centenary International Rubber Conference by the Assistant Statistician.

Visits

Visits were made to the Computer Centres at the State Engineering Corporation and University, Peradeniya, regarding analysis and graphical work, the Library of the Department of Census and Statistics for reference and some Estates in connection with meteorological work.

Research Investigations

The effect of weather on Hevea *growth*

The field work on the weather and growth study was terminated in mid-April and the tabulation and analysis of data were completed in time to present the results at the Centenary Rubber Conference. The many inquiries of foreign delegates regarding the methodology adopted and the results are considered to be signs of success of the investigations.

The effect of weather on Hevea *yield*

Graphical work and analysis of data collected in 1973 were continued to be carried out at the Peradeniya University Computer and at the State Engineering Corporation, Computer. Tabulation of hundreds of variables was completed. The problem of missing values was overcome by the use of an ICL packaged programme giving regression estimates.

A mathematical model for latex-flow

Three curves were fitted for the data of a single tree available for a period of one year. The logistic curve was fitted to the untransformed data. Cumulative

data were satisfactorily described by an exponential curve fitted by Steven's itenative method described in 1950, and using Mead's method of 1970 developed for plant density and yield relationships.

Descriminatory analysis

Rubber seed samples from different clones were collected and their linear measurements tabulated. The work is being continued.

Leaf area estimation

Leaf samples of Jak (*Artocarpus indicus*), Rubber (*Hevea brasiliensis*) and Manioc (*Manihot* spp.) were collected, their lengths, maximum breadths and the planimetered areas were measured. A paper was prepared on the subject, entitled "A general regression equation for leaf-area estimation", illustrated by an example using the Jak sample data. This paper received favourable comments from Professor S. C. Pearce, University of Kent, U.K.

OTHER WORK

Many hours were spent in the collection and tabulation of data for an analysis of Personnel and Finances during a ten year period at the Institute. The kind permission of the Director of the Department of Census and Statistics was obtained to employ the Statistical Draughtsman of his Department for graphical work in this connection. The results of an experiment carried out at the Specification Laboratory, at the request of Mr. H. C. Baker, Consultant, have been presented as a note. Routine analysis of the experimental data of the Research Departments and some analyses for Research Papers were also attended to.

Publications

The Assistant Statistician participated in the preparation of the following papers :—

(1) Some methods for determining Leaf Areas in *Hevea* by U. P. de S. Waidyanatha and G. A. J. P. R. Goonasekera. *Q. Jl. Rubb. Res. Inst. Sri Lanka* **52**, 10 - 20.

(2) An analysis of Personnel and Finances of the Rubber Research Institute of Sri Lanka from 1964 to 1975, with special reference to Research Departments by G. A. J. P. R. Goonasekera and L. T. Peiris. (in press).

(3) The effect of weather on young *Hevea* Growth by G. A. J. P. R. Goonasekera and L. T. Peiris. *Proc. Cent. Int. Rubb. Conf. Sri Lanka*, 1976.

(4) A general regression equation for leaf area estimation by G. A. J. P. R. Goonasekera.

(5) A note on the Ash Content determination of natural rubber by G. A. J. P. R. Goonasekera and P. A. J. Yapa. (in preparation).

Quarterly Progress Report for 1976 and the Annual Review for the previous year were also prepared by the Assistant Statistician.

Liaison work

Dr. K. S. E. Jayatillaka, Head, Economics Research Department and Computer Department of the Central Bank, generously extended his assistance in overcoming difficulties encounted in the course of research investigations. Professor R. R. Hocking of the Department of Computer Science and Statistics, Mississippi State, U.S.A., consented to extend his services to the Statistics Section as a Consultant.

Meteorology

The following instruments are installed at the Dartonfield Meteorological Station :—

(1) Sunshine Recorder
(2) Annemometer
(3) Pluviograph
(4) Thermohygrograph
(5) Barograph
(6) Barometer
(7) Screen Thermometers (current dry, current wet, dry maximum and dry minimum)
(8) Earth Thermometers (10, 20, 30 and 122 cm depths)
(9) Hygrometer, and
(10) Evaporimeter.

Readings were taken twice daily. A summary is given in the annexed Table. Requests for meteorological data summaries from outsiders and Research Officers were attended to and the rainfall data were continuously supplied to the Estate Department.

Due to the pressure of work, not much attention could be paid regarding the instruments installed in other Estates.

METEOROLOGICAL STATISTICS — DARTONFIELD — 1976

Longitude — 60°09' E
Latitude — 60°32' N
Height above sea level — 6550 cm

MONTH	Rainfall (mm)			Screen Temperature (°C)				Soil Temperature (°C)										Atmospheric Pressure mm of mercury	
								Average at 8-30 a.m.						Average at 3-30 p.m.					
	Monthly total	Greatest Daily fall and date	No. of Rainy days	Mean daily max.	Highest Max. and date	Mean daily min.	Lowest Min. and date	122 cm depth	30 cm depth	20 cm depth	10 cm depth	05 cm depth	Minimum on grass	122 cm depth	30 cm depth	20 cm depth	10 cm depth	05 cm depth	Mean at 8-30 a.m.	Mean at 3-30 p.m.
JAN.	83·0	34·3 (14)	6	29·7	34·5 (21)	19·2	15·9 (21)	27·4	27·3	26·6	26·8	25·2	19·2	27·5	27·6	28·4	29·1	32·4	759·09	756·64
FEB.	26·1	11·6 (15)	5	31·2	34·5 (9)	19·1	16·5 (9)	28·0	27·9	27·6	26·8	25·9	18·9	28·0	29·6	29·6	31·4	33·6	758·08	755·91
MAR.	141·4	38·2 (30)	11	32·6	35·0 (23)	19·6	17·5 (3)	29·2	29·7	29·6	28·5	27·5	19·7	29·3	31·4	31·6	33·8	37·4	757·87	755·55
APR.	634·2	88·3 (23)	24	30·4	34·0 (5)	21·2	19·0 (3)	28·8	27·6	27·7	27·2	26·7	21·5	28·5	28·4	28·7	29·5	30·5	757·77	755·74
MAY	222·7	48·3 (12)	18	30·5	32·5 (10)	21·6	20·0 (17)	28·4	28·1	28·2	27·7	27·1	22·3	28·4	29·5	29·5	30·7	32·1	757·61	755·99
JUN.	207·8	50·3 (26)	21	30·6	31·9 (20)	21·6	20·2 (10)	28·6	28·5	28·3	27·7	27·2	22·2	29·0	30·3	30·6	32·5	33·8	757·21	755·83
JULY	209·2	55·1 (23)	25	29·4	31·5 (12)	21·1	19·3 (1)	28·6	27·9	27·8	27·2	26·6	21·7	28·6	28·9	29·1	30·3	31·3	757·31	755·88
AUG.	307·7	114·6 (23)	20	29·0	31·6 (12)	20·7	19·4 (24)	28·2	27·5	27·4	26·9	26·4	20·7	28·2	28·4	28·4	29·5	30·6	757·47	755·93
SEP.	88·7	35·7 (10)	15	29·7	31·8 (30)	20·1	19·3 (23)	28·4	28·1	28·1	27·6	27·1	21·4	28·4	29·9	30·0	31·6	33·0	758·52	756·72
OCT.	527·8	170·3 (9)	27	29·2	33·2 (1)	20·1	19·0 (6)	27·7	27·2	27·2	26·9	26·5	20·7	28·2	28·9	28·9	29·7	30·3	758·26	756·12
NOV.	620·4	108·0 (12)	28	29·0	32·5 (24)	20·1	18·5 (14)	26·6	27·0	27·0	26·6	26·3	21·0	28·0	27·9	28·1	28·7	29·1	757·24	755·49
DEC.	45·3	89·4 (23)	22	30·2	33·5 (20)	19·9	18·5 (14)	27·8	27·1	27·2	26·6	25·9	20·9	27·7	28·1	28·1	31·8	31·7	758·30	756·64
MEAN	259·9		19	30·1		20·4		28·1	27·8	27·7	27·2	26·5	20·9	28·3	29·1	29·3	30·7	32·2	757·89	756·03

REVIEW OF THE ADVISORY SERVICES DEPARTMENT AND ECONOMIC RESEARCH UNIT

BY

A. B. DISSANAYAKE

1. General

The annual report comprises :—

A. Advisory Services to Smallholders
B. Advice to Estates
C. Economic Research

2. Staff

The Head, Advisory Services Department and Economic Research Unit, the Deputy Head, one Assistant Advisory Officer and the Assistant Agricultural Economist were on duty throughout the year. Mr. R. A. Wijewansa, Assistant Advisory Officer left the services of the Institute on 30th September 1976. Mr. D. B. Weligodapola, Divisional Advisory Officer, Ratnapura, retired from service on 30th September 1976. I wish to place on record our appreciation of the services rendered by these Officers to the Smallholders and the Rubber Research Institute.

Mr. H. D. B. H. Gunasekera took up duties as an Assistant Agricultural Economist from 1st September 1976.

3. Other Administrative Matters

3. 1. Correspondence

Inward	—	6,652
Outward	—	11,021

3. 2. With Rubber Controller

Inward — 3096 (applications for new planting unregistered rubber lands and new planting permits)

Outward — 2803 (preliminary reports, final inspection reports and special reports).

From Rubber Instructors to smallholders — 2471

A. Advisory Services to Smallholders

1. *New Planting*

1. The following visits were carried out :—

First visits	—	167
Subsequent visits	—	397

1. 2. *Lining*	*No. of permits*	*Acreage*
This year's permit areas :—		
Soil conservation	13	99
Planting holes	75	111
Last year's permit areas :—		
Soil conservation	62	66
Planting holes	57	77
Marking of trees for tapping	17	672 trees

2. *Replanting*

1. Visits :	
Permits issued	2,684
Visits to this year's permit areas	5,976
Visits to previous year's permit areas	21,809

2. 2. *Lining*	*No. of permits*	*Acreage*
This year's permit areas :—		
Soil conservation	1,303	1,610
Planting holes	1,428	1,850
Previous year's permit areas :—		
Soil conservation	534	799
Planting holes	576	888
Marking trees for tapping	271	8,731 trees

3. Special Inspections for Rubber Control Department

Visits for preliminary reports	477
Visits for final inspections and special reports (new planting)	2,240
Visits for special reports (replanting)	3,748
Visits for recommendation of subsidy payments by Divisional Advisory Officers and Senior Rubber Instructors	445
Visits to Commodity Purchase Depots	830
Number of Plants inspected at Commodity Purchase Depots	15,241

4. Smallholders' Rubber Conferences

During the year under review 2 Smallholder conferences were held one at Aranayake in May and the other at Kiriella in June.

5. Meetings and Conferences

The Head Advisory Services Department, the Deputy Head and the Divisional Advisory Officers attended two conferences at the Ministry of Plantation Industries. All Officers of the Advisory Services Department attended the Centenary International Rubber Conference held at the BMICH from the 15th to 17th December.

The Deputy Head attended the ANRPC Conference on "Progress and Development of Smallholders" at Hatyai, Thailand in October.

The Head Advisory Services participated in the special sessions of Sri Lanka Association for the Advancement of Science on Scientific and Technical Co-operation among Non-Aligned Countries. He also attended the Annual Session of the Sri Lanka Association for the Advancement of Science.

The field officers attended the conferences organised at the District Kachcheri of three respective areas.

6. Publications

Advisory leaflets on Manufacture of Smoked Sheet, Tapping, White Root Disease (Sinhala & English) and Bark Rot (English) were revised and published. Revised advisory leaflets on *Oidium* leaf disease and soil conservation are with the printer.

7. Improvements of Smallholders' Sheet Rubber

Progress on the construction of Group Processing Centres is as follows :—

1.	Group Processing Centres in operation	87
2.	Group Processing Centres (work completed)	13
3.	Group Processing Centres under construction	2
4.	Group Processing Centres surveys completed	18
5.	Group Processing Centres surveys going on	20

During the year under review the expenditure incurred in the construction of group processing centres was Rs. 3,06,095/50 cents. 3009 coagulating pans were given at subsidy rates to group processing centres while 308 sq. ft. of monel mesh were sold at subsidised rate to smallholders and group processing centres.

8. Other Visits

A total of 6,510 visits to group processing centres and 1,000 visits to demonstration and ordinary smoke houses were made during the year.

9. Training Classes for Smallholders

A total of 445 trainees were provided with lectures and practicals at 20 training classes. Of these 302 trainees were successful at the oral test and are being issued with certificates.

10. Fertilizer Demonstration Plots

During the year under review the 76 fertilizer demonstration plots which commenced in 1972 were maintained.

11. Demonstrations

The following demonstrations were given by field staff during the year :—

Sheet making	530
Tapping	618
Disease control	286
Miscellaneous	769

B. Advice to Estates

1. *Visits*

A total of 159 visits were made to medium and large estates by the officers of the Department.

2. *Other visits*

In addition a total of 114 visits were made in attending interviews, committee meetings and other discussions with scientific officers.

3. *State Rubber Manufacturing Corporation*

The Head attended 11 meetings while the Deputy Head attended 3 meetings of the State Rubber Manufacturing Corporation during the year.

4. *Seminars*

A scheme of Seminars for Land Reform Commission personnel was started and three seminars were held during the year. The Head attended a seminar on Agricultural Research Management for 2 days at the Agricultural Research and Training Institute. The Assistant Agricultural Economist attended a seminar on Export Marketing at the Academy of Administrative Studies.

C. Economic Research

1. *The Economics of Production of Rubber*

First, a questionnaire for the survey of smallholdings was prepared, tested in the field and amended. The survey was started using the graduate technical assistants and is being continued.

2. *The effect of the fuel crisis*

Prices of inputs to the NR plantation industry was collected and the data studied. The findings were presented in a paper at the Centenary International Rubber Conference in December.

3. *Economics of Resource use*

The data collected have been coded for analysis by computer.

4. *Group Processing Centres*

The data on monthly performance of Group Processing Centres are being studied. A separate progress report on the functioning of Group Processing Centres for the year 1976 is being prepared.

The survey to find out the reasons as to why some of the original members of the Group Processing Centres have left showed the following to be the three most important reasons :

(A) Inaccuracies in the measurement of the dry rubber content in latex.

(B) Problems in the payment for latex.

(C) Poor management by the committee.

5. *Replanting*

The collected data are being studied.

6. *Fertilizer use*

The results of the preliminary studies indicated an absence of correlation between the leaf nutrient levels and the yield per acre. This could be due to the sample studied which may not be appropriate to the study. Further work will be undertaken after discussions with the Soils Chemistry Department.

7. *Papers*

The following papers were presented during the year :—

(a) To the special sessions of the Sri Lanka Association for the Advancement of Science on Scientific and Technological Co-operation among Non-Aligned Countries held in Colombo.

(i) "Techno-economic co-operation and exchange of expertise among Non-Aligned Countries" by A. B. Dissanayake and Ariya Abeysinghe of the Ministry of Plantation Industries.

(ii) "The Agro-Economic Norm and the development of Agriculture among Non-Aligned Countries" by A. B. Dissanayake and G. R. Chandrasiri.

(b) To the ANPRC conference on Progress and Development of Smallholders held in Hat Yai, Thailand.

(iii) "Extension methods — our experience at the Rubber Research Institute of Sri Lanka" by A. B. Dissanayake.

(iv) "Problems in the purchasing and collection of smallholders' rubber for Central Processing in Sri Lanka" by A. B. Dissanayake.

(v) "The Socio-Economic Aspects of Group Processing of Smallholders' Latex in Sri Lanka" by G. R. Chandrasiri.

(c) To the Centenary International Rubber Conference, Sri Lanka.

(vi) "An economic evaluation of the profitability of the NR plantation industry of Sri Lanka after the fuel crisis" by A. B. Dissanayake.

(vii) "Future trends in extension methods for smallholders" by A. B. Dissanayake.

(viii) "The specification and estimation of a Production function for smallholding rubber in Sri Lanka" by G. R. Chandrasiri, B. Carrad, C. K. Tee, and S. Weerasinghe.

8. *Popular Articles*

The following popular articles were written for publication during the period :—

(a) *In English*

(i) "The competitive position of Natural Rubber" by A. B. Dissanayake for the *Daily News* supplement.

(ii) "Agricultural Extension" by A. Dahanayake for the *RRISL Bulletin*.

(b) *In Sinhala*

(iii) "Advisory Services and how it should function" by A. B. Dissanayake for the *Lankadeepa* supplement.

(iv) "Natural Rubber" its development and global outlook by A. B. Dissanayake for the *Vidya* Magazine.

(v) "The economics of Group Processing Centres" by A. B. Dissanayake for the *Vidya Vyapthi* magazine.

(vi) "The origin of Natural Rubber" by A. B. Dissanayake for the *Rubber Puwath*, Rubber Research Institute, Bulletin.

REVIEW OF THE ESTATE DEPARTMENT

By
W. A. Fonseka

SUMMARY

The total extent of Dartonfield Group was 1553 acres 1 rood 16 perches including the 6 acres handed over by the Land Reform Commission. The planted acreage was 989¾ of which 718½ acres were tapped during the year. The extent of immature areas and nurseries was 254½ acres and 16¾ acres, respectively.

The weather pattern experienced during the year was not conducive for tapping and harvesting of crop. The severe drought experienced from mid January to mid March, and the heavy and unusual distribution of rainfall recorded in April, October and November interrupted normal tapping and contributed to reducing yields causing heavy short fall in crop. Hedigalla Division suffered most in this respect.

The crop harvest, 375, 391 lb, represented an average yield of 523 lb. per acre and fell short of the estimate by 24·92%.

Wintering was early this year. No symptoms of *Oidium heveae* was noticeable on early wintering trees, but late winterers suffered slight leaf-fall.

Budwood of clones of RRIC series and PB 86 continued to be much in demand, and issues were made to estates and smallholders on request.

Routine weeding, manuring, disease control and other agricultural operations were carried out in both mature and immature areas of the Group.

Estimates for 1976 in connection with the working of the Group were prepared and submitted to the Rubber Research Board for approval.

Dartonfield Factory commenced manufacture of latex crepe from Mukalana Estate and Galawatte Division latex, during the course of the year. This was in addition to the manufacture of latex from Horagoda Estate, which commenced in 1975.

Staff

The Estate, Superintendent, Mr. W. A. Fonseka, and the Assistant Superintendent, Mr. S. G. Fernando, were on duty throughout the year.

The Office Assistant, Mr. A. C. Swaris, was based in Head Office as Office Assistant (Estates) with effect from 20-1-76.

K. P. attached to Nivitigalakele Division, Mr. G. D. A. Weerasooriya, was transferred to Kuruwita Sub-station on 1-1-76 while in his place the K. P. at Dartonfield, Mr. S. K. S. de Silva, was reverted to Nivitigalakele on the same day.

Mr. J. S. de Zoysa, K.P. at Hedigalla Division was transferred temporarily to Kuruwita Sub-station with effect from 13th Sept., 1976 consequent to the Officer-in -charge of Kuruwita Sub-station being interdicted.

Mr. P. V. N. Dharmagunawardena, Estate Medical Assistant, and Mr. J. D. Wimalasena, K.P. Dartonfield assumed duties on 11-3-76 and 2-8-76, respectively. On 1-1-76 the post of Factory Attendant at Nivitigalakele was abolished. Mr. N. L. D. Piyadasa, the officer who held this post earlier, was transferred to Dartonfield as Acting Field Assistant.

The Estate Department cadre stood at 26 at the end of the year, made up as follows :—

Senior Staff	..	1
Intermediate Staff	..	1
Assistant Staff	..	15
Minor Staff	..	9
		26

Correspondence

Inwards	..	555
Outwards	..	1370

Acreage Summary

	Dartonfield			Nivitigalakele			Hedigalla			Total		
	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P.
Mature ..	90	1	07	85	3	00	542	1	17	718	1	24
Immature ..	25	2	12	46	0	23	183	0	00	254	2	35
Nurseries ..	5	2	00	9	1	07	2	0	00	16	3	07
Total ..	121	1	19	141	0	30	727	1	17	989	3	26
Abandoned ..	9	2	00	14	0	36	59	2	30	831	1	26
Building sites *etc.* ..	40	2	36	15	1	33	8	1	18	64	2	07
Pinewood Plantation ..	—	—	—	—	—	—	1	0	34	1	0	34
Roads ..	6	2	22	0	3	27	9	0	04	16	2	13
Swamp areas ..	—	—	—	0	2	08	0	2	20	1	0	28
Streams & Reservations ..	0	0	29	—	—	—	13	0	29	13	1	18
Jungles *etc.* ..	—	—	—	1	3	38	376	0	00	377	3	38
	178	1	26	174	1	12	1195	1	32	1548	0	30
Land handed over by Land Reform Commission	—	—	—	5	0	26	—	—	—	5	0	26
Total ..	178	1	26	179	1	38	1195	1	32	1553	1	16

Visiting Agent

The visiting Agent, Mr. M. R. C. Peiris paid two visits to Dartonfield Group on 27th & 28th February 1976 and on 27th & 28th August 1976. His reports were submitted to the Rubber Research Board.

Weather (Estate Gauge)

Comparative rainfall figures (in inches) for 1976 and 1975 are given below :—

Month	Dartonfield		Nivitigalakele		Hedigalla	
	1976	1975	1976	1975	1976	1975
January ..	3·27	5·55	1·45	6·45	3·15	3·97
February ..	1·03	7·65	0·74	6·91	2·30	12·60
March ..	5·57	16·15	9·65	15·18	15·46	19·79
April ..	24·97	21·49	22·64	20·03	22·61	24·73
May ..	8·96	29·87	9·32	25·66	18·07	34·89
June ..	8·18	20·77	6·93	18·49	11·17	27·13
July ..	8·24	5·56	9·19	6·40	14·21	5·55
August ..	12·11	10·68	11·47	11·85	17·21	16·41
September ..	3·49	15·02	3·69	16·02	5·34	19·24
October ..	20·78	24·53	19·65	24·38	26·48	31·73
November ..	24·43	31·84	22·79	32·73	26·45	39·31
December ..	17·83	7·52	19·06	7·92	22·35	24·10
	138·86	196·63	136·58	192·02	184·80	259·45
Average (five years period)	172·84″		161·62″		201·16″	
Total No. of wet days ..	222	240	198	223	212	239

The total rainfall for the year at Dartonfield, Nivitigalakele and Hedigalla Divisions amounted to 138·86 in., 136·58 in., 184·80 in., on 222, 198 and 212 days, respectively.

The second and fourth quarters of the year received heavier rainfalls. The wettest months were April, October and November and the rainfall at Hedigalla in October was the highest recorded and amounted to 26·48 inches.

Crop

The weather conditions were not favourable for harvesting of crop. The main factors that contributed to the deficit in crop during the year were :—

(1) Uneven wintering and very severe drought experienced during the re-foliation period.

(2) Heavy and uneven distribution of rainfall specially during heavy cropping months of September, October and November.

(3) Poor out-turn of non resident tappers at Hedigalla, particularly during late tapping days, due to uncertainty of tapping possibilities.

(4) Poor bark reserves particularly on upper panels in intensified areas at Hedigalla.

(5) Reduced acreage in tapping compared to the estimate.

	1976	1975
Estimated ..	500,000 lb	500,000 lb
Harvested ..	375,391 ,,	371,331 ,,
Deficit ..	124,609 lb	128,669 lb

The crop harvested for the year 1976 was 75·08% of the season's estimate.

Comparative yield records of Individual fields :

	Acreage in tapping	Total yield in lb 1976	Total yield in lb 1975	Yield in lb per acre 1976	Yield in lb per acre 1975
Dartonfield					
1952 Re. Area	27	19,689	16,094	729·2	596·1
1953 - do -	8	5,020	4,224	627·5	528·0
1954 - do -	2½	1,525	1,488	610·0	595·2
1955 - do -	5	3,132	3,840	626·4	768·0
1955/56 - do -	4¾	3,046	3,565	641·3	750·6
1960/61 - do -	31½	23,838	20,406	756·8	647·8
1965 - do -	11½	10,612	7,115	922·8	618·7
	90¼	66,862	56,732	740·9	628·6
Nivitigalakele					
1953 Clg.	10	6,633	5,200	663·3	520·0
1954 ,,	10	8,035	5,314	803·5	531·4
1962 Re. Area	16¾	17,949	19,940	1,071·6	1,190·5
1963 - do -	14	14,998	14,690	1,071·3	1,049·3
1964 - do -	8	9,261	7,941	1,157·6	992·7
1965 - do -	10	9,994	8,058	999·4	805·8
1966 - do -	5¾	5,185	4,585	901·7	798·4
1967 - do -	8¾	7,168	5,711	819·2	652·7
1968 - do -	2½	992	—	396·8	—
	85¾	80,215	71,439	935·5	858·1
Hedigalla					
1952 Clg.	79½	54,840	55,467	689·8	697·7
1953 ,,	60	7,914	38,939	131·9	649·0
1954 ,,	171	73,358	73,245	429·0	428·3
1955 ,,	78	29,198	25,787	374·3	330·6
1956 ,,	60	30,160	29,848	502·7	497·5
1957 ,,	17¼	7,196	8,054	417·2	466·9
1965 Re. Area	2	2,266	1,742	1,133·0	871·0
1967 - do -	17	6,629	4,818	389·9	481·8
1968 - do -	9¼	5,502	4,304	594·8	465·3
1969 - do -	22¼	7,811	956	351·1	43·0
1970 - do -	26¼	3,440	—	131·0	—
	542½	228,314	243,160	420·9	477·4
Total for the group	718½	375,391	371,331	522·5	543·9
Outside Sources		397,908	55,313		
Total		773,299	426,644		

Tapping

Tapping was continued throughout the 'wintering' period. Recovery tapping was done as follows :—

Dartonfield Division	—	18 days
Nivitigalakele Division	—	4 days
Hedigalla Division	—	13 days

All tapping panels in experimental areas were treated with Antimucin, but commercial areas were not treated. Tapping cuts were also marked with appropriate guide lines for bark consumption in keeping with the systems of tapping adopted in various experimental areas.

Apart from the fields estimated, 26¼ acres of 1970 Replanting at Hedigalla was brought under tapping during the year.

Analysis of Tapping rounds on Dartonfield Group for 1976 (1975 figures in brackets)

Dartonfield

	Early Tapping		Double Tapping		Late Tapping		Winter rest		Rain		Holidays *etc.*	
1st Qr.	82	(69)	3	(—)	2	(17)	—	(—)	1	(4)	3	(—)
2nd Qr.	49	(32)	—	(—)	20	(22)	—	(—)	18	(32)	4	(5)
3rd Qr.	58	(61)	10	(—)	10	(13)	—	(—)	14	(18)	—	(—)
4th Qr.	45	(34)	5	(8)	22	(27)	—	(—)	20	(23)	—	(—)
	234	(196)	18	(8)	54	(79)	—	(—)	53	(77)	7	(5)

Nivitigalakele

1st Qr.	83	(61)	—	(—)	7	(19)	—	(—)	1	(10)	—	(—)
2nd Qr.	38	(28)	—	(—)	25	(25)	—	(—)	24	(34)	4	(4)
3rd Qr.	48	(54)	4	(—)	26	(25)	—	(—)	14	(13)	—	(—)
4th Qr.	42	(29)	—	(5)	25	(26)	—	(—)	25	(32)	—	(—)
	211	(172)	4	(5)	83	(95)	—	(—)	64	(89)	4	(4)

Hedigalla

1st Qr.	68	(51)	6	(—)	3	(11)	—	(—)	7	(28)	7	(—)
2nd Qr.	40	(18)	—	(1)	19	(14)	—	(—)	27	(55)	5	(3)
3rd Qr.	42	(32)	7	(12)	21	(27)	—	(—)	22	(21)	—	(—)
4th Qr.	34	(18)	—	(9)	27	(33)	—	(—)	31	(32)	—	(—)
	184	(119)	13	(22)	70	(85)	—	(—)	87	(136)	12	(3)

Manufacture

A summary of the various forms of manufacture during the year is given below :

Latex Grades

	Total lb	Percentage
Pale Crepe No. 1 ..	310,308	95·41
- do - No. 2 ..	4,754	1·46
- do - No. 3 ..	10,177	3·13
	325,239	100 00

Scrap Grades

Scrap Crepe No. 1 ..	30,750	61·31
- do - No. 2 ..	15,605	31·12
- do - No. 3 ..	3,797	7·57
	50,152	100·00
Total ..	375,391	
Outside sources ..	397,908	
	773,299	

Due to storage difficulties at Dartonfield Factory scrap was manufactured at Mukalana for a few months.

Latex, collected by Horagoda Estate, Lathpandura, Mukalana Estate, Mahakalupahana, and Gilewatta Estate, Agalawatta, was accepted for pale crepe manufacture. A sum of -/30 cts. per lb was levied as manufacturing charges.

Factory Machinery

Mill No. 2

Repaired in July 1976. Regrinding and regrooving rolls, rebushing end bearings and attended to minor repairs. Mill was out of commission (under repairs) from 20/2/76 — 16/6/76.

Mill No. 5

Repaired same as above mill. remained out of commission (under repairs) from 2/7/1976 — 15/12/76.

Mill No. 6

Drive motor ball bearings ceased and were replaced in August 1976. After a few days use these new bearings also functioned defectively and the motor sent back for repairs on 13/9/76. This was still under repairs at the end of the year.

Mill No. 7

Small end pinion and the safety bush broke at the same time on 2/6/76. It was detected that this was due to an old extensive crack along the key hole of the pinion. This machine remains out of commission awaiting supply of a new pair of machine cut end gears.

Mill No. 8

Sent for repairs on 25/2/76 — overhauling rolls, rebushing bearings *etc.* This machine remained out of commission from 25/2/76 — 7/6/76.

Mill No. 9

Both roller journals broke on 31/1/76. New roller barrels and a new pair of end gears were supplied and fitted. The machine was out of commission from 31/1/76 — 6/2/76. New driving shaft collar was fitted on 9/2/76.

Pests and Diseases

Oidium heveae : Wintering was early this year ' *Oidium* ' was not noticeable in early wintered areas, but, late winterers suffered a fairly heavy leaf-fall. A few rounds of ' spot ' dusting were carried out.

Gloeosporium alborubrum : The incidence was negligible.

Phytophthora Spp : No noticeable attack was experienced.

Bark-rot : A few cases were detected and treated.

Root diseases : Some cases of *Fomes lignosus* and *Ustulina zonata* were detected in mature areas and remedial measures adopted.

Storm damage : The number of trees uprooted due to wind damage at Dartonfield, Nivitigalakele and Hedigalla Divisions totalled to 54, 35, 125 trees respectively.

Capital Account — *Agricultural Development*

Dartonfield Division — Immature Areas :

1973	Replanted area ..	15 acres	
1974	- do - ..	10¾ ,,	25¾

Nivitigalakele Division — Immature Areas :

1970	Replanted area ..	17¼ acres	
1971	- do - ..	11½ ,,	
1972	- do - ..	6 ,,	
1974	- do - ..	11¼ ,,	46¼

Hedigalla Division — Immature Areas :

1971	Replanted area ..	17 acres	
1972	- do - ..	20 ,,	
1974	- do - ..	64 ,,	
1975	- do - ..	82 ,,	183
			255

1970 Replanted Area :

17½ Acres at Nivitigalakele : This area consists of stumped buddings of clone RRIC 45, budded stumps of clones RRIC 13, 45, 100, 101, PR 252, TRCI 2, WR 101 and AVROS 1734. Plants are growing fairly satisfactorily.

1971 Replanted Areas :

(a) *11½ Acres at Nivitigalakele :* This replanting was planted with budded stumps of clone RRIC 50 and experimental clones. Growth is fairly satisfactory.

(b) *17 Acres at Hedigalla :* Budded stumps of clones RRIC 15, 48, 50, 101 and PR 252 are planted in this area. Growth is vigorous. Girth of trees in the area planted with RRIC 100 is very much superior to the girth in the rest of the areas.

1972 Replanted Areas :

(a) *6 Acres at Nivitigalakele :* This plantation consists of clones RRIC 45, 110, experimental clones No. 506 and some selected seedlings from the Genetics & Plant Breeding Department. Plants are coming up well.

(b) *20 Acres at Hedigalla :* Clones RRIC 100 and 101 are planted in this area and growth is good.

1973 Replanted Areas :

15 acres at Dartonfield : This area is an experimental block and consists of clones RRIC 101, PB 86 and experimental clones of the Botany Department. Growth is satisfactory.

1974 Replanted Areas :

(a) *10¾ acres at Dartonfield :* This acreage is planted with clone PB 86, and plants are coming up well.

(b) *11¼ Acres at Nivitigalakele :* This area consists of experimental clones supplied by Genetics & Plant Breeding Department. Growth is satisfactory.

(c) *64 Acres at Hedigalla :* Clones of RRIC 102, 103 and PB 86 are planted in this area. Ground conditions are satisfactory and growth is vigorous.

1975 Replanting :

82 acres at Hedigalla : 13,991 budded stumps of clone PB 86 were planted in this area. Growth is satisfactory.

Monthly weeding of all the immature areas detailed above was carried out and the younger replantings are maintained in covers.

Nurseries

Budwood multiplication nurseries : 7¼ acres at Nivitigalakele. 5½ acres at Dartonfield and RRIC clone area at Hedigalla.

Routine weeding, manuring and other agricultural operations were carried out on all these nurseries.

Seedling Stock Nurseries

(a) All seedling stock nurseries were satisfactorily maintained throughout the year. Routine works were carried out.

(b) Stocks were budded to meet both experimental and commercial requirements.

(c) Two new nurseries were established at Nivitigalakele and Hedigalla for use in 1977.

Budwood Issues

To outside estates	..	554 yards
For experimental buddings of Plant Pathology Dept.	..	369 ,,
For experimental buddings of Bot. Dept.	..	390 ,,
For experimental buddings of Genetics & Plant Breeding Dept.	..	255 ,,
For estate Dept. budgraftings	..	318 ,,
		1,886 ,,

Budded stumps Issues :

For 1976 Replanting at Hedigalla (from N'Kele only) — 3,578 budded stumps.

Field and Technological Experiments

Required labour and necessary assistance were given to Botany, Genetics & Plant Breeding, Plant Pathology, Soils Chemistry and Rubber Chemistry Departments for carrying out various field and technological experiments.

Roads

All motorable roads within the estate, including main approach roads to outlying Divisions, were maintained in fair order, effecting surface repairs where necessary.

The damaged culvert on the main approach road to Hedigalla was replaced by a new culvert by the Department of Highways.

Estimates

Estimates for 1976, both capital and revenue, in respect of Dartonfield Group, were prepared and submitted to the Rubber Research Board for approval. These estimates were prepared on the Metric system in keeping with Government Policy.

Labour and Health

Labour force : Although the permanent labour force was adequate, the out-turn of workers were unsatisfactory, specially on rainy days and during paddy cultivation periods.

Nine labourers reaching the age limit were retired and gratuities were paid. Two workers left on their own accord under medical grounds. Gratuities and travelling allowances were paid to six repatriates of Indian Origin.

Applications for refund of EPF dues were made in respect of 17 workers. In all 31 cases were settled in full including previous years outstanding claims. A, B, G & H EPF forms which were in arrears in respect of 290 workers were filled and a balance of 34 is still to be attended to.

Four labour tribunal cases were reported during the year, out of which three applications were dismissed while one applicant was reinstated.

There were six labour trade unions operating within the Group. No strikes were reported.

In accordance with the Industrial Dispute Act, two labourers were granted sick leave payments.

Line rooms : Line room accommodation remained satisfactory. Repairs to lines and cottages where necessary were attended to. Building of new cottages was not undertaken during the year.

Wages: Wages were paid during the year in accordance with the Wages Board's Ordinance in force applicable to Rubber Growing and Manufacturing Trade. Besides the minimum wage, incentives were paid to supervisory kanganies.

Dartonfield Group

Working Ceylonese	*Resident*	*Non-resident*	*Total*
Men	63	163	226
Women	48	152	200
Children	—	—	—
Working Immigrants			
Men	32	—	32
Women	29	—	29
Children	1	—	1
	173	315	488

Annual holidays : Annual holidays with holiday pay wages were given to all labourers who were entitled to these in accordance with the labour ordinance.

Festival advances : Substantial festival advances were given to all labourers during Sinhala New Year and Deepavali festivals to be deducted over a period of ten months.

Maternity benefits : In all twenty full and four alternative maternity benefits payments were made.

Workmen's compensation : Fourteen accidents, sustained to workers were reported, of which, thirteen workers received compensation.

Feeding children : All non-working resident children over one - year of ages were issued with ¼ lb bread daily. Fortnightly cash payments were made to reident non-lactating mothers with infants under one year, as infant milk foods were not readily available in the open market.

Health : The health of the members of the Institute's staff and of the estate labourers was satisfactory, during the year. An out-break of "Chicken-Pox" in the Group was reported during September.

Immunisation against polio and vaccinations of BCG and Triple were carried out at the estate dispensary with the assistance of the Public Health Inspector of the area. A mass anky treatment programme too was undertaken.

Sanitary measures : Staff bungalows and labour quarters were regularly sprayed with disinfectant fluids. No DDT spraying was undertaken due to non-availability of DDT powder in the open market.

Births : 19 infants were born during the year on the Group.

Deaths : There were four deaths on the Group this year.

A list of the more common diseases treated by the Institute's Estate Medical Assistant is given below :—

Influenza	..	..	968
Ulcers	..	..	996
Round worm	..	..	753
Diarrhoea and enteritis	..	..	687
Eye and Ear Diseases	..	..	241
Other Diseases	..	..	6,207
			9,852

The number of cases treated during the year was very high as it included non-residents cases too. The Rubber Research Board as a social service gesture had approved treating of non-residents who are relations of workers employed in the Institute.

General

Workers Councils : Two Workers Councils established at Hedigalla and Dartonfield/Nivitigalakele, continued functioning.

Visits : A few members of the Rubber Research Board including the Chairman visited Hedigalla Division of Dartonfield Group on 25th May 1976.

Centenary Celebrations : Necessary assistance was rendered in connection with the Pirith Ceremony and Sangeeka Dana organised by the Institute on 5th and 6th December 1976 to commemorate the Rubber Centenary.

REVIEW OF THE KURUWITA SUB-STATION

BY

SALIE M. DIAS

Acreage Statement

Mature Rubber	A.	R.	P.
1961 Replanting	83	0	00
1962 Replanting	38	3	00
1963 Replanting	22	2	00
1964 Replanting	18	0	00
1965 Replanting	19	2	00
1966 Replanting	10	0	00
1967 Replanting	10	0	00
1968 Replanting	10	0	00
1969 Replanting	10	0	00
Total Rubber in tapping ..	221	5	00
Nurseries	2	0	20
Paddy	5	2	00
Roads, Buildings & Uncultivated	17	1	10
Total	247	0	30

Year	*Rainfall*	*Wet days*
1975 ..	189·60 in.	246
1976 ..	146·38 ,,	272

The year commenced with prolonged drought conditions and a severe attack of *Oidium*. From Mid-March onwards the rain, set in and continued during the rest of the year. The second half of the year under review was quite wet, though the year under review has yielded one of the lowest rainfall records in recent year.

Some of the RRIC Clones, especially RRIC 45 was particularly susceptible to *Oidium*.

	1976	1975
Estimated crop ..	210,000 lb	180,000 lb
Crop Secured ..	159,430 lb	130,913 lb
Increase ..	28,517 lb	Over Season 1975.

The estimated crop has not been harvested due to the early prolonged drought, and the inability to carry out any recovery tapping, due to despatch of latex to Elston Estate. I do not visualize that the estimated yield could be achieved on this property due to the multiplicity of clones, some of which are quite low yielding. This is to be expected at a Research Station. The same yield results as on a Commercial plantation cannot be realised, as this Research Station is constantly trying out new local and introduced clones, with a view to giving the Industry the most successful Commercial Clones.

Manufacture

This was for a time carried out at Palmgarden Estate on the basis of payment of manufacturing charges. The arrangement was not satisfactory. Therefore, it was discontinued and the latex sent to Elston Estate, Puwakpitiya, which now belongs to the Plantation Division of the Institute. Latex transport had also to be given up as there was rapid pre-coagulation due to the multiplicity of Clones. Latex transport has been replaced with supply of coagulam. Here too the facilities are poor, as no adequate tank capacity is available, and there is no adequate factory facilities since the Sub-Station factory was handed over to the SRMC which is putting up a Central Crepe Factory on the site of the Sub-Station factory.

Staff

Mr. G. D. Weerasooriya who took over from Mr. M. C. Perera, has been suspended pending a disciplinary inquiry. His place has been taken by Mr. J. S. de Zoysa a very young officer.

Labour

Labour was on strike for a period of nearly one week, after the interdiction of Mr. Weerasooriya. The excuse for the strike was non-payment of advances. The matter was looked into by the Labour Department and on their advising the Union Staff that advances had been paid as usual, the workers reported back to work.

General

Mr. M. R. C. Peiris continues as the Visiting Agent and has given me invaluable advice and assistance. I wish to place on record my thanks for the assistance and co-operation I have received from the Director, Administration and Scientific staff during the year under review.

REVIEW OF THE LIBRARY AND PUBLICATIONS SECTION

BY

J. A. AMARAWEERA

The Librarian and Publications Officer was in overall charge of both the Headquarters Library at Dartonfield and the Colombo Office Library at Ratmalana. The latter was under the direct supervision of the Library Assistant and Assistant Publications Officer, Miss L. I. T. Ramanaden. The Organisation of the Colombo Office Library was completed in the first quarter of the year and stocks have been physically verified and kept in proper order. It is a pleasure to record here that most of the Research Institutes and Establishments in the Country were assisted and catered to by our library in their requirements for literature and information. Indexing of research papers and literature connected with Rubber, Plastics and Agriculture was started at the Colombo Office Library by the Library Assistant and this is being continued. We were able to contribute to the Bibliographical compilation 'Current Content' published by the Industrial Development Board in the fields of Rubber and Plastics.

Printing of eight revised smallholding folders and three revised Advisory Circulars both in Sinhala and English has been completed during the year and we observed that there was a big demand for such publications among the students of Government Schools, Agricultural Schools and University campuses since studies on the Rubber Industry has been introduced to their curricula.

We wish to record with appreciation the assistance of the Director RRIM, in supplying us with the necessary material and colour blocks for the printing of the Advisory Circular No. 81 on South American Leaf Blight both in Sinhala and English.

Library Acquisitions

During the year, 200 books were added to the library stocks, of which 145 were bought locally and from abroad fifty five books were received as gifts, out of which forty five were donated by the Overseas Development Authority, U.K.

Two hundred and thirty five titles of periodicals were received at the library and the break-up was as follows :

		Local	Overseas
On subscription	..	05	99
On exchange/gratis	..	25	106

We subscribed to 18 Abstracting Journals during the year.

Quotations were called for the binding of periodicals, 314 volumes were leather bound, and added to the existing large collection of bound volumes.

International Liaison

Agreements for exchange of publications were made with the following 16 institutions :

BIOTROP-SEAMEO Regional Centre for Tropical Biology — Indonesia
Institut Francais Du Caoutchouc — Paris
The Lenin State Library of USSR — Moscow
Department of Primary Industry — Papua New Guinea
Agriculture Canada — Bibliotheque — Canada
University of California — USA
Library of the Academy of Sciences of USSR
Forest Product Research Laboratory
Library of Academia Sinica — Peking, Peoples Republic of China
Bibliotheca Bogoriensis — Bogor, Indonesia
The Research Institute for Horticulture — Jakarta, Indonesia
CSIRO — Canberra, Australia
Korea Scientific & Technological Information Centre — Seoul, Korea.

We obtained 37 photocopies of papers through the BLLD photocopy service. We thank the British Council for arranging for this facility.

Institute library has been selected as AGRIS subcentre for the Agricultural Information Bank for Asia (AIBA) under the direction of the CARI library, Gannoruwa, Sri Lanka.

In our exchange mailing list, there were 35 Institutions and abstracting services all over the world.

Photocopies of the content pages of the current journals that are received at the American Centre Library were received continuously during the year and also photocopies of interesting papers in them. We wish to record here, our sincere thanks to Mrs. Margret Goonaratne, the Chief Librarian, American Centre, for her kind assistance in arranging for this service.

Conferences and Seminars

The Librarian and Publications Officer and the Library Assistant participated in the UNESCO Training Course and workshop on the Development of Book Production in Sri Lanka, conducted under the Joint Sponsorship of the Asian Cultural Centre for UNESCO, Japan ; National Book Development Council, Sri Lanka : Sri Lanka Foundation Institute and the UNESCO National Commission, Sri Lanka on 12th — 30th January, 1976 at the Sri Lanka Foundation Institute, Colombo.

Seminars and Conferences

The Librarian and Publications Officer attended the following :

1. Opening Ceremony of the Natural History Museum Complex, Colombo and for the discussion with the officials who liaised the project, on behalf of the Director on 22nd January 1976.

2. (a) Seminar on ' Current literature retrieval and dissemination of methods.

   (b) Lecture on activities of the IDRC given by Mr. Arthur Vespry on 10-03-76 at National Science Council (NSC).

3. Seminar of Science and Technological Librarians regarding the compilation of S & T Information Directory and proposed Union Catalogue organised by NSC 16-09-76.

4. Centenary International Rubber Conference Sri Lanka, 15, 16 and 17 December, 1976.

5. Panel of moderators for the Department of Examinations, Sri Lanka.

Lectures and Talks

The Librarian and Publications Officer delivered the following lectures and talks:

1. On 24th September, 1976 — on ' the Introduction of *Hevea* to Ceylon and the development of NR plantation industry, to the HNCE students at K/Kamburawela Maha Vidyalaya, Lathpandura.'

2. On 12-12-76 — Brief talk and interview regarding ' the Introduction of Rubber to Ceylon ' over the programme — ' Sandella ' broadcast by the Sri Lanka Broadcasting Corporation (SLBC).

3. On 15-12-76 — Radio interview regarding the Centenary International Rubber Conference — Sri Lanka, 1976 for the programme ' Behind the News ' over Channel I — SLBC.

4. Two write-ups for the programme ' Shanida Sadaya ' of SLBC on 11-12-76 and 18-12-76, respectively.

Other Activities

Writer :

1. Served on the Board of Survey for annual verification 1976.

2. Made publicity arrangements for the Centenary Pirith Ceremony and almsgiving organised by the Employees of RRISL.

3. Publicity arrangements for the Centenary International Rubber Conference, Sri Lanka, 1976 (CIRC — '76).

4. Assisted in arranging newspaper supplements in connection with the CIRC — '76,

5. Supplied News items regarding the activities and research findings of the Institute to the SLBC.

6. Was a member and elected co-secretary of the Lanka Book League — Colombo.

7. Liaised on publishing the *Vidya* Journal special issue on Rubber with the Science Students Organisation, Sri Lanka.

Revision of Subscription rates

The Rubber Research Board has approved the revision of the present annual subscription rates for the Institute publications, *viz.*

Rs. 75/- (local)

Rs. 200/- (overseas)

The title of the Institute's Journal has been changed to ' The Journal of the Rubber Research Institute of Sri Lanka ' which will be published whenever a sufficient number of papers are available.

Publications by Librarian & Publications Officer

1. Plant diseases and its preventive methods (in Sinhala), *Vidya*, **10 (3)**, 21 - 29 (1976).

2. One Hundred years of Rubber in Sri Lanka (in Sinhala), *Vidya*, **10 (10)**, 1 - 9 (1976).

3. Natural Rubber Industry : Hundred years (in Sinhala), *Dinamina*, 16th December, 1976.

4. *Hevea* : Marvellous tree (in Sinhala), *Mihira*, 27th December, 1976.

5. *Hevea* plantation : Hundred years of History, *Rubber Puwath, Vol.* 7, 1976.