THE
RUBBER RESEARCH INSTITUTE OF SRI LANKA

ANNUAL REVIEW FOR 1978

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Registered Office and Laboratories
Dartonfield, Agalawatta.

Colombo Office
Consisting of the :

Advisory Services Department & Economic Research Unit, Rubber Chemistry Department, Specifications Laboratory
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Ratmalana,
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THE RUBBER RESEARCH INSTITUTE OF SRI LANKA

STAFF

(As at 31st December 1978)

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

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Assistant Geneticist & Plant Breeder	...	Vacant
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Senior Field Assistant	...	B. M. S. G. Peiris
Field Assistants	...	D. S. Gamage 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.)
Plant Pathologist	...	Vacant
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Personal Assistant to the Director P. Samarasinghe

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K. D. Chandradasa, B. A. (Cey.)
P. W. Karunaratne, B. A. (Cey.)
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Mechanical Foreman	...	M. M. Anderson
Building Foreman	...	W. S. J. Benjamin
Transport Assistant	...	B. D. Ponnamperuma
Clerk (Special Grade)	...	D. D. D. Adikaram
Clerk Typist		N. Jayasekera
Graduate Assistant	...	D. P. K. Gamage, B. A. (Cey.)

Workshop Charge-hand	...	W. D. Dharmawardena
Mechanic	...	K. A. Siripala

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Accounting Assistant	...	A. K. D. Amaradasa
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Book-Keeper (Special Grade)	...	K. D. D. Navarathne
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Cashier	...	D. C. A. D. B. de Silva
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Assistant Store-Keeper	...	P. L. R. A. W. Cooray

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Factory Officer	...	C. C. Jayasekera
Senior Assistant Clerk	...	U. D. Shelton Perera
Checkroll Clerk/Typist	...	A. A. Ariyaratne
Assistant Nursery Manager	...	A. K. D. L. H. Samaranayake
Assistant Factory Officer	...	D. S. K. Ranaweera

Kuruwita Sub-station

Assistant Estate Superintendent	...	S. G. Fernando
Rubber Research Board's Estates Chief Clerk	...	B. H. Rodrigo

**On study leave overseas.*

DIRECTORS REVIEW FOR 1978

by

O. S. PERIES

GENERAL

Value: Natural Rubber (NR) is one of the most important commodities exported by developing countries. More than 90 percent of NR is produced in South East Asia, and the export of this material earned the producing countries on an average $ 1,660 million a year from 1972 to 1975. NR ranks second in terms of value among all agricultural raw materials, fourth among all agricultural commodities and fifth among all commodities exported by developing countries. Between 1970 and 1975, exports of NR accounted for 22-35% of the export earnings of Malaysia, 5 - 19% of Indonesia's, 8 - 15% of Thailand's and 12 - 23% of Sri Lanka's. At present the total NR exports are estimated to be worth $ 2,500 million. These statistics, given by the Plastics & Rubber Weekly, show the importance of NR in the economies of all these countries.

Prospects: The position of the NR industry now appears to be more secure than it has ever been before, in view of the high petroleum prices. However, it is essential to give the industry the necessary incentives to replant, to innovate on methods of production, to improve factories, consolidate smallholdings and to produce the kind of raw material that has the greatest market demand. The industry requires both monetary, research and other incentives to play its rightful role in the fast expanding field of elastomers. Dr. B. C. Sekhar, Controller of Rubber Research & Development, Malaysia, rightly points out that, if at all NR loses out to synthetics and other substitutes, it will not be due to competition from synthetics but because NR production has not expanded fast enough. The present forecast is that there will be a deficit of 1 million tons of NR in the early 1980s. Sri Lanka is only a small producer of NR, our share being 5% of world production; but all NR producing countries, including Sri Lanka, must strive to double their production in the next 6 - 8 years, to meet the prospective world demand for NR. In this, the Sri Lanka Government is playing its part - the replanting subsidy, and the research cess have been doubled during the last year, there is an attractive factory development scheme and incentives for fertilizer usage are being finalized.

Rubber Master Plan: The Government has also arranged for the Commonwealth Development Corporation to carry out a study on the rehabilitation and development of our rubber industry. A team led by Sir Roger Swynnerton visited Sri Lanka in November to study rubber smallholdings, estates, factories and marketing systems and to assess where early investment is needed and how Britain can help with expertise and equipment. The World Bank has already identified two districts for systematic replanting of smallholdings. The FAO/UNDP has provided substantial financial aid for equipment for the Rubber Research Institute.

Price Stabilisation: The prospects for an international NR agreement are very good, after the negotiating conference which took place in Geneva in December. Sri Lanka's Gamini Corea, Secretary General of UNCTAD, has stated that the main issues to be negotiated are pricing mechanisms and the type and size of buffer stocks that would be used to regulate prices. NR is the first commodity, without an existing international agreement, to reach the stage of a negotiating conference under the UNCTAD integrated programme on commodities. This position has been achieved mainly by the efforts of the Association of Natural Rubber Producing

Countries (ANRPC). The latter is not planning to be a producer's cartel, by initiating the price stabilisation scheme. Its avowed intention is to stabilise NR prices at levels which would be remunerative to producers and at the same time fair to consumers.

Rubber exports by developing countries totalled $ 2.5 billion in 1976 and was their second most important agricultural export. Therefore, all ANRPC countries are anxious to ensure that the industry prospers and takes its rightful place in the economy of each of their countries.

Comparative Prices NR/SR: The price forecasts at the beginning of the year were that styrene-butadiene rubbers (SBR) would increase in cost by at least 12%. These forecasts were more than borne out as the year progressed: in Britain SR prices went up by £ 35 - £ 57 per tonne by mid-year. NR dealers felt at the time, that the higher SR prices would give them "more room for manoeuvre". One of the factors holding down SR prices is the availability of NR at lower prices, e. g. at the beginning of the year NR was available at £ 515 per ton compared to SBR at £ 545 per ton. The higher cost of synthetics is the result of the increase in price of raw materials, and this trend is likely to go on as the forecasts in Table 1, show. These were made by Brian Budd, Director of Energy and Materials Management for Monsanto Europe, at a meeting in London in late 1978.

Table 1. PETROCHEMICAL PRICE PROJECTIONS 1977 - 1987, $ PER TON DELIVERED N. W. EUROPE

(From: European Chemical News, November 1978)

	1977	1982	1987
Crude oil	101	126	180
Naphtha	130	160	225
Benzene	230	305	435
Ethylene	340	415	580
Styrene	400	480	635
Butadiene	500	545	725

These price factors led to B.F. Goodrich deciding to close its isoprene rubber facilities in Texas, stating that it can "see no way of making SR production profitable at this time." This was confirmed by the UK decision to shelve the proposed plant to produce SR, using North Sea butane as a feedstock. The alternative fuel value of LP gas was simply too high to make a polymerisation unit viable (Rubber World, August 1978).

Guayule: There were several references throughout the year, regarding the renewed interest of the USA in the extraction of rubber from the Guayule (pronounced Va-you-lay) plant. It is a fact that the US Senate approved a Bill to promote the development of commercial rubber production from the Guayule shrub, which grows in Mexico and the South-Western part of the US, under arid conditions. Research on the project will start in 1980 with an allocation of $ 5 million, going up to $ 35 million. However, the writer sees no threat to South East Asian NR from this study. Guayule was known and rubber extracted from it several decades ago; but the special conditions under which the plant grows and produces rubber, the costly method of extraction and the resin content of the plant would all militate against its commercial use in the forseeable future, unless under a war footing. Therefore, NR has nothing to fear from this development now.

New Tyre Designs: Several new tyre designs were publicised during the year. Goodyear announced its "flat-proof" tyre, that can maintain its shape even with a foot-long section cut out of it. This tyre has no tube, no sealant, no special rim and no inside support device. Its secret is the development of a sidewall rubber compound that can support the weight of the car. The compound permits the use of thick sidewalls, which support more weight, but flex less, thus avoiding heat build-up. When this development is ready for the market, it will eliminate what Goodyear calls the "automotive security blanket" - the spare tyre.

Goodyear has also teamed with France's Michelin to help sell the concept of the elliptic tyre in the US. This is also a new tyre design to counter the flat tyre and give a more comfortable ride. The two companies have agreed to standardize the size and shape of the special wheel rims required for the new type tyre.

The other development is the polyurethane tyre, and a prototype steel braced moulded polyurethane tyre has been successfully tested on a standard car. Very few other details have been released, but that it is a low profile tyre, is moulded and fitted with steel belts (European Rubber Journal). The development of this type of tyre will take at least 10 years, but it is something that NR must take into consideration from now. A moulded, polyurethane tyre would have been unthinkable just a few years ago; but one has already been road tested surprising observers and confounding critics. Therefore, NR too should put in every effort into research to keep up with and go ahead of the Joneses.

National Targets: As far as Sri Lanka is concerned the immediate targets for the industry should be to replant all the senile rubber with recently developed, high yielding clones, as soon as possible. This will help us increase production in the next few years, enabling us to profit by the high prices for NR in the future. It is also important to encourage inter-cropping in the newly replanted areas. The Institute has shown that bananas, pineapple, passion fruit and coffee can be grown successfully in the wet areas and cocoa and coffee in the dry areas. Intercropping will give an attractive income during the immature period of the rubber plant, so that more owners, particularly smallholders, will be encouraged to replant.

It is also important to improve the management standards of smallholdings, by bringing large numbers of them into composite groups. The management of each group should be in the hands of the equivalent of a fully qualified Estate Superintendent, and all the inputs should be supplied to them from central organisations e.g. budgrafts of higher yielding clones from district or estate nurseries. All smallholdings should be fertilized on the basis of soil and foliar analysies and effective intercropping programmes should be undertaken on all of them. Finally, they should be replanted on a 25 - 30 year cycle and the rubber wood from the senile trees used on a planned basis, for the manufacture of furniture, chipboard, flooring material and other wood products, with only a fraction being used as firewood. A scheme for large estates to assist smallholders with the supply of fertilizer and planting material, processing of latex and in general a closer integration of smallholders with estates is essential. This scheme should be given the highest priority in implementation. This will improve the living standards in the villages of Sri Lanka, and lead to the proper economic utilization of the limited land resources of this country.

RESEARCH STUDENTS

The Institute accepted five National Science Council (NSC) scholarship holders to read for Ph.D. and M.Sc. degrees, in the scheme for training of potential research officers. Two more NSC scholars will join the Institute in the near future.

RESEARCH

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

Genetics & Plant Breeding

The RRIC 100 series clones, particularly RRIC 100 and RRIC 103, were planted on a larger scale, especially on Estates. Individual planting preferences were also noted for RRIC 101 in veiw of its very high initial yields. Fifteen clones including RRIC 120, RRIC 123, RRIC 130 and RRIC 131 were sent to the RRIM station at Trinidad for testing for resistance to South American Leaf Blight. A 4 x 4 Diallel Crossing Programme with RRIC 100, 101, 102 and 103 was successfully completed under the supervision of the Geneticist. Selections were made on the basis of yield and vigour from previous hand pollinated progeny. Two International Clone Trials were planted at Neboda and Hanwella. Yield and growth of clones such as RRIC 103, RRIC 118, RRIC 100 in the Bibile and Matale Districts indicate that the new clones could be profitably grown in the drier districts: the drought resistance characteristic of *Hevea* was an added advantage.

Botany

It would be best to aim at yield increases in the order of 20 to 30% per year with Ethrel stimulation. This could be achieved either by limiting applications of Ethrel to two or three times a year during periods of good weather and tapping on the S/2,d/2,100% system or by reducing the tapping intensity to 67% in the S/2, d/3, 67% system with Ethrel applications below the tapping cut once every two months. Where applications are limited to twice or thrice a year, a better yield response was noted for applications above the cut.

The two clones PB 86 and RRIC 52 have responded well to daily tapping on the S/2, d/1, 200% system with the incidence of dry trees remaining below 10 per cent. Of the two clones PB 86 may therefore be suitable particularly for smallholders, who tap their rubber daily. In another trial, recovery tapping of clone PB 86 (to bring up to 180 tappings per year) has resulted in appreciable yield increases without detrimental effects on trees. These observations can now be put into practical use on a limited scale on large estates. To begin with 180 tappings per year should be aimed at. If problems of Brown Bast arise, this Institute should be consulted immediately.

Callus cultures, originating from stem explants were induced to differentiate roots when transferred to a root differentiating medium. Another important observation was the development of a plantlet with a distinct root and stem from callus obtained from endosperm tissue. This indicates that plantlet formation in *Hevea* callus cultures can be achieved.

Trials involving the establishment of grasses and legumes among young rubber for cattle fodder were continued. In terms of herbage production, *Panicum maximum*, appears to do better when grown in combination with *Pueraria phaseoloides*, with high levels of Phosphorus. *Brachiaria brizantha* on the other hand was more productive when grown alone with high levels of Nitrogen. A combination of *P. maximum* and *Pueraria* appears to be an acceptable system for intercropping with immature *Hevea*.

Among cash crops, intercropping with bananas has been popular among estates, it has been found to be less labour intensive and provides a quicker return with little or no problems in marketing. The cultivation of pineapple in the wet zone has not been popular due to high costs of weeding.

Plant Pathology

White Root disease caused by *Rigidoporus lignosus* is the most serious disease of rubber in Sri Lanka and about 8 - 10% of the total area cultivated with rubber is affected by this disease. Immediate steps should be taken by all concerned, to take adequate action to eradicate infected roots at the time of uprooting for replanting. A new root disease caused by *Fusarium solani* f. sp. *heveae* was detected, for the first time and there was clear evidence that the fungus has gained entry into the host through the wounds caused by severe pruning of roots.

Field investigations on epidemiology of *Oidium heveae* revealed that RRIC 7 and 52 were the most susceptible and resistant clones, respectively. There were two peaks of secondary leaf fall on susceptible clones and two peaks of spore production were also evident. "Bayleton" was as effective as sulphur in controlling *Oidium* under field conditions.

Some of the local and introduced clones were more resistant to Bark Rot than the other clones. The susceptibility to Bark Rot varied when grown at different locations. The use of different knives, tapping systems and zoospore concentrations, affected the susceptibility and spread of Bark Rot in the clone PB 86.

PB 86 was more susceptible to *Colletotrichum gloeosporioides* than RRIC 100 and 103 but less so than RRIC 52. Appressoria were commonly found along the junctions of epidermal cells. Well developed acervuli were formed within 72 h of inoculation. Leachates of different clones also affected the germination and growth of this fungus.

Sporocarps of *Rigidoporus lignosus* show a bimodel pattern of spore release and viable spores were released from early stages of development. There were several critical conditions for basidiospore germination. Basidiospores successfully colonised rubber wood under laboratory conditions but failed to do so under field conditions. Stock plants of clones RRIC 45, 101, LCB 1320 and IRCI 9 appear to be more resistant to *Rigidoporus* than a number of other root stocks.

Contamination of rubber sheets with various species of fungi significantly affected the Plasticity Retention Index, Volatile Matter, Dirt Content and Plasticity.

Rubber Chemistry

The blocking of latex crepe laces on a commercial scale for export on the basis of technical specifications was organised and implemented by the Institute. This should lead to an increased demand for Sri Lanka latex crepe. Since RPA 3 will not be commercially available in future, studies were carried out to find a suitable substitute, and it was found that titanium dioxide at low concentrations (0.01% to 0.03% on d.r.c.) added to latex as a dispersion gave promising results. Thioglycollic acid also looks promising for use as a substitute for RPA 3. It was also established that high quality latex crepe can be produced without using RPA 3 and that the lack of this material will not be a calamity to the industry. A method of preparing low ammonia bacteriostatic creamed latex was perfected and the product is cheaper than high ammonia creamed latex. Topanol A gives a reasonable ageing resistance.

Sixteen papers were presented by the staff at local and overseas conferences and three patent applications were made.

The Department's staff assisted the various University Campuses by giving approximately 200 lectures on polymer chemistry and technology.

Rubber seed oil is used in Sri Lanka as a substitute for coconut oil, at 5 to 10% in soap manufacture. It was found that Topanol A, when grafted to NR, gives a reasonable ageing resistance to NR, and pilot scale trials are being done in preparing the rubber for commercial evaluation.

Studies on the commerial production of cyclised rubber was continued. Calcium stearate was shown to possess synergistic anti-oxidant properties when used with amine antioxidants.

Latex from clones RRIC 100, 101 and 102 are suitable for latex crepe manufacture. The use of room temperature curing latex in bathroom carpet backing was developed and the product is now being exported.

The Rubber Technology Division continued to give assistance to local industrialists in setting up small and medium scale rubber industries.

Advisory Services

A total of 16 training classes were held for smallholders. Out of the 529 smallholders who attended these classes 212 successfully completed the course.

Progress on the construction of group processing centres is as follows:

In operation	...	97
Work completed and ready for opening	...	2
Under construction	...	4
Surveys approved	...	5
Surveys going on	...	3

Economic Research

Several surveys conducted by this Unit on the economics of producing rubber are in progress.

Statistics

A new Assistant Statistician was recruited on the 1st of November. Two research projects, "The effect of weather on yield of Hevea" and "General leaf area estimation" were continued. The section was mainly involved in routine statistical analysis for the research departments and also recording of Meteorological data

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. C. G. Silva, Soils Chemist returned to the Island in May 1978, having completed a one year course of training in Plant Nutrition at the University of Missouri, Columbia, U. S. A.

Dr. U. P. de S. Waidyanatha, Botanist, attended a Workshop on Mycorrihiza at Kumasi, Ghana, from 28.8.78 to 6.9.78.

Dr. A. Coomarasamy, Rubber Chemist, attended the I.R.R.D.B. Symposium in Kuala Lumpur, Malaysia, from 15th to 18th May 1978.

Dr. M. R. N. Fernando, Rubber Chemist, attended the Natural Rubber Technology Seminar held in Kuala Lumpur, Malaysia, from 30th November to 1st December 1978.

Dr. N. Yogaratnam, Soils Chemist, attended an Inter-Regional training course conducted at the German Democratic Republic from 3rd May to 2nd June 1978.

Dr. A. M. A. Amarapathy, Rubber Chemist, attended the International Polymer Latex Conference held in the United Kingdom from 31.10.78 to 2.11.78.

Mr. L. S. S. Pathiratne, Technical Assistant, Botany Department, followed a course of training in Instrumentation and Biochemical Techniques at the University of Bristol, England, from 15.9.77 to 14.9.1978.

Dr. P. A. J. Yapa, Biochemist, attended the tenth Conference of the Indian Rubber Manufacturers' Research Association held in India from 14th to 16th December, 1978.

Mr. M. K. S. A. Samaraweera, Assistant Soils Chemist, who was sent abroad earlier on a Colombo Plan Scholarship, continued his post graduate studies at the University of Bristol.

Mr. H. D. B. H. Gunasekera, Assistant Agricultural Economist, proceeded to Australia on 22nd June 1978 to do his post graduate studies at the Australian National University.

Mr. L. B. K. Silva, Experimental Officer, Rubber Chemistry Department, proceeded to the U. K. to undergo a short course of training at the Bristol Polytechnic, United Kingdom.

The Director visited Indonesia and U. S. A. for 2 weeks each in May/June, on a World Bank assignment on rubber replanting in Smallholdings in Indonesia.

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

Officers in Grades I & II	...	23
Officers in Grade III	...	13
Officers in Grades IV to IX	...	239
Officers in Grades X to XIII	...	129
Total	...	404

VISITORS

Visitors to the Institute included:

The Parliamentary Consultative Committee on Plantations, headed by the Hon'ble Minister of Plantation Industries, Mr. M. D. H. Jayawardena
Professor G. Scott, University of Aston in Birmingham
Dr. L. R. Wallace, Director of Agricultural Research, Ministry of Agriculture & Fisheries, New Zealand
A delegation from the Chinese Embassy
A team of Agricultural Economists from the IAEA
A group of Superintendents of the Janatha Estates Development Board, Kegalle Region
A Norwegian Youth Delegation
Mr. Cyril Gamage, Additional Secretary, Ministry of Plantation Industries

Mrs. Vietta Dowd, National Technical Information Service, Washington.
Dr. J. E. Ferguson CIAT, Colombia
Professor J. Curnow, Department of Statistics, University of Reading , U. K.
Dr. Leslie Fowden, Rothamsted Experimental Station, U. K.
Dr. J. T. Swarbrick, Queensland Agricultural College, Australia
Dr. A. Hiepko, BASF, West Germany
Dr. A. Mappes, BASF, West Germany
Mr. Ken Knight of Messrs. Easthampton Rubber Thread Co., U. S. A.
Mr. Barry E. Thorne, British High Commission
Rubber Master Plan Team, headed by Sir Roger Swynnerton
Dr. B. S. Capper, Tropical Products Institute, London
Mr. C. M. Rush, F. A. O., Rome
Dr. Bryan Wheeler, Imperial College, London
Dr. Y. Barrada, Head of Soil Fertility, Irrigation & Crop, Production, IAEA
Dr. Stephen Schwartz, Unesco Expert on Scientific Information
Mr. Kerel Vlassak, University of Leuven, Belgium
Mr. M. Neugebaner, Liepzig, German Democratic Republic
Mr. C. W. Brookson and party, F. A. O., Rome

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.

Several final year students of the Faculties of Agriculture, Science and Engineering from the various University Campuses were provided with short term courses of training at the Institute.

PUBLICATIONS

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

Peries, O. S. Director's Review for 1977

Peries, O. S. Studies on relationship between weather and incidence of leaf diseases of Hevea - Planter (in Press)

Peries, O. S. The etiology of "Bark Cracking" disease of *Hevea brasiliensis* *Plant Disease Reporter*, 61, 946 - 948.

Peries, O. S. Transfer of Technology in the rubber industry, RRISL Bulletin (in Press)

Peries, O. S. & Liyanage, N. I. S. - Observations on spore production, release biology and colonization of *Hevea* by basidiospores of *Rigidoporus lignosus*. Paper presented at the 31st Sessions of the SLAAS.

Liyanage, A. de S., Peries, O. S., Dantanarayana, D. M. & Dharmaratne, A. Environmental factors that influence the establishment and sporulation of *Phytophthora* spp. on rubber pods. Paper presented at 31st Sessions of the SLAAS.

Theses

Tillekeratne, L. M. K. A study of the role of hydroperoxides in the degradation and stabilisation of polymers. (1978). Thesis submitted for the Degree of Doctor of Philosophy of the University of Aston in Birmingham, U. K. March 1977.

Amarapathy, A. M. A., Nadarajah, M. and Manel, M. G. Manufacture of high quality rubber fabrics using natural rubber latex. Paper presented at the IRRDB Seminar, held in Kuala Lumpur, Malaysia, May 1978.

Amarapathy, A. M. A. Methods of purifying waste engine oil and studies on black loaded natural rubber mixes containing this ingredient. Paper presented at the Indian Rubber Manufactures Research Association Conference, Ahamadabad, India, December 1978.

Amarapathy, A. M. A. and Scott, G. Mechanisms of antioxidant action improved aging performance of latex products containing bound antioxidants. Paper presented at the International Polymer Latex Conference, London, October 1978.

Coomarasamy, A., Yapa, P. A. J. and Kasinathan, S. Use of Palmyrah seed distillate as a coagulant for NR latex. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.

Fernando, D. M. Review of the Genetics and Plant Breeding Department for 1977.

Fernando, D. M. Perspectives in Agricultural Research in Sri Lanka *vis-a-vis Hevea*. SLAAS Sessions, December 1978.

Fernando, M. R. N., and Nadarajah, M. Vulcanising systems for low temperature and sunlight curing of natural rubber compounds. Paper presented at the International Rubber Conference, Kiev, U.S.S.R., October 1978.

Fernando, M. R. N. and Nadarajah, M. Some practical uses of low temperature and sunlight curing of natural rubber compounds. Paper presented at the IRRDB Seminar, Kuala Lumpur, Malaysia, May 1978.

Fernando, M. U. G., Fernando, M. R. N., Nadarajah, M. and Dahanayake, P. Further progress in the use of rubber for the improvement of impact resistance in ferrocement boats. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.

Fernando, W. S. E., Tharmalingam, R. and Perera, M. S. G. Self reinforced granular rubber. Paper presented at the IRRDB Conference at Kuala Lumpur, Malaysia, May 1978.

Fernando, W. S. E., Coomarasamy, A and Tillekeratne, L. M. K. Some aspects of the chemical modification of NR. Paper presented at the IRRDB Symposium, Kuala Lumpur, Malaysia, May 1978.

Liyanage, A. de. S., and Fernando, D. M. Nursery methods for screening leaf and panel disease resistance in *Hevea*. Paper presented at the IRRDB Symposium, Kuala Lumpur, Malaysia, May 1978.

Liyanage, A. de S., Gunaratna, W. D. L., Munasinghe, G, and Bandara, J. M. R. S. Studies on a new disease of rubber (*Hevea brasiliensis*) caused by *Fusarium solani* f. sp. *heveae*. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.

Liyanage, A. de S., Peries, O. S., Dantanarayana, D. M., Dharmaratne, A. Environmental factors that influence the establishment and sporulation of *Phytophthora* spp. on rubber pods. Paper presented at the 3rd International Plant Pathology Congress, Munchen, West Germany, August 1978.

Nadarajah, M., Coomarasamy, A. and Tharmalingam, R. Recent developments in Sri Lanka for increased natural rubber usage. Paper presented at the International Rubber Conference, Kiev, U. S. S. R., October 1978.

Peries, O. S. The etiology of "Bark Cracking" disease of *Hevea brasiliensis* *Plant Diseases Reporter, 61*; 946 - 948.

Peries, O. S. Studies on the relationship between weather and incidence of leaf diseases of *Hevea*. *Planter*, Kuala Lumpur, Malaysia (in press).

Peries, O. S., and Liyanage, N. I. S. Observations on spore production, release, biology and colonisation of *Hevea* by basidiospores of *Rigidoporus lignosus*. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.

Peries, O. S. Transfer of Technology in the rubber industry. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.
Peries, O. S. Personnel Management. Paper presented at the Seminar on Personnel Management, SEARCA, Kandy, September 1978.
Pooni, H. S., Jinks, J. L. and Jayasekera, N. E. M. An investigation of gene action and genotype x environment interaction in two crosses of *Nicotina rustica* by triple test cross and inbred line analysis. *Heredity* (1978) 41 (1) 83 - 92.
Rajapakse, R. A. and Nadarajah, M. Ageing properties of natural rubber with cashew nut shell liquid incorporated into latex. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.
Silva, C. G., Arsecularatne, B. P. M. and Wickremasinghe, L. J. Radiotracer studies for determining the active root distribution of *Hevea brasiliensis* using 32P. Paper presented at the International Symposium on the Uses of Isotopes and Radiation in Research on Soil and Plant Relationships, Colombo, December, 1978.
Silva, C. G., Graham, E. R. Labile pools and distribution coefficients for soil calcium magnesium and potassium determined with exchange equilibria and radioisotopes. *Missouri Agricultural Experimental Station, Journal Series.* No. 8228.
Tillekeratne, L. M. K. and Sebastian, S. A. R. D. Efficient vulcanisates of liquid rubber with similar mechanical properties as conventional rubbers. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.
Waidyanatha, U. P. de S., Yogaratnam, N., and Ariyaratne, W. A. Mychorrhizal infection on growth and nitrogen fixation of *Pueraria* and *Stylosanthes*, and uptake of Phosphorus from two rock phosphates. *New Phytologist, 79,* (in Press).
Waidyanatha, U. P. de S. Mycorrhizae of *Hevea* and leguminous ground covers in rubber plantations. Proceedings, International Workshop on Tropical Mycorrhizal research, Kumasi, Ghana, Aug/September 1978 (in Press).
Yapa, P. A. J., Nadarajah, M. and Lionel, W. A. Production of high quality rubber from skim latex. Paper presented at the IRRDB Symposium in Kuala Lumpur, Malaysia, May 1978.
Yapa, P. A. J., Nadarajah, M. and Loganathan, K. S. Use of papain treatment of NR latex to produce superior quality rubber. Paper presented at the Indian Rubber Manufacturers Research Association Conference, Ahamadabad, India, December, 1978.
Yogaratnam, N., Nadarajah, M. and Dayaratne, W. C. Soil erosion and run off studies in rubber plantations. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December 1978.
Yogaratnam, N. and Silva, F. P. W. Standardisation and improvement of soil testing methods for the soils of Sri Lanka with emphasis on soil phosphate. Paper presented at the 34th Annual Sessions of the SLAAS, Colombo, December, 1978.

Social and Sports Activities

The sports activities of the Recreation Club during the year under review were mainly concentrated internally, action being centred on popularising and expanding the activities among members.

The only outside tournament in which the members participated during the year was the States Services Cricket Tournament, with fair results.

REVIEW OF THE BOTANY DEPARTMENT

by

L. B. Chandrasekera

SUMMARY

Long term experiments with yield stimulants in Sri Lanka have indicated that, for prolonged stimulation, it would be best to aim at yield increases in the order of 20 to 30 % per year. This could be achieved either by limiting applications of Ethrel to two or three times a year during the periods of good weather and tapping on the s/2, d/2, 100% system or by reducing the tapping intensity to 67% on the s/2, d/3, 67% system with Ethrel applications below the tapping cut once every two months. Where applications are limited to twice or thrice a year, a better yield response was noted for applications above the cut. The use of 2% a.i. Ethrel has been less effective than 10% Ethrel.

Over a period of eight years, in one trial, the two clones PB 86 and RRIC 52 have responded well to daily tapping on the s/2, d/2, 200% system, with the incidence of dry trees remaining below 10 per cent. Of the two clones PB 86 may therefore be suitable particularly for smallholders who tap their rubber daily. In another trial, recovery tapping of clone PB 86 (to bring up to 180 tappings per year) has resulted in appreciable yield increases without detrimental effects on trees. These observations may be of significance, particularly to plantations located in the wet zone, where a large number of tapping days are lost owing to rain. Steps have now been taken to screen clones of the RRIC 100 series as well for any possible tolerance to high intensity and recovery tapping.

Among the older clone selections, clone IRCI 2 has suffered extensive wind damage in most trials. The yields of the two clones IRCI 9 and PR 252 have been comparable with those of clone PB 86. Clone RRIC 48 has been yielding better than clone PB 86 over a period of 16 years and should be considered for moderate scale planting in estates. Another clone belonging to the same category is clone RRIC 13. Among clones of the RRIC 100 series, the clone RRIC 100 has given very high yields, in all trials, during the first year of tapping, but this yield is not maintained in subsequent years.

The use of rubber rainguards in the wet zone has resulted in substantial increases in the number of tappings recorded for each year. The economics of the use of rainguards, in relation to present increase in labour wages and cost of materials, are being evaluated.

Callus cultures, originating from stem explants were induced to differentiate roots when transferred to a root differentiating medium. Another important observation was the development of a plantlet with a distinct root and stem from callus obtained from endosperm tissue. This indicates that plantlet formation in *Hevea* callus cultures could be achieved.

Trials involving the establishment of grasses and legumes among young rubber for cattle fodder were continued. In terms of herbage production, *Panicum maximum*, appears to be better, when grown in combination with *Pueraria phaseoloides*, at high levels of Phosphorus. *Brachiaria brizantha* on the other hand was more productive when grown alone at a high level of Nitrogen. *B. miliformis* was the least productive. In terms of competition with rubber, the least competitive was

B. miliformis while *B. brizantha* was the most competitive with *P. maximum* being intermediate. This competition was reduced when the grass was grown with a legume especially *Pueraria*. A combination of *P. maximum* and *Pueraria* appears to be an acceptable system for intercropping with immature *Hevea*.

Among cash crops, intercropping with bananas has been popular among estates. It has been found to be less labour intensive, and provides a quick return with little problem in marketing. The cultivation of pineapple in the wet zone has not been popular due to high costs of weeding. No suitable weedicide has been found so far. Coffee, when interplanted with rubber, has flowered in the second year and come into full bearing at the end of the third year. While cacao could be successfully established under mature rubber, yields under dense shade have been poor.

DETAILED REVIEW

Staff

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

The Senior Technical Assistant, Mr. W. V. G. Fernando, Technical Assistants Messrs I. R. M. Amarakoon, D. K. Angammana, W. A. Ariyaratne, K. A. G. Bandara, L. B. Chandrasena, J. G. de Mel, L. S. Kariyawasam, T. C. Weerasinghe, Miss C. W. Ranasinghe, Senior Field Assistants: Messrs. M. C. Perera and R. B. Gunaratne and Field Assistants: Messrs. D. A. Brahmana, S. Kodikara, U. K. D. Lewis, N. L. D. Ruban, W. T. Silva and S. Wilbert were on duty throughout the year.

Mr. W. R. A. N. Ratnayake resigned from the Department on 27.08.1978 to enter the University.

Mr. L. S. S. Pathiratne, Technical Assistant resumed duties at the Insitute on 19th September 1978 after training at the Bristol Polytechnic, U. K., on instrumentation.

Research Grants and Students

U. P. de S. Waidyanatha, Botanist, was awarded an annual research grant of US $ 4000 by the International Foundation for Science, Sweden, extendable for two years for research on VA mycorrhiza.

The following research students worked in the Department during the year:

Mr. S. N. Dissanayaka on "Growing of grasses and legumes under young rubber", for the degree of Ph. D.

Mr. M. H. Mendis on "Hevea Tissue Culture", for the M.Sc. degree.

Mrs. Ramanee Jayasinghe on "Vesicular arbuscular mycorrhiza in rubber growing soils", she submitted a dissertation in partial fulfilment of the requirements for the M.Sc. degree, University of Sri Lanka, Colombo Campus.

Mr. A. H. Ranjan joined the Department on Ist November as a temporary student to pursue research leading to a higher degree. He is studying vesicular arbuscular mycorrhiza.

Visits

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

Meetings and Conferences

The Head of the Department attended the following Conferences and Seminars:

Agricultural Advisors Conference, Talduwa Club, Avissawella.
Group discussion on intercropping, Minor Export Crops Research Station, Matale.

Planters meeting at Kegalle, organized by the Sri Lanka Association for the Advancement of Science.

R. Satchuthananthavale, Botanist, participated in the Planter's Conference organised by the Janatha Estates Development Board, at Talduwa.

U. P. de S. Waidyanatha, Botanist, participated in the following:
International Workshop on Tropical Mycorrhiza Research, held under the aegis of the International Foundation for Science, Sweden.

IAEA/FAO Symposium on the use of Isotopes and Radiation in research on soil-plant relationships held in Colombo.

Publications

1. Annual Review of the Botany Department, 1977.

2. Waidyanatha, U. P. de S., Yogaratnam, N., and Ariyaratne, W. A., (1978) - Mycorrhizal infection on growth and nitrogen fixation of *Pueraria* and *Stylosanthes*, and uptake of phosphorus from two rock phosphates. *New Phytol. 79* (1) - in press.

3. Waidyanatha, U. P. de S. (1978), Mycorrhizae of *Hevea* and leguminous ground covers in rubber plantations - Proc. Int. Workshop on Tropical Mycorrizal Research, Kumasi, Ghana, Aug/Sept. 1978 - in press.

YIELD STIMULATION EXPERIMENTS

Field Experiment No. 58 - Ethrel Stimulation Experiment - Malaboda Estate

During the period 1971 to 1977, 10% Ethrel was applied to a 3.8 cm. strip of scraped bark below the tapping cut, once in two months, on panels D and E of clone PB 86 and tapped on the s/2, d/2, 100% system. In 1978 the application of stimulants was discontinued in order to examine whether there would be any depression in yields as a result of intensive stimulation during the previous seven years. The average yields, recorded per tapping block for the first eight years, are given in Table 1.

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
1977	5.22	4.40
1978	4.26	3.79
No. of trees tapped in 1978	304-299	251-243
Percentage of scrap, 1978	6.2	6.4
Brown Bast Cases, 1978:		
Percentage Partially dry	4.2	2.0
,, Totally dry	3.6	3.6

In this trial, significant yield increases were recorded only up to the third year of stimulation. Discontinuing the use of stimulants has not depressed the yields below the level of the controls. (*L. B. Chandrasekera* and *D. A. Brahmana*).

Field Experiment No. 63 - Ethrel stimulation experiment - Eladuwa Estate.

Ethrel at 10% concentration 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 eight 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 controls plots.*

Year	Treatments	
	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
1977	40.0	31.2
1978	43.2	27.2
No. of applications	6	—
No. of trees tapped in 1978	725-708	255-252
Percentage of scrap	12.8	8.2
% Brown Bast cases 1978 (percentage)		
Partially dry	2.9	0.8
Totally dry	2.6	1.4

In this trial, the stimulated plots continued to maintain satisfactory yield increases over unstimulated control plots in the eight year. (*L. B. Chandrasekera and D. A. Brahmana*).

Field Experiment No. 73 - 1972 Ethrel stimulation experiment - Eladuwa Estate.

In this experiment there are 8 treatments with 20 trees per plot randomised within a tapping task and replicated three times. The applications of Ethrel below the cut is on a 3.8 cm strip of scraped bark while above cut application is on a 2.5 cm band of renewing bark. Stimulation is being done on panel D of clone PB 86 and the average yields recorded in 1978 for two applications of stimulants during the year are given in Table 3.

Table 3. *Mean yields of dry rubber for the various treatments in 1978*

Treatments	Mean yield g/tree/tap	Mean yield as% of control
Above cut application		
1. s/2, 100% — Unstimulated control	25.6	100
2. ,, + Coconut oil	25.9	101.3
3. ,, + 5% Ethrel	31.9	124.4
4. ,, + 10% Ethrel	31.27	122.1
Below cut application		
5. s/2, d/2, 100%— Unstimulated control	30.04	100
6. ,, + Coconut oil	24.09	80.19
7. ,, + 5% Ethrel	33.9	112.72
8. ,, + 10% Ethrel	30.5	101.63

Over the years, above cut applications of Ethrel have resulted in a better yield response. (*R. Satchuthananthavale, C. Weerasinghe, G. de Mel & I. R. M. Amerakone*).

Field Experiment No. 80 - Ethrel stimulation experiment - Talgaswela Estate

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

Table 4. *Yields of dry rubber in kg. for the various treatments in the fifth year in 1978*

	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 application	6	3	—
Total yield in kg. (3 tapping tasks 1978)	3133	3324	2506
Trees tapped 1978	664-660	662-657	631-629
Scrap percentage	14.5	13.9	13.4
Brown Bast cases			
Percentage Partially dry	3.3	2.6	0.8
,, Totally dry	2.1	2.0	1.1

During the period of the experiment the most profitable treatment has been to tap at a reduced intensity of 67% with stimulation once every two months (*L. B. Chandrasekera & D. A. Brahmana*).

Field Experiment No. 93 - Ethrel stimulation experiment - Eladuwa Estate.

This experiment, started in 1976, compares 2% and 5% a.i. Ethrel applications under the s/2, d/2, 100% tapping system on clone PB 86. In the years 1976 and 1977 stimulant applications were made below the tapping cut. In 1978 a change was made to above cut applications. The yields recorded in 1978 for two applications are given in Table 5.

Table 5. *Mean yield of dry rubber for various treatments in 1978*

	Treatments	Mean yield g/tree/tap	Mean yield as % of control
1.	s/2, d/2, 100% — Unstimulated control	24.01	100
2.	,, + 2% Ethrel	27.42	114.20
3.	,, + 5% Ethrel	31.79	132.40

Above cut applications of stimulants have resulted in a better yield response than below cut applications. (*R. Satchuthananthavale, C. Weerasinghe, G. de Mel & I. R. M. Amarakone*).

Two large scale Ethrel stimulation trials were initiated in 1978 at Elston and Frocester Estates. Two further small scale trials were started in the same year at Galewatte Estate. In all these trials, located in different planting districts, Ethrel at 5% a.i, concentration will be applied above the tapping cut twice a year and the trees tapped on the S/2, d/2, 100% system. These trials are designed to evaluate further, on a district level, the present recommendations on the use of Ethrel in estates. (*R. Satchuthananthavale*).

TAPPING EXPERIMENTS

Field Experiment No. 53 - Tapping Experiment - 1961 Replanting, Dartonfield

Six tapping treatments are compared on four clones on a randomised block design with 5 tree plots. Each treatment in clones RRIC 7, 45 and 52 is replicated eight times and in clone PB 86 six times. The present tapping treatments were introduced in 1971. Before this the trees were tapped on S/2, d/2, 100% from March 1968. Test tapped data from 1978 are given in Table 6.

Except clone RRIC 7, all other clones have responded well in terms of increased yields to the s/2, d/1, tapping system. However, RRIC 7 and RRIC 45 have a high incidence of dry trees. Hence these clones may not be suitable for 200% intensity tapping. The responses of all clones to full spiral and double cut tappings have been relatively poor. On the basis of the above data, RRIC 52 and PB 86 appear to be clones that should be responsive to tapping intensities over 100 per cent on the s/2 system. (*U. P. de S. Waidyanatha & C. W. Weerasinghe*).

TABLE 6. *Yield, girth increment and brown bast (BB) data for 1978*

TAPPING SYSTEM	RRIC 45			RRIC 45			RRIC 52			PB 86		
	YIELD (kg/ha)	GIRTH INCRE-MENT (cm)	% BB	YIELD (kg/ha)	GIRTH INCRE-MENT (cm)	% BB	YIELD (kg/ha/	GIRTH INCRE-MENT (cm)	% BB	YIELD (k/ha)	GIRTH INCRE-MENT (cm)	% BB
s/2 d/2 100%	1532.4	2.3	7.5	1156.2	2.4	10.0	1720.4	2.7	5.0	2102.2	1.5	—
s/2 d/1 200%	2557.0	3.3	32.5	1515.8	1.5	22.5	2688.6	2.4	7.5	3142.2	1.8	6.6
s/1 d/4 100%	938.0	2.2	22.5	583.8	1.5	20.2	1256.2	1.0	5.0	1145.5	1.8	10.0
s/1 d/3 133%	1249.5	1.4	17.5	688.5	1.1	22.5	1267	1.4	7.5	1874.2	2.1	13.3
2s/2 d/4 100%	987.8	2.5	7.5	816.3	1.5	7.5	1004.4	1.5	7.5	1347.5	1.8	10.0
2s/2 d/3 133%	1245.8	2.0	15.0	896.7	1.5	17.5	1120.9	1.9	12.5	1837.5	1.1	3.3

Field Experiment No. 85 - Tapping Experiment - Nivitigalakele

Five tapping treatments inclusive of puncture tapping and quarter spiral tapping with stimulation are being tested on virgin bark. The experiment accommodates 7 clones in a split-plot design with clones in the main plots and tapping systems in the sub-plots. Each clone and tapping system are replicated 5 times with each sub-plot accommodating 6 trees. Tapping commenced in November 1977. The results for 1978 are given in Table 8.

Table 8. *Yield (kg/ha) and girth increment (cm) in parenthesis for 1978*

Treatment	RRIC 100	RRIC 101	RRIC 13	RRIC 45	PR 252	AV 1734	IRCI 2	WR 101	MEAN
s/2 d/3 67%	875	1514	419	577	621	570	673	397	706
	(1.5)	(0.7)	(2.3)	(3.3)	(1.0)	(1.0)	(1.1)	(2.0)	(1.6)
s/2 d/2 100%	1223	1997	625	741	775	786	774	769	961
	(2.8)	(0.4)	(3.1)	(2.8)	(1.0)	(0.7)	(1.7)	(1.4)	(1.7)
s/4 d/2 50%+E	1057	1549	520	526	553	686	631	642	771
	(2.9)	(0.7)	(3.4)	(3.8)	(1.7)	(1.2)	(1.8)	(1.3)	(2.1)
M1 d/3 + E	507	831	316	301	529	489	522	338	479
	(4.4)	(2.2)	(4.3)	(3.6)	(2.0)	(1.5)	(3.1)	(3.7)	(3.1)
M2 d/3 + E	287	493	176	180	312	279	323	191	280
	(4.5)	(2.2)	(5.0)	(4.0)	(2.6)	(1.4)	(2.8)	(3.4)	(3.3)

E - 5% Ethrel was applied bimonthly on s/4 cuts and on puncture tapping bands after every 10 tappings. Bands were shifted by one cm after each 20 tappings. M1 = 1 metre band tapped with 10 pricks. M/2 = $\frac{1}{2}$ metre band tapped with 5 pricks.

s/2 d/2 tapping has given the highest yield for all clones. Tapping on a quarter spiral with stimulation has yielded higher for RRIC 100, RRIC 101 RRIC 13, AV 1734, and WR 101 but lower for RRIC 45, PR 252 and IRCI 2 than s/2 d/3 tapping: RRIC 101 has recorded comparable yields for the two tapping systems. Puncture tappings have given poor yields. There appears to be no striking clone x tapping system interaction except in the case of WR 101 where the yield for the s/2 d/3 67% system is very low compared to the s/2 d/2 100% system. This is hard to explain. There is also an inverse correlation between yields for tapping systems and girth increments. (*U. P. de S. Waidyanatha & S. Wilbert*).

Field Experiment No. 94 - Tapping experiment - Nivitigalakele

Five tapping treatments are being investigated on 5 tree plots of clone RRIC 45 with each treatment replicated 7 times. The treatments commenced in July 1975. The yield and girth data for 1978 are summarised in Table 9.

Table 9. *Yield, girth increment and Brown Bast data for 1978*

Treatment	Yield kg/ha	Girth increment (cm)	Percentage Brown Bast
s/2, d/2, 100%	2183.0	1.82	5.8
s/2, d/1, 200%	2806.2	1.70	8.6
s/2, d/2 (2x2d/4) 100%	2041.8	0.71	2.9
s/2, d/1 (2x2d/2) 200%	3019.4	0.49	8.6
2s/2, d/2, 200%	2118.2	0.92	14.3

The data indicate that there is no particular advantage in the change over of panels at each tapping. At the 200% intensity, tapping of a half spiral daily, appears to be better than tapping of two half spirals alternate daily. (*U. P. de S. Waidyanatha & S. Wilbert*).

Field Experiment No. 95. Tapping Experiment, PB 86, 1963 replanting Nivitigalakele.

The treatments given in Table 10 were applied in August 1975 to 7 tree plots replicated five times in a randomised block experiment.

Table 10. *Yield, girth increment, and Brown Bast data for 1978*

Treatment	Yield (kg/ha)	girth increment (cm)	% BB
s/2, d/2, 100% (control)	1366.7	1.7	8.6
s/2, d/2, 100% (Recovery *)	2151.1	2.1	5.7
s/2, d/2, 100% (Recovery **)	1767.1	1.6	5.7
s/2, 2d/3, 133%	2183.0	2.0	17.2
s/2, d/1, 200%	2009.6	1.8	17.2

* Recovery of lost tapping days by daily tapping in good weather until all the lost days are recovered.

** Recovery tappings spaced out so that only a maximum of 6 additional tappings are done per month.

The data clearly show that revovery tappings (to reach 180 tappings per year) resulted in appreciable yield increases without detrimental effects to trees. Increasing tapping intensities to 133 and 200% also gave increased yield but this was associated with a higher incidence of Brown Bast, which, however, was not observed on PB 86, in other experiments even at the 200% tapping intensity. (*U. P. de S. Waidyanatha & S. Wilbert*).

Field Experiment No. 96, Tapping Experiment 1964 Replanting - Eladuwa Estate

In this Experiment, 6 tapping treatments replicated 5 times were applied to 12 tree plots of clone RRIC 52, commencing in May 1976. The high level cuts G and H were introduced on the panel opposite the existing cut, at 53 and 196 cm respectively. All cuts are tapped downwards. The data for 1978 are given in Table 11.

Table 11. *Yield, girth increment, and Brown Bast data for 1978*

Treatment	Yield (kg/ha) L	H	TOTAL	Girth increment (cm)
s/2, d/2, 100% (Panel L	1688	—	1688	0.23
s/2, d/1 200% (Panel L)	2346	—	2346	0.15
s/2, d/1, (2x2d/2) 200% (Panel L or H_1)	1652	1322	2978	0.17
s/2, d/1, (2x2d/2) 200% (Panel L or H_2)	1372	1267	2639	0.17
2s/2 d/2 200% (Panel L—H_1)	1466	1261	2727	0.14
2s/2 d/2 200%(Panel L—H_2)	1527	1190	2616	0.10

Normal = (lower) panel H_1 — 2nd panel 53 cm above L and on opposite side
H_2— 2nd panel 106 cm above L and on opposite side

No Brown Bast affected trees have been recorded in this experiment to date. Daily tapping on a half spiral has recorded an appreciable increase in yield over s/2, d/2 tapping. Tapping of 2 panels at 200%, either by alternating the panel at each daily tapping or tapping both panels alternative daily, appears to be still better. Separating the two panels more widely apart has had no beneficial effect. The data are consistent with that from other experiments, that clone RRIC 52 can be economically exploited at intensities higher than 100%. (*U. P. de S. Waidyanatha & M. C. Perera*).

Field experiment No. 103, Tapping Experiment 1970 Replantation, Nivitigalakele

The tapping treatments shown in Table 12 were applied in July 1977 to single tree plots each replicated 6 times.

Table 12. *Yield (kg/ha) and girth increment (cm) in parenthesis for 1978*

Treatment	RRIC 45	AV 1734	RRIC 100	RRIC 101	MEAN
2s/8 d/3 33% + E	911 (5.2)	856 (1.7)	1180 (3.8)	1305 (1.7)	967 (2.8)
s/4 d/3 33% + E	643 (4.4)	636 (1.2)	1114 (3.2)	1150 (1.5)	813 (2.4)
MI d/3 + E	761 (5.5)	856 (1.3)	963 (4.1)	805 (1.4)	786 (2.7)
MI + Ma d/3 + E	871 (4.5)	871 (1.3)	1422 (2.3)	1308 (1.7)	1011 (2.2)
s/2 d/3 67%	717 (2.8)	654 (1.4)	1316 (4.0)	1330 (1.4)	931 (2.5)

MI and MI+MI = Puncture tapping one and two are metre bands placed on opposte sides of trunk respectively. Each band tapped with 10 pricks and bands shifted monthly.

E = 1 gm of 5% Ethrel per application applied monthly (10 tappngs) with i puncture tapping and bimonthly with normal tapping.

Two s/8 cuts spaced 21" apart on two panels appear to be better than S/4 cuts with Ethrel stimulation and compares with the S/2, d/3 67% system in terms of yield. Puncture tapping of a metre band again gave the lowest yield although the yield in this trial for this treatment is better than in the previous experiment described.

This may be because, in this experiment a new band is stimulated and tapped monthly, whereas in the previous experiment, each band was stimulated twice so that shifting to a new band takes place only bimonthly, resulting in a lower response. Further, if economic yields are to be obtained with puncture tapping, it appears necessary to tap at least a length of 2 metres. *(U. P. de S. Waidyanatha).*

Field Experiment No. 108, *Tapping Experiment, RRIC 101, 1969 Replantation, Eladuwa Estate.*

The nine treatments as given in Table 13 are being tested on 3 tree plots replicated 6 times, on a randomised block experiment. The treatments commenced on 4th April 1978.

S/2, d/2 tapping has given yields 50% more than S/2, d/3. Tapping two panels alternatively so far appears to have advantage over tapping the same panel throughout. Puncture tapping is not superior to half spiral tapping. It is too early to comment on the effect of separation of panels wider apart or on the direction of tapping. *(U. P. de S. Waidyanatha & M. C. Perera).*

Table 13. *Yield (kg/ha) from 4th April to 30th November, 1978.*

Treatment	Lower cut	Higher cut	TOTAL
s/2 d/3 67%	777	—	777
s/2 d/2 100%	1362	—	1362
s/2 d/2 100% (↓↑ ;21"; Annual)	1233	—	1233
s/2 d/2 100% (↓↑ ; 42" Annual)	1131	—	1131
s/2 d/2 100% (2x2d/4) (↓↑ ; 21")	540	498	1035
s/2 d/2 100% (2x2d/4) (↓↓ ; 21")	525	558	1083
s/2 d/2 100% (2x2d/4) (↓↑ ; 42")	735	585	1170
s/2 d/2 100% (2x2d/4) (↓↓ ; 42")	519	531	1050
M1 d/3 + E	918	—	918

↓↑ = Lower panel tapped down upper panel tapped up.

↓↓ = both panels tapped down.

21", 42" — distance between 2 panels.

M1 d/3+E — 1 metre band puncture tapped with 5% Ethrel stimulation every 4-6 weeks.

Field Experiment No. 109 - Tapping Experiment, RRIC 100; 1969 replanting Eladuwa Estate

The four treatments as given in Table 14 were applied on 24.6.78 to 4 tree plots of clone RRIC 100, Each being replicated five times in a randomised block experiment.

Table 14. *Yield (in kg/ha) from 24.6.78 to 30.11.78*

Treatments	lower cut	Upper cut	Total
s/2, d/3 67%	908	—	908
s/2, d/2, 100%	1305	—	1305
S/2, d/2, (2x2d/4) (↓↓ ; 21")	471	414	885
s/2, d/2, (2x2d/4) (↓↓ ; 42")	544	409	953

↓↓ = Both cuts tapped downwards.

21", 42" — Distance between the two cuts.

Because the data available are only for a period of five months, no definite conclusions can be drawn. However, the S/2, d/2 system has outyielded the S/2, d/3 system. So far there appears to be no advantage of tapping two panels each on alternate days over tapping the same panel throughout. There is also no advantage in spacing out the two cuts. (*U. P. de S. Waidyanatha & M. C. Perera*).

Field Experiment No. 110, Tapping Experiment, RRIC 103, 1969 Replantation, Eladuwa

The treatments as given in Table 15 are applied to 5-tree plots each replicated 7 times. The design of the experiment is randomised blocks.

Table 15. *Yield (kg/ha) from 14.4.78 to 30.11.78, on various tapping systems.*

Treatment	Lower cut	Upper cut	Total
S/2, d/3 67%	1417	—	1417
S/2, d/2, 100%	1849	—	1849
S/2, 2d/3, 133%	2206	—	2206
S/2, 2d/3 133% (2x4d/6) (↓↑ ; 21")	1374	1246	2620
S/2, 2d/3 133% (2x4d/6) (↓↑ ; 42")	1353	1131	2484
2M d/2 + E *	3211	—	3211
S/4, d/2 50% + E **	2576	—	2576

* Puncture tapping of a 2 metre band along trunk with 5% ethrel applied every 5-6 weeks.

** 5% ethrel applied every 2 months.

Yield for half spiral cuts increased with increasing intensity from 67 to 133%. Tapping two panels, each on alternate tapping days, appears to be better for this clone than tapping the same panel throughout. Response both to puncture tapping of a two metre band and $S/_4$ tapping with Ethrel appears good. The results should however be considered with reservation because of the short period over which the experiment has been conducted up to date. (*U. P. de S. Waidyanatha* and *M. C. Perera*).

Field experiment No. 111. Tapping Immature Hevea Experiment I, 1973 Replantation, PB 86 Dartonfield.

The treatments given in Table 16 were replicated 15 times on a randomised block experiment with single tree plots. Treatments commenced in August 1977.

Until July 1978, yields were on the whole poor being 4-6 gm/tree per tapping; and differences between treatments were not marked. However, thereafter, yields improved especially in the S/2, S/8, + E.

Table 16. *Yield and girth data for 1978, for various tapping systems*

Treatment	Yield (kg/ha)	Girth increment (cm)
S/2, d/3 67%	339.0	5.8
S/2, d/6, 34%	185.1	6.5
S/8, d/3, 17% + E	244.5	6.7
S/8, d/6 8% + E	112.6	6.1
M/2, d/3 + E	159.0	6.2
M/2, d/6 + E	85.6	7.1
M I d/3 + E	224.1	6.6
M I d/6 + E	119.8	6.2
Untapped	—	8.3

M/2, MI—0.5 or I metre respectively of puncture tapped band with monthly stimulations; band shifted monthly.

E = I gm of 5% Ethrel applied bimonthly on cuts and monthly on bands.

MI + E systems gave 10 to 15 g/t/t/; S/2, d/3, s/8 d/3 + E and MI d/3 treatments have given appreciably higher yields than the others. Yet, it is doubtful whether tapping these trees is economic, unless the yields improve substantially. Girthing is quite satisfactory in tapped trees although less than in untapped trees. (*U. P. de S. Waidyanatha & D. K. Angammana*).

Field Experiment No. 112. Tapping Immature Hevea Experiment II, 1973 Replantation, PB 86, Dartonfield.

Three levels of Ethrel, 3 numbers of punctures per I metre band and two frequencies of tapping were tested commencing, mid-March 1978 on a factorial experiment with single tree plots replicated 8 times. Treatments are given in Table 17.

Table 17. *Yield and girth increments from 15th March to 30th November, 1978, in relation to various treatments.*

Treatment	Yield (kg/ha)	girth increment (cm)
1 gm 5% Ethrel	273.3	6.12
2 gm 5% Ethrel	290.4	6.20
2 gm ,, ,,	323.9	5.71
5 punctures/metre	284.3	6.03
10 ,, ,,	303.7	6.02
15 ,, ,,	299.7	5.99
Puncture tapped d/2	378.4	6.05
,, ,, d/4	190.9	5.97
S/2, d/4, 50%	119.5	6.19
S/2, d/2, 100%	248.3	5.56

Increasing the amount of Ethrel increased yield, whereas increasing the number of punctures had little effect on yield; 10 punctures per metre appeared optimal. Increasing, the frequency of both puncture and normal tapping from 4 to 2 days doubled yields per hectare. Puncture tapping with stimulation was more effective than conventional tapping in this experiment. Girthing was slightly depressed with increased yields consequent on the increased quantity of Ethrel applied. (*U. P. de S. Waidyanatha & D. K. Angammana*).

CLONE EVALUATION TRIALS

Field Experiment No. 16 - 1956 Clone trial - Hedigalla : All clones are planted in monoclonal blocks of 300 trees per clone. Tapping commenced in 1963 and the average yields for the best selections are given in Table 18.

Table 18. *Yield of dry rubber in kg per ha per year for 140 tappings of 350 trees, tapped S/2, d/2, 100% from 1963*

Year	Clone				
	IRCI 9	PR 252	RRIC 48 * PB 86		AV 144T
Mean yield; virgin bark	1971.9	1833.5	1798.9	1556.7	
,, ,, renewed bark	1452.9	1383.9	1971.9	1522.1	
,, ,, ; 1978	1245.4	1466.8	2385.5	1480.6	4.91
Trees tapped in 1978	189-180	196	108-106	201-200	48-46
Average girth in cm 1978	97.8	73.3	71.3	84.5	81.0
Percentage Brown Bast	3.7	—	2.8	84.5	2

*Tapped in 1964

Clone RRIC 48 has yielded better than the control clone PB 86 in both virgin and renewed bark. It has good vegetative characters and is now recommended for moderate scale planting in estates. In clones IRCI 9 and PR 252, the yields on renewed bark were slightly depressed as in the control clone PB 86. (*L. B. Chandrasekera & W. T. Silva*).

Field Experiment No. 19 - 1962 Clone Trial - Nivitigalakele : All clones are planted at 150 trees per clone. The yields of some of the better selections in this trial are given in Table 19.

Table 19. *Yield of dry rubber in kg per ha per year for 140 tappings of 350 trees (tapped on S/2, d/2, 100%).*

Year	Clone			
	RRIC 93	RRIC 5	RRIC 39	PB 86
Mean yield; 1969-1977	2075.6	2075.6	1868.1	1625.9
,, ,, ; 1978	1826.6	2020.3	1999.5	1899.2
No. of trees tapped in 1978	80-79	80-86	96-97	110-114
Percentage Brown Bast 1978	1.2	—	1	3.5
Mean girth in cm 1978	66.9	76.5	74.6	77.6

The yields of all experimental clones have so far been generally better than the control clone PB 86. However, RRIC 5 is a vigorous grower with good vegetative characters. Test tapping of this trial will be discontinued in 1979. (*L. B. Chandrasekera & W. T. Silva*).

Field Experiment No. 23 - 1965 Clone Trial - Dartonfield: Clones in this trial are planted in 50 tree plots replicated three times. Test tapping results for the first five years are given in Table 20.

Table 20. *Yield of dry rubber in kg per year for 140 tappings of 350 trees (tapped S/2 d/2 100% from June 1973)*

Clone	Trees tapped 1978	girth in cm 1978	YIELD	
			Mean Yield 1973 — 1977	Mean Yield 1978
RRIM 600	128	64.2	1990.5	2242.4
RRIC 90	118-116	57.6	1583.7	1528.8
RRIC 91	112	69.9	1220.4	1365.8
RRIC 45	118	63.5	1273.8	1104.2
RRIC 88	114	69.2	1109.1	1012.2
RRIC 89	111-110	59.6	1273.8	871.8

The clone RRIM 600 continues to be the best yielder in this trial. It is now recommended for moderate scale planting in Sri Lanka. Test tapping of this trial will be discontinued in 1979. (*L. B. Chandrasekera & N. L. D. Ruban*).

Field Experiment Nos. 25 & 27: The clones under test in these two experiments were IRCI 2 and RRIC 36 with clone PB 86 serving as the control. Clone IRCI 2 has suffered extensive wind damage in both trials. Clone RRIC 36 which has continuously yielded better than clone PB 86 is now recommended for large scale planting in the relatively dry districts. Test tapping of both these trials were discontinued in 1979. (*L. B. Chandrasekera & W. T. Silva*).

Field Experiment No. 41 - 1966 Yield Trial - Yatawatte Estate, Matale.

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 cms. 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 the 4th year. The average yields recorded in this trial are given in Table 21.

Table 21. *Yield in g. dry rubber per ha/year for 140 tapping of 350 trees (tapped, S/2, d/3 67% from March 1973 and on S/2, d/2 100% from 1976)*

Clone	Trees tapped 1978	girth 1978 cm.	Yield	
			Mean Yield 1973 1977	Mean Yield 1978
RRIC 36	716-668	63.6	1336.7	1641.8
RRIC 41	716-653	62.9	862.1	1341.6
RRIC 86	682-631	59.5	779.7	1162.4
PB 86	683-644	63.6	983.2	1356.1

Under the relatively dry climatic conditions in the Matale District, clone RRIC 36 has been the best yielder with no evidence of susceptibility to panel diseases. This clone is now recommended for large scale planting in this district. (*L. B. Chandrasekera & N. L. D. Ruban*).

Field Experiment No. 44 - 1967 Yield Trial - Udapolla Group - Polgahawela

All clones are planted in 135 tree plots replicated three times. The yields recorded during the first six years in tapping are given in Table 22.

Table 22. *Yield in kg/ha of dry rubber for 140 tappings of 350 trees (tapped S/2, d/2, 100% from Aug. 1973).*

Clone	Trees tapped in 1978	girth 1978 cm	Mean Yield	Mean Yield
			1973-1977	1978
RRIM 600	323-296	70.2	1840.4	3060.9
RRIC 36	366-335	67.6	1666.0	2368.3
RRIC 45	321-391	69.6	1443.3	2576.6
RRIC 89	335-354	68.1	1380.3	1787.1

The clone RRIM 600 remains the best yielder in this trial with clone RRIC 36 coming second best. Both these clones are now recommended for large scale planting in this district. (*L. B. Chandrasekera & N. L. D. Ruban*).

Field Experiment No. 48 - 1969 Yield Trial - Salawa Estate, Hanwella.

In this trial, four clones RRIC 45, 100, 101 and AVROS 1734 are planted in 135 tree plots replicated 3 times. They were first tapped in April 1976 when the trees reached a girth of 50 cm. Test tapping results for the past 3 years are given in Table 23.

Table 23. *Yield in kg/ha/year dry rubber for 140 tappings of 350 trees, (tapped S/2, d/2, 100%).*

Year	CLONE			
	RRIC 100	RRIC 101	RRIC 45	AVROS 1734
Mean yield 1976	1230.2	2194.0	1162.4	1399.7
,, ,, 1977	1317.3	1661.2	1210.8	1351.2
,, ,, 1978	2218.2	1646.7	1607.9	1811.3
,, ,, 1976-78	1588.6	1834.0	1327.0	1520.7
No. of trees tapped in 1978	362	356	367	341
girth (1978) cms	54.0	57.6	57.1	53.6

The two clones of main interest in this trial are RRIC 100 and RRIC 101. The high yields recorded for RRIC 101 in the first year of tapping have not been maintained while RRIC 100 has given steady yield increases. (*L. B. Chandrasekera & U. K. D. Lewis*).

Field Experiment No. 49 - 1969 Yield Trial - Vogan Group, Matugama

Eight clones RRIC 45, 88, 89, 90, 91, 100, 101 and RRIM 600 are planted with clone PB 86 serving as the control in plots of 165 points per clone replicated three times. Tapping commenced on the S/2, d/2, 100% system in July 1977 at a girth of 50 cm. Average yields recorded in 1977 and 1978 are given in Table 24.

Table 24. *Yield in g. dry rubber per tree per tapping (tapped S/2, d/2, 100%)*

		CLONE								
	Year	RRIC 91	RRIC 100	RRIC 101	RRIC 89	RRIC 88	RRIC 600	RRIC 45	RRIC 90	PB 86
yield	1977	20.6	25.2	43.3	22.3	15.8	30.8	23.0	27.1	27.7
,,	1978	21.4	29.0	35.4	23.9	16.6	28.1	23.3	33.1	28.4
trees tapped	1978	434	455	384	387	408	389	375	263	339
girth	1978	64.5	60.2	59.6	58.6	58.7	57.2	54.3	49.8	55.4

As in other trials, the high yields recorded for RRIC 101 in the first year have declined in the second year of tapping. The more promising clones in this trial are the RRIC 90, 100 and RRIM 600. (*L. B. Chandrasekera & S. Kodikara*).

Field Experiment No. 69 - 1970 Yield Trial - Govinna Estate, Govinna

In this trial, four clones RRIC 45, 100, 101 and AVROS 1734 are planted at 150 points per clone replicated three times. Tapping commenced in March 1977 on S/2, d/2, 100% system of all trees that have reached a girth of 50 cm. The average yields recorded in 1977 and 1978 are given in Table 25. (*L. B. Chandrasekera & N. L. D. Ruban*).

Table 25. *Yield in g. dry rubber per tree per tapping (test tapped from March 1977 S/2, d/2, 100%).*

	RRIC 101	RRIC 100	RRIC 45	AVROS 1734
yield 1977	30.5	20.5	17.0	23.4
,, 1978	32.7	25.2	25.0	25.2
girth 1978 cm	58.2	57.9	51.0	49.3

POLYCLONE TRIALS

Field Experiment No. 83 - 1966 Small scale polyclone trial - Dartonfield

Twenty five local and foreign clones are planted as unreplicated single tree plots. Tapping commenced in 1973, and the data recorded in the sixth year of tapping are given in Table 26. (*L. B. Chandrasekera & N. L. D. Ruban*).

Table 26. - *Yield of dry rubber (tapped S/2,d/2, 100%).*

Average yield (g/tree/tapping)	- 82.4
Average theoretical yield in kg. per tapping task of 250 trees	- 20.6
Average theoretical yield in kg/ha for 140 tapping	- 4265
Average girth in cm of trees at 12 yrs.	- 92.9

Field Experiment No. 86 - Polyclone trial - Hedigalla

Clones RRIC 41, 45, 86, 88 and 89 are planted as single tree plots replicated 90 times. The average yields recorded during the fourth year of tapping are given in Table 27. (*L. B. Chandrasekera & W. T. Silva*).

Table 27. *Yield of dry rubber (tapped S/2,d/2, 100%)*

Average yield (g/tree/tapping)	- 24.2 kg
Average theoretical yield per tapping task of 250 trees	- 6.1 kg
Average theoretical yield/ha (140 tappings)	- 1261 kg
Average girth of trees at 11 yrs age	- 59.7 c.m.

Field Experiments No. 86 - 1975 Polyclone trial - Yatawatte Estate, Matale

The clones planted are RRIC 13, 36, IRCI 2, RRIM 600 and PB 86. Randomly distributed monoclonal plots of each clone serve as the controls. Each treatment is replicated three times. In 1978, the average girth of trees in plots varied between 7.7 cm for RRIC 36 and 10.0 cm for PB 86. (*L.B. Chandrasekera & N. L. D. Ruban*).

Table 28. *Immature areas*

Field expt. No. (and Estate)	Year planted	Av. girth (cm) at the end 1978						
64 (Farnham)	1971 (14.61 ha)	RRIC 13 41.4	RRIC 45 43.2	RRIC 48 43.0	RRIC 50 40.4	PR 252 43.8	IRCI 2 40.7	AVROS 1734 43.6
77 (Mirishena)	1971 (4.05 ha)	RRIC 102 49.0	RRIC 103 47.9	IRCI 9 39.8	PB 86 36.9			
100 (Elston)	1977 (4.05 ha)	RRIC 13	RRIC 101	RRIC 102	PB 86			
101 (Halpe)	1977 (4.05 ha)	RRIC 48	IRCI 7	IRCI 9	PB 86			

STOCK EXPERIMENTS

These trials were laid down in order to evaluate the suitability of seed of the popularly planted clones in Sri Lanka for use as rootstocks.

Field Experiment No. 61 - 1967 Stock experiment - Nivitigalakele: The clone RRIC 45 is tested on six clonal seedling families used as rootstocks. Girth of trees at 9½ years age and yield in the third year of tapping are given in Table 29.

Table 29. *Mean girth and yield of RRIC 45 on different types of rootstocks*

Rootstock	Mean girth cm	Mean yield g/tree/tapping
RRIC 52	58.4	26.7
,, 41	59.5	25.6
RRIM 623	58.9	25.4
RRIC 89	54.7	23.1
,, 5	57.3	22.1
Tjir 1	55.4	21.6

The data indicate that clone RRIC 45 grows well and yields better on rootstocks of RRIC 52, RRIM 623 and RRIC 41 as compared with the other types of rootstocks used in the trial. (*A. C. I. Samaranayake & U. S. Weerakoon*).

Field Experiment No. 88 - 1975 Stock experiment - St. George State Plantation, Matugama

Scion clones of RRIC 45, 103, Wagga 6278 and PB 86 were budded on to seedling rootstocks of clones RRIC 45, 103, Wagga 6278 and PB 86. The mean girth of trees at 3½ years from planting are summarised in Table 30.

Table 30. *Mean girth of trees for various combinations of rootstocks and scions (cm)*

Rootstock	Scions				
	PB 86	RRIC 45	Wagga 6278	RRIC 103	Rootstock mean
PB 86	32.30	35.00	32.84	38.18	34.58
RRIC 45	31.21	34.80	30.99	37.34	33.58
Wagga 6278	31.05	32.56	31.71	35.95	32.81
RRIC 103	31.98	33.92	32.70	36.02	33.65
Scion Mean	31.35	34.08	32.07	36.87	

The rootstocks of clone PB 86 have induced the best scion growth followed by rootstocks of clone RRIC 45 and RRIC 103. In scion growth, clone RRIC 103 shows the most vigorous growth. (*A. C. I. Samaranayake, R. B. Gunaratne & L.S. Kariyawasam*).

Field Experiment No. 113 - 1978 stock experiment - Eladuwa Estate, Paiyagala

This trial consists of 24 rootstock/scion combinations of six scions (PB 86, RRIC 94 RRIC 48, RRIC 52, RRIC 13 and RRIC 100) and four rootstocks (PB 86, RRIC 94, RRIC 52 and RRIC 100). Each plot consists of 14 plants replicated four times.

Sprouting of the bud patches were recorded at weekly intervals at the early stages and the results on analysis show significant rootstock effects on the emergence of buds. The rate of emergence appear to vary with the scion clone and a significant stock/scion interaction on sprouting was evident.

INTERCROPPING TRIALS

Field Experiment No. 78 - Intercropping trial - Yatawatta Estate, Matale

In this trial, clone RRIC 45 is planted at spacings of 2.4x9 m. A single row of Bananas was planted centrally between each pair of rubber rows spaced 3.6m along the row. Three plots of 250 trees each not interplanted served as the controls. The average girth of rubber trees at the end of four years were 21.6 cm for the intercropped plots and 20.6 cm for the control plots.

In October 1977, the bananas, which were getting shaded out were removed and the area was interplanted with coffee. A single row of coffee between each pair of rubber rows spaced 2.4 m. along the row was planted to give a stand of approximately 667 coffee plants per hectare. The plants were trained as to single stems by removal of basal shoots. A few plants flowered for the first time towards the end of 1978.

The average girth of rubber measured at the end of 5 years was 29.8 cm for the intercropped plots as against 28.6 cm for the control plots. There was an improvement in the growth of rubber in the intercropped plots probably due to the extra fertilizer given to the subsidiary crop. (*L. B. Chandrasekera & N.L.D. Ruban*).

Field Experiment No. 79 - 1973 Intercropping trial - Yatawatta Estate, Matale: This trial was designed to investigate the possibility of establishing cacao under mature rubber in the dry planting districts. Clone PB 86 is planted at spacings of 2.4 m x 9 m. A single row of cacao seedlings were planted between each pair of rubber rows spaced two metres along the row. Cacao was first established in polybags before transplanting in the field and was fertilized regularly. A few trees in a plot located in a more sheltered position flowered at the end of 1978. The growth rate of young cacao in this trial has been relatively slow, probably due to intense root competition from mature rubber.

A further 8 hectares of mature rubber (clone PB 86) was interplanted with cacao seedlings at spacings of 2.4 m x 9 m in December 1976. Here too the same initial establishment difficulties were noticed. (*L. B. Chandrasekera & L. D. Ruban*).

Field Experiment No. 87 - 1975 Intercropping trial - Hatbawe Group

In a block of 4 ha planted with rubber at spacing of 2.4 m x 9 m three randomised plots totalling 2 ha in extent were interplanted with coffee in the same year in which rubber was planted in the form of bare root budded stumps. Coffee was raised in polybags and later transplanted in the field without shade. A single row of coffee seedlings spaced 1.2 m along the row, were planted. At the end of 1977 there was overcrowding of coffee along the row and it was therefore thinned out to a tree spacing of 2.4m along the row. The coffee plants flowered for the first time at the end of two years in 1977. However, at the end of 1978 the coffee was in full bearing with light shade provided by the rubber.

The average girth of rubber recorded after three years at the end of 1978 were 25.2 cm. for the intercropped plots as compared with 22.5 cm. for the control plots. (*L. B. Chandrasekera & U. K. D. Lewis*).

Robusta coffee trial

Average girth 1978 in cm.

Treated	25.2 cm
Control	22.5 cm

Expenditure to data Rs. 2,227.41

The original stand of coffee thinned out to spacings of 2.4 m along the row. The plants flowered at the end of 2 years in November 1977.

(The first crop has been harvested along with the estate crop.
The estimated Crop furnished by the Estate is approx 22 lb. from the Expt.).

Field Experiment No. 99 - Smallholder demonstration trial. Meegahatenna.

In this trial, an extent of 1.2 ha, planted with rubber at spacings of 2x8.2 m were interplanted with banana and pineapple in November 1976. A single row of bananas was planted between each pair of rubber rows spaced 3.7 m along the row. The bananas were kept circle weeded and regularly fertilized. Flowering commenced towards the end of 1977, and in 1978 the plots were in bearing.

In the pineapple plots , 4000 pineapple suckers were planted at four rows of pineapple spaced 0.45 m x 1.2 m between each pair of rubber rows. As the pineapple plots require clean weeding, planting was confined to flat land. Due to the rapid growth of weeds, pineapple growing with hand weeding appears to be unprofitable in the wet zone. However, suitable weedicides are being tried out. (*L. B. Chandrasekera & U. K. D. Lewis*).

Field Experiment No. 102, Coffee trial, Elston Estate. This is a preliminary trial to evaluate the effects of different degrees of shade on the initial establishment of coffee among rubber. Three rubber areas replanted in 1971, 1973 and 1977 were selected to represent dense shade, light shade and no shade. Approximately 300 coffee seedlings were planted under rubber in each of the replanted areas, the coffee being confined to a single row between each pair of rubber rows spaced 10 ft along the row. At the end of one year, it was observed that the initial establishment and early growth of coffee were very satisfactory in plots with dense and light shade. In plots with no shade there were many deaths and the surviving plants showed very slow growth. (*L. B. Chandrasekera & U. K. D. Lewis*).

INTERCROPPING WITH FORAGE GRASSES AND LEGUMES

Field Experiment No. 90 - Productivity of grasses and legumes and their effects on Hevea:

Growth of three forage grasses and two legumes each alone or in combination with a legume is being tested. The grass only plots are fertilized with 100 or 200 kg N/ha/yr and the legume + grass plots with 30 or 60 kg P/ha/yr as conc. superphosphate. All plots receive appropriate basal dressings of nutrients. The effect of the various treatments on growth of *Hevea* is also being investigated.

The experiment commenced in July 1975 on this replantation when *Hevea* plants (PB 86) were three months old.

The dry matter yields of forage and girth of trees are given in Table 31.

The dry matter yields for 1978 have been on the whole poor. This is partly due to some nutrient deficiencies as was evident from the foliage and increasing shading from the growing rubber trees. Three years of continuous zero grazing appears to have caused nutrient imbalances which are now being investigated.

Performance of *P. maximum* appears to be better when in combination with *Pueraria* especially at the higher phosphorus level. *B. brizantha* on the other hand is more productive when grown alone at the higher level of nitrogen, and the legume component in the mixed a plots is meagre. *B. miliformis* is the least productive and is now disappearing, particularly from the mixed plots. The legume productivity in all instances was higher at the higher level of phosphorus.

The least competitive grass is *B. miliformis* whereas *B. brizantha* is the most with *P. maximum* intermediate. The competition is far less when the grass is grown with a legume, especially *Pueraria:* and the *P. maximum-Purearia* combination appears an acceptable system for intercropping with immature. *Hevea* considering both the level of productivity and competition. (*U. P. de S. Waidyanatha & S. Wijesinghe*).

Table 31. *Dry matter yield (kg/ha) of forage, and girths of Hevea trees for 1978*

Treatment		Forage yield (kg/ha) N_1 or P_1	Forage yield (kg/ha) N_2 or P_2	Girth (cm) N_1 or P_1	Girth (cm) N_2 or P_2
P. maximum (Pm)		5755	6380	18.6	18.0
Pm + Centro	grass	7302	7890	19.2	19.8
	legume	413	682		
Pm + Puero	grass	6746	8027	19.9	21.4
	legume	938	1170		
B. brizantha(Bb)		5110	6067	16.2	16.3
B.b. + Centro	grass	4408	4585	17.1	16.1
	legume	242	396		
B.b. + Puero	grass	5008	4891	18.5	17.8
	legume	896	924		
B. miliformis (Bm)		4156	4443	23.1	23.7
Bm + Centro	grass	2737	3050	23.4	24.2
	legume	806	963		
Bm + Puero	grass	3389	3362	23.7	23.7
	legume	1504	1168		
Puero cover (no fertilizer)	—	—		26.6	
Naturals (no fertilizer)		—	—	26.2	

Field Experiment No. 91. Varietal experiment with forage grasses: The grass species given in Table 32, are being tested at 100 and 200 kg/N/ha/yr.

The dry matter yields of herbage have been low on the whole, partly due to shading from the closing rubber canopies. The response to nitrogen too has been poor. The stands of *B. miliformis* and *B. mutica* are poor and are being gradually displaced by weeds. NB 21 which was one of the most vigorous-growing of the types tested has decreased in productivity over the three years. It appears that this grass needs a high level of nutrients and management for good productivity. *B. ruziziensis* is very sensitive to soil nitrogen levels and shows nitrogen deficiency unless nitrogen is applied very regularly. The most promising of all appears to be Guinea A and Guinea *B. B. dictyoneura* (Koronovia grass) although not popular in Sri Lanka is very promising, establishes quickly and forms a complete ground cover and remains weed-free throughout. *Paspulum plicatulum*, another grass known for good performance in poor soils has also shown promise.

Table 32. *Dry matter yields (kg/ha) of different grasses for 1978*

Treatment	*100 kg N/ha*	*200 kg N/ha*
Brachiaria miliformis	2816	4124
B. ruziziensis	4042	4752
B. mutica	3511	3093
B. dictyoneura	8166	7613
Setaria anceps	4229	5447
Paspalum plicatulum	7262	7651
Pennisetum purpureum (NB 21)	4091	4916
Panicum maximum (Guinea B)	9227	10565
P. maximum (Guinea A)	11596	12007
P. maximum (Green panic)	4348	4415

Field Experiment No. 114. Productivity of P. maximum growing singly or in association with Pueraria and their effects on Hevea:

The grass and legume were established around *Hevea* plants in concentric rows, 0.5 m apart, starting at 1 or 1.5 m away from the base of the plant and extending to 3 m. In mixed plots, one half of the row was grass and the other half legume. Each plot hence consists of a single tree with the pasture around it. Each treatment (Table 33) was replicated 12 times in a randomised block experiment. The rubber plants and the forages were established in June 1977. The grass only plots received 100 kg N/ha/ry plus a basal dressing of conc. superphosphate (30 kg P+ha/yr) and muriate of potash (60 kg K/ha/yr). The grass+legume plots received only conc. superphosphate (60 kg P/ha/yr) and muriate of potash (60 kg/ha/yr) Rubber was fertilized separately as usual.

The treatments are as given in Table 33.

Table 33. *Dry matter (DM) yields (effective area basis) crude protein (CP) content and girths of rubber trees for 1978.*

Treatment		DM(kg/ha)	% C.P.	Tree girths(cm)
P. maximum - 1.0m *		19024	8.5	10.2
- do - 1.5m *		16991	8.7	11.2
	*legume	11324	18.4	
P. maximum—Pueraria - - 1.0m				9.4
	grass	17873	8.9	
	*legume	9941	18.4	
- do - 1.5m				11.3
	grass	17436	8.8	
Pueraria cover (not fertilized)		—	—	11.1

*planted 1.0 or 1.5 m away from base of trees

It is noteworthy that the total dry matter productivity was higher in the mixed plots than in nitrogen - fertilized grass plots. The growth of *Pueraria* was very good in all the plots and only the *Pueraria* that was trailing up the grass shoots were cut back together with the grass. In spite of this, the legume component in the cut herbage was excellent. Although not clearly reflected in the crude protein contents, the grass in the mixed plots always looked greener than that in the grass

only plots, suggesting that the associated legume provided more nitrogen (and other benefits) than was available to the grass only plots. There appeared to be some competition on *Hevea* from forages, when compared to the uncut *Pueraria* cover; but this was only when the forages were established at 1 m from the base of the plants and not at 1.5 m. (*U. P. de S. Waidyanatha & S. Wijesinghe*).

OTHER INVESTIGATIONS

Rainguards

A large scale Rainguard trial was started during 1977 at Eladuwa Estate in a 1963 replanting on five clones with three tapping tasks each. Two tapping tasks in each clone were fitted with rubber rainguards while one task without rainguards serves as the control.

The same rainguards used in 1977 were removed from the original position and refixed near the tapping cuts in 1978. These rainguards are therefore usable for a second year. A summary of tapping and yield data for the year 1978 are given in Table 34.

Table 34. *Large Scale Rainguard trial, Eladuwa estate, 1963 replanting. Details of tapping days and crop intake per tapper per day for 1978*

	Control	*Rainguards*
Days not tapped	84	57
Mean yield in kg per tapper per day	4.04	4.6
Total additional yield in kg for 10 blocks with rainguards		582.7

In another large scale trial sited at Eladuwa Estate, 28 additional tappings for plots with rainguards were recorded from April to December 1978, giving an additional 420 kg dry rubber at an average intake of 11.02 kg per tapper per day. In the small scale trial at Dartonfield 17 additional tappings, were recorded for plots with rainguards giving an extra 65.5 kg dry rubber for the year 1978. Further large scale trials, representing the various planting districts with different degrees of rainfall were initiated in 1978 at Frocester Estate, Govinna, and Elston Estate, Puwakpitiya.

In collaboration with the Estates Advisory Department of the Institute, a rainguard trial was laid down in 1978 in a smallholding at Elpitiya. In this trial, 4 tapping tasks of clone PB 86 were selected, two of which were fitted with rainguards and tapped on the S/2, d/2, 100% system. The rainguard blocks recorded 8 additional tappings during 1978 as compared with the control plots. (*R. Satchuthananthavale, C. Weerasinghe & G. de Mel*).

Tissue Culture

Hevea callus cultures established from different source materials like seedling and clonal stem explants, anthers and endosperm were maintained in sub-cultures and their growth on different growth media was studied. In experiments aimed at inducing organ formation, callus cultures originating from stem explants were observed to differentiate roots when transferred to a root differentiating medium.

Another noteworthy observation was the development of a plantlet with a distinct root and stem from callus obtained from endosperm tissue. Although this plantlet was later lost due to fungal contamination, this was an indication that plantlet formation in *Hevea* callus cultures could be achieved.

Liquid suspension cultures were successfully established from callus cultures obtained from both stem and anther explants, using a horizontal orbital shaker. These suspension cultures were observed to contain both single cells of various shapes and groups of cells. These single and groups of cells were subsequently grown on agar petri plates using the Bergmann technique.

Root formation - Callus cultures established from seedling stem explants and grown on modified Murashige & Skoog (M & S) medium were transferred to media containing high levels of auxin and kinetin and cultured for 4 weeks. These cultures were later transferred to media containing low levels of auxin and kinetin. After 4 weeks in culture, good root formation was observed.

Liquid suspension cultures - Callus cultures from anthers and stem explants which were grown on agar medium were transferred to liquid media and continuously agitated by means of horizontal orbital shaker at about 150 r.p.m. Good cell separation was observed. At the end of 4 weeks the liquid suspension contained both single cells and small groups of cells. This cell suspension was added to fresh agar medium and plated in petri plates. After 3 weeks in culture these single cells and groups of cells were observed to undergo cell division. So far no embryoid formation has been observed. (*R. Satchuthananthavale, M. H. Mendis & C. Weerasinghe.*)

Embryo culture

Seedlings grown from decotylised embryos under asceptic conditions on semi solid medium were later transferred to a complete mineral solution containing major and minor elements but without sucrose. These plants developed leaves and remained alive for more than a month. Attempts to transfer these plants to soil proved unsuccessful. (*R. Satchuthananthavale & I. R. M. Amarakoon*).

Physiology of disease resistance

Preliminary studies on thin layer chromatographic separation of polyphenols from *Hevea* leaves were carried out, this will be continued. (*R. Satchuthananthavale & G. de. Mel*)

Growth substances in Hevea:

The presence of phenolic inhibitors was detected in methanolic extracts of *Hevea* buds and bark tissues after chromatographic separation. These have not yet been identified. (*A. C. I. Samaranayake* in collaboration with *R. Satchuthananthavale* and assisted by *L.S. Kariyawasam & G. Bandara*).

Reduction of the period of immaturity

Stumped buddings of clones RRIC 100 and 101 were planted in 25 tree plots replicated eight times. The control plots were planted with budded stumps. The establishment of stumped buddings was not very satisfactory in this trial due to the dry weather that followed planting. Those that were established have shown satisfactory growth. (*A. C. I. Samaranayake, R. B. Gunaratne & G. Bandara*).

Polybag plants could not be included in the earlier experiment due to delay in establishing this material. A separate trial was therefore set down in order to compare establishment and growth of polybag plants with bare root budded stumps. The buddings were grown in polybags for 8 months and carried 4-5 leaf whorls at the time of field planting. (*A. C. I. Samaranayake, R. B. Gunaratne & L. Kariyawasam*).

Growth variability in field plantings of budded stumps:

In a trial to investigate the possibility of reducing the tree to tree variability in growth within a clone by the use of various planting methods, the following treatments were compared:

1. A single brown budded stump per planting point planted bare root.
2. A single green budded stump per planting point planted bare root.
3. Two brown budded stumps planted bare root at each planting point, and the weaker one removed later.
4. Two green budded stumps planted bare root at each planting point, and the weaker one removed later.
5. Green buddings, with one hardened whorl of leaves, in polybags.

The experiment is on a randomized block design with 12 tree plots, replicated six times.

Though green buddings with one whorl of leaves showed better growth over the other treatments up to 14 months from planting, these differences were not maintained in later growth. The treatments have failed to reduce the growth variability as compared with the normal planting of bare root budded stumps. (*A. C. I. Samaranayake, R. B. Gunaratne, & L. S. Kariyawasam*).

Establishment and growth of budded stumps: The following treatments were applied to bare root, brown buddings as single tree plots replicated 30 times.

a) Lateral roots pruned to 12 inches.

b) ,, ,, ,, ,, 6 ,,

c) ,, ,, ,, completely.

The rate of sprouting of buds was not influenced by the various treatments, but field establishment was poor when roots were pruned completely. (*A. C. I. Samaranayake & R. B. Gunaratne*).

In another trial to study the effects of root inducing hormones and other chemical substances on establishment and growth of budded stumps, the following treatments were applied to stimulate root initiation.

1. 100 ppm Naphthyl Acetic Acid (NAA) overnight dip.
2. 100 ppm Indole Butyric Acid (IBA) overnight dip.

3. 500 ppm NAA - sprayed on to roots before planting.

4. 1000 ppm NAA - ,, ,, ,, ,, ,, ,, .

5. 500 ppm IBA - ,, ,, ,, ,, ,, ,, .

6. 1000 ppm IBA - ,, ,, ,, ,, ,, ,, .

7. Suspension of Furadan in water sprayed on to roots.

8. 3 g Furadan placed in the planting hole.

9. Water - overnight dip.

Early observations indicate that the rate of sprouting of buds varied with different treatments. With 1000 ppm. and 500 ppm. IBA about 40% of the stumps remained dormant even after two months from planting whereas in other treatments only 20-25% remained dormant. (*A. C. I. Samaranayake, R. B. Gunaratne & G. Bandara*).

Effects of hormones and placement of fertilizer on root induction and root development in budded stumps: Each of the following treatments was applied to six budded stumps, which were then planted at random in the field.

a) Roots dipped in 50 ppm IBA for 18 h.

b) ,,- ,, ,, water ,, ,, .

c) ,, ,, ,, 2000 ppm IBA for a few seconds.

Fertilizer was applied on the surface of soil around each plant in half the number of plants and at a depth of two feet from the surface around the rest of the plants. After one year there does not appear to be marked differences in the pattern of root growth between the various treatments. (*A. C. I. Samaranayake, U. P. de S. Waidyanatha & S. Wilbert*).

Crown budding: In field experiment 89, located at St. George State Plantation, Matugama, as reported in the Annual Review for 1977, there was satisfactory establishment of crowns. In certain clones where the crowns were too heavy, excess branches were selectively pruned. (*A. C. I. Samaranayake & R. B. Gunaratne*).

Characterisation of clones: The purpose of this investigation is to study a number of clones to identify criteria if any, that could be used in the early selection of clones.

Ten clones of varying yield potential were selected and 50 budded stumps of each clone were planted in the field as single tree plots at the normal spacing of 8'x30'. In between two rows an additional row was planted with the same clones so that plants could be removed for destructive sampling at different stages of growth, leaving a normal stand of plants for long term observations.

Data collected on the rate of emergence of the bud on analysis showed that emergence varied with different clones (Ann. Rep, 1977).

Growth measurements were recorded at monthly intervals until one year from planting. After which measurements were taken at intervals of 3 months.

Ten plants from each clone were sampled at the age of 15 months. Extension growth of the stem, number of branches, girth of stem, number of leaf whorls, number of leaves in each whorl, leaf shape, leaf area and length of petioles were measured. Fresh weight of leaf, stem petioles, bark, wood and roots, dry weight of leaf, stem, petioles, bark, wood and root were recorded.

In addition samples were removed and preserved from the stem, leaves and petioles for anatomical studies.

Before these plants were uprooted a modified method of microtapping was carried out on these plants with and without Ethrel stimulation. Accepted high yielding clones gave high yields on microtapping too.

Trees in the "Retaining Rows" were also microtapped so that a permanent record on early yields of each tree could be kept and also individual variation in yield could be studied. Even in these data the trend in yield was the same, high yielding clones giving high yields on microtapping (Table 35). *(A, C. I. Samaranayake, U. P. de S. Waidyanatha, A. Ekanayake & L. S. Kariyawasam).*

Table 35. *Yield in grms/tree/tapping of micro-tapped trees*

	Retaining rows (at 17 months, mean of 5 tappings on 40 trees)	Uprooting rows (at one year, mean of 5 tappings on 15 plants)
RRIC 45	0.085	.057
RRIC 52	0.222	.089
RRIM 600	0.193	.088
RRIC 101	0.235	.107
RRIC 88	0.115	.076
GT 1	0.354	.186
RRIC 100	0.277	.125
LCB 870	0.035	.041
PB 86	0.318	.139
IRCI 2	0.204	.111

BROWN BAST STUDIES

Investigations in 1978 were primarily oriented towards ascertaining how best Brown Bast affected trees can be exploited. In the experiments reported below, trees affected by Brown Bast were selected and rested or tapped in different ways.

Tapping of Brown Bast Trees, Clone RRIC 101, 1969 Replantation, Eladuwa Estate. Following a spell of excessive yields, about 40 trees in this replantation were affected by this syndrome and were rested for about three months. The following treatments each on four trees, were applied thereafter in October 1977.

Table 36. *Yield (g/t/t) from 13.10.77 to 30.11.78*

Treatment	g/tree/tapping
1. Resting of affected bark	—
2. Removal of affected bark, application of Kankerdood and resting	—
3. Same as (2) but tapping on s/2, d/2, 100% downwards at 100 inches on opposite panel	40.1
4. Isolation of affected bark with grooves and tapping as in (3)	60.4
5. Tapping at 100" without any treatment of affected bark	63.6
6. Continuation of tapping of affected bark	45.8

In the first few months of tapping the yields in treatment (6) were comparatively poor and all new cuts yielded normally. However, in the last three months, yields of treatment (6) have increased considerably, whereas those of treatment (3) have declined as a result of two of the four trees in the latter yielding very poorly. (*U. P. de S. Waidyanatha & M. C. Perera*).

Tapping of Brown Bast trees, Clones RRIC 89 and PB 28/59

1961 Replantation, Dartonfield: Each of the treatments as given in Table 37 were applied on selected Brown Bast trees, there being 5 to 8 trees per treatment.

Table 37. *Yield data (g/t/t) from July to December, 1978*

Treatments	Yield in gm/tree/tapping	
	RRIC 89	PB 25/59
1. Tapping upwards on V cut (d/2) above affected bark	41.4	66.9
2. Tapping on opposite panel (S/2 d/2) downwards	26.2	11.1
3. Affected bark removed, panel dressing applied and tapped on V cut as in (1)	34.1	63.3
4. Tapping of affected panel	8.8	18.4
5. Unaffected (normal) trees tapped S/2 d/2	25.8	30.6

These data confirm that only poor yields are recoverable by continuing tapping the affected panel or tapping opposite panel because dryness (partial) often spread rapidly to the opposite panel too.

Brown Bast affected trees in a field are invariably the potentially highest yielding tress. This is clearly evident from the data which also stresses the need to tap such tress on unaffected panels. The recoverable yields in so doing are substantial. (*U. P. de S. Waidyanatha & C. Angammana*).

NITROGEN FIXATION

Field Experiment No. 92, Nitrogen fixation by legume covers and effect of ground covers on Hevea:

The treatments given in Table 38, replicated 5 times, were tested in a randomised block experiment. There were 20 rubber plants spaced at 14x16 ft per plot. The experiment commenced in June/July 1975 with the planting of rubber and establishment of covers. The experiment, as reported previously, had two set backs due to bandicoot and cockchafer grub damage to rubber plants.

Nitrogen accretions by leaf litter of *Pueraria* were estimated throughout 1978 by bi-weekly dry weight estimations of leaf litter from sub-plots which was later returned to the respective sub plots, except for a small sample used for determination of % N. It was not possible to do this for *Calopogonium* because of its poor growth and invasion of the plots by weeds. The data for *Pueraria* suggest that neither rhizobial inoculation nor fertilizing with 100 kg/N/ha (as Urea) per year, improved litter production. Also naturally established legumes which did not give as good a cover as sown *Pueraria* did not contribute as much N as did *Pueraria* by way of litter. Because of the question of nutrient recycling it is not possible to say how much nitrogen is fixed by this third year *Pueraria* cover but the fixation appears substantial.

From the girth data, there is some indication that nitrogen (Urea) fertilizing of the cover has improved tree growth. Also the growth in the *Calopogonium* plots appears to be slightly better. This may partly be due to the fact that, in the dry months of January and February, the *Calopogonium* cover dies out leaving a surface mulch so that there is more moisture conservation and in fact less competition for moisture with the rubber plant. On the other hand a *Pueraria* cover which withstands the drought can compete with the rubber for moisture. Further, bandicoot damage which was greater in the *Pueraria* plots on account of the dense cover may also be contributing towards the relatively smaller diameters of trees in these plots. (*U. P. de S. Waidyanatha, & L. S. S. Pathiratne*).

Table 38. *Nitrogen contribution by leaf litter and tree growth as affected by the various cover treatments for 1978.*

Treatment	Total N (kg/ha) in leaf litter	Tree diameter (cm)
Pueraria inoculated with Rhizobium	129.1	8.2
Pueraria not inoculated	151.0	8.7
Pueraria + 100 kg N/ha/yr	126.7	9.1
Calopogonium inoculated with Rhizobium	—	8.6
Calopogonium not inoculated	—	9.3
Calopogonium + 100 kg N/ha/yr	—	9.2
Naturally established legumes	87.1	9.0
Naturals (without Mikania)	—	8.9

MYCORRIHIZA

Spore types and numbers in some local soils: Soil samples collected from several sites in rubber growing areas were examined for mycorrhizal spores and sporocarps. Glomus types were the most common both in the Wet Zone and Dry Zone (Moneragala) soils and, in all, some 16 types were recorded. Amongst these, *G. fasciculatus*, *G. mosseae* and *G. microcarpus* were identified. *Sclerocystis* types

were the next most frequent in the soils examined and there were about 5 types. Three types of *Acaulospora* and two of *Gigaspora* were also observed. attempt is now being made to identify these types.

Counts of spores were also made in a few soil samples from four sites and they were categorised according to the classification of Mosse and Bowen (1968).

The yellow vacuolate was the commonest spore type at all sites, there being as many as over 2000/g of soil at one of the sites. The other more prevalent types were white reticulate, red brown laminate and honey coloured sessile.

The highest spore numbers were found in Moneragala, located in the Dry Zone, and it had more than double the number recorded for the highest site (Avissawella) in the Wet Zone. It is believed that whereas periodic dry conditions encourage spore formation, wet conditions favour vegetative (mycelial) growth. This perhaps explains the high spore numbers recorded for Moneragala. However, only a few soil samples have been used per site for counts hitherto and no definite conclusions can be drawn. Nevertheless, it is noteworthy that the spore numbers at all locations are amongst the highest reported in the literature, suggesting the richness of VA mycorrhizae in local soils. (*U. P. de S. Waidyanatha, R. Jayasinghe, Research student, in collaboration with A. de S. Liyanage, Plant Pathology Department*).

BIOLOGICAL SUPER PHOSPHATE

It has been reported that phosphate uptake by plants from rock phosphates increases when the latter is applied to the soil together with sulphur. It is believed that the sulphur is converted to sulphuric acid in the soil by sulphur bacteria and this acid solubilizes the phosphate. The availability of phosphate is also reported to be greater when rock phosphate is pelletized with sulphur in the proportion of about 10:1, with the inclusion in the pellets, of a small quantity of a soil inoculum of sulphur bacteria. We have undertaken to test this principle particularly with local apatite. One experiment was completed and three others are in progress.

In a pot experiment with *Pueraria*, apatite and sulphur were tested singly and in combination. Concentrated superphosphate with or without sulphur, gypsum and gypsum with apatite were also treatments. Gypsum treatment was designed to supply sulphur in the sulphate form so that the effect and interactions of sulphur as sulphate could be isolated from that due to the elemental form (during its oxidation in the soil).

The data showed a significant response to apatite which was increased by the addition of sulphur. Sulphur by itself had no effect. Gypsum increased plant growth, and when added with apatite there was a further improvement of growth. The data indicate a sulphur x phosphorus interaction, which however was not confirmed by the concentrated superphosphate + sulphur treatment. There was also the indication that all phosphate applications caused greater phosphate uptake compared to the non-phosphate treatments.

In a second pot experiment with *Panicum maximum* as the test plant imported rock phosphate, local apatite and concentrated superphosphate were tested with or without sulphur. Sulphur and phosphorus were in the ratio of 1:10. The mixtures with a trace of soil enriched with sulphur bacteria were also tested in pellet form. A pre-vulcanised latex formulation was used as binder in the pelleting.

The data (Table 41) show that there was response to all phosphates when applied alone with the least response to apatite. However the response even to apatite is marked when compared to the controls and the other no phosphate treatments. There was also a positive PxS interaction for apatite and conc. super but inexplicably not for RP. (imported rock phosphate). In all instances pelletizing was inferior to mixing the material with the soil. This may be related to poor distribution of material in soil and decreased surface area of phosphate particles resulting from pelletization which was not compensated for by any (if at all) increase in solubilization by the pelleting.

In conclusion, on the basis of the data from these two experiments, it appears that the sulphur x phosphorus interaction is a direct one, and not due to solubilization of phosphorus by the addition of sulphur. More experiments, including in addition rock phosphate+a sulphate as a treatment, need to be done for further clarification of this data. Two field experiments investigating this principle were set down in 1978, one with *Hevea* at Lowmont and the other with *Pueraria* at Padukka. No results have yet been available from them. *(U. P. de S. Waidyanatha, W. A. Ariyaratna, in collaboration with N. Yogaratnam, L. Wickremasinghe of Soil Chemistry & A. Coomaraswamy of Rubber Chemistry Dept.).*

Index to Field Experiments

Experiment No.	*Description*	*District/Site*
16	1956 Clone Trial	Hedigalla
19	1962 Clone Trial	Nivitigalakele
23	1965 Clone Trial	Dartonfield
41	1966 Yield Trial	Yatawatte Estate, Matale
44	1967 Yield Trial	Udapolla Group, Polgahawela
48	1969 Yield Trial	Salawa Estate, Hanwella
49	1969 Yield Trial	Vogan Group, Matugama
53	1971 Tapping Experiment	Dartonfield
58	1971 Ethrel Trial	Malaboda Estate, Matugama
61	1969 Stock Experiment	Nivitigalakele
63	1971 Ethrel Trial	Eladuwa Estate, Paiyagala
64	1971 Yield Trial	Farnham Estate, Puwakpitiya
69	1970 Yield Trial	Govinna Estate, Govinna
73	1972 Ethrel Trial	Eladuwa Estate, Paiyagala
74	1973 Tapping Experiment RRIC 45	Nivitigalakele
77	1973 Yield Trial	Mirishena Estate, Govinna
78	1973 Intercropping trial (Banana/Coffee)	Yatawatta Estate, Matale
79	1973 Intercropping Trial (Cacao)	Yatawatta Estate, Matale
80	1974 Ethrel Trial	Talgaswela Estate, Talgaswela
83	1966 Polyclone Trial	Dartonfield
84	1967 Polyclone Trial	Hedigalla
85	1970 Tapping Experiment	Nivitigalakele
86	1975 Polyclone Trial	Yatawatta Estate, Matale
87	1975 Intercropping Trial	Hathbawe Estate, Rambukkana
88	1975 Stock Experiment	St. George Group, Matugama
89	1975 Crown budding Experiment	St. George Group, Matugama
90	Establishment of Forage Grasses and Legumes under Rubber	Eladuwa Estate, Paiyagala

Experiment No.	*Description*	*District/Site*
91	Varietal Experiments with Forage Grasses in Rubber	Eladuwa Estate, Paiyagala
92	Cover Crop Experiment	Padukka Group, Padukka
93	Ethrel Trial	Eladuwa Estate, Paiyagala
94	Tapping Experiment; RRIC 45	Nivitigalakele
95	Tapping Experiment; PB 86	Nivitigalakele
96	Tapping Experiment; RRIC 52	Eladuwa Estate, Paiyagala
99	Intercropping Smallholder demonstration Trial	Meegahatenna
100	1977 Yield Trial	Elston Estate, Avissawella
101	1977 Yield Trial	Halpe Group, Tummodera
102	1977 Intercropping Trial Coffee	Elston Estate, Avissawella
103	Puncture Tapping Experiment	Nivitigalakele
107	1978 Stock Experiment	Eladuwa Estate, Paiyagala
108	Tapping Experiment; RRIC 101	Eladuwa Estate, Paiyagala
109	Tapping Experiment; RRIC 100	Eladuwa Estate, Paiyagala
110	Tapping Experiment RRIC 103	Dartonfield
111	Tapping Experiment PB 86	Dartonfield
112	Tapping Experiment PB 86	Dartonfield
113	1978 Stock Experiment	Eladuwa Estate, Paiyagala
114	1977 Intercropping Trial grass	Eladuwa Estate, Paiyagala

REVIEW OF THE GENETICS AND PLANT BREEDING DEPARTMENT

by

D. M. Fernando

SUMMARY

RRIC 100 and RRIC 103 was approved for approximately 60% new plantings. There was also appreciable planting preference for RRIC 101. Fifteen clones were sent to the RRIM station at Trinidad for SALB test. A low incidence of dry trees and resistance to wind-damage was noted in RRIC 100. A 4 x 4 Diallel crossing programme was successfully concluded during the year. A number of new plantings were carried towards clone evaluation and stock/scion effect. Two new international clone trials were also planted during the year. Yields and growth in Matale and Bibile Districts showed that the newer clones could be profitably grown in the drier districts: the drought resistant characteristic of rubber was an added advantage.

DETAILED REVIEW

STAFF

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

Mr. B. M. S. G. Peiris was promoted to Senior Field Assistant during the year. Mr. P. Samaranayake, Senior Technical Assistant, and Messrs K. B. A. Karunasekera, K. W. Rupatunga and W. D. Gunadasa, Technical Assistants, were on duty throughout the year. Field Assistants Messrs. D. S. Gamage, A. K. M. S. Senaratne and W. A. C. Wijesinghe and Field Attendants: Messrs W. D. Armon and D. S. Deduwakumara were also on duty throughout the year.

PUBLICATIONS

D. M. Fernando, Review of the Genetics and Plant Breeding Department for 1977.

D. M. Fernando, Perspectives in Agricultural Research in Sri Lanka. *vis-a vis Hevea*. SLAAS Sessions Dec. 1978.

Pooni, G. S., Jinks, J. L. and Jayasekera, N. E. M. An investigation of gene action and genotype x environment interaction in two crosses of *Nicotina rustica* by triple test cross and inbred line analysis. *Heredity* (1978) 41 (1) 83 - 92.

VISITS

The Technical and field staff of the Department paid visits to experimental areas. D. M. Fernando and N. E. M. Jayasekera participated in Seminars organized at Kegalle for the JEDB, at Galle for the SLSPC and at Avissawella for the JEDB.

RESEARCH STUDENTS

Miss M. Goonetilleke a final year student in the Faculty of Agriculture completed a research project entitled 'Selection in *Hevea* seedling populations.

GENERAL

A resurgence of interest was noted in recently registered RRIC clones. RRIC 103 was the most popular of these clones and its use was only limited by lack of budwood. Co-operation from outside estates in offering suitable experimental areas resulted in the use of almost all budwood of promising material.

CLONE EVALUATION

Dry trees - The incidence of dry trees was highest in RRIC 101 but certain estates recorded a negligible number of dry trees even in this clone. Over a large number of trees examined the percentage dry trees recorded for the early RRIC 100 series is shown in Table 1.

Table 1. *Brown bast incidence,*

Clone		No. of trees tapped	No. of dry trees	% dry trees
RRIC 100		487	4	.8
RRIC 101		627	91	44.5
RRIC 102		497	28	5.6
RRIC 103		1238	53	4.2
Controls	RRIC 45	726	35	4.8
	RRIM 623	303	21	6.9
	PB 86	27	3	11.1

Wind damage - The 1978 cyclone provided an index of resistance with reference to some clones in the 1967 planting at Bibile (Table 2):

Table 2. *Wind damage*

Clone	Trees tapped	No. of trees damaged by wind	Percentage damaged
RRIC 101	389	3	.7
IAN 710	386	3	.7
RRIC 100	428	5	1.1
RRIC 45	441	3	2.9
RRIC 112	375	15	4
RRIC 103	270	12	4.4

The adverse effect of the large crown of RRIC 103 was evident under these conditions. (*D. M. Fernando and B. M. S. G. Peiris*).

Early opening of tapping cuts - With increased rubber prices there was a distinct preference for vigorous clones such as RRIC 103. Extensive extents of RRIC 100 and RRIC 101 were also planted during the year. Higher rubber prices ensured the fertilizer inputs necessary for appreciable early yields.

Yields- RRIC 100, 101 and 103 on commercial estates out-yielded all the other clones except RRIM 600. In one estate a 1971 clearing of PB 28/59 gave a higher intake of dry rubber per task than a 1972 replant of RRIC 100. Both clones averaged above 6 kg of dry rubber per task of 275 trees. In drier areas such as Moneragala and Bibile, RRIC 103 and RRIC 104 showed satisfactory growth and yields. The very large variation inherent in yield assessment owing to differing tapping abilities, and differing sensitivities to deep tapping, calls for a very wide range of areas for reasonably accurate comparative assessment. Such plantings in different agroclimatic zones have been carried out for RRIC 100 to RRIC 110 series. For the series RRIC 111 to 131, SLSPC and JEDB estates have responded very favourably regarding the inclusion of experimental areas. (*D. M. Fernando and N. E. M. Jayasekera*).

New Plantings

It is proposed to test promising clones of RRIC 100 series in one trial. For this purpose 20 acres from each of the following estates have been selected.

Estate	*Planting district*
Peenkande State Plantation	Ratnapura
Elston Estate	Kelani Valley
Eladuwa Estate	Kalutara
Hatbawa Estate	Kegalle
Walahanduwa Estate	Galle

Budgrafting for this experiment has already been started and the following clones will be tested in all 5 sites.
Test Clones: RRIC 100, 101, 102, 103, 104, 105, 107, 110 and 118
Controls : PB 86, RRIM 600
(*N. E. M. Jayasekera in collaboration with U. P. de S. Waidyanatha, assisted by P. Samaranayake and K. B. Karunasekera*)

Genotype x environment interaction

White Root disease was observed in certain experimental sites. Incidence of the disease is fairly high at Bentota Group, when compared with other sites. The affected plants at Bentota Group were successfully treated on the advice of the Head, Plant Pathology Department.

A girth measurement was recorded at the end of 1978. Means of girth measurements are given in Table 3.

Table 3. *Girth measurement (cm) 1978*

	Morali-oya	Bentota	Hunu-wella	Golinda	Bentota	Monro-via	Bibile	Clone Mean
PB 86	20.34	22.52	23.60	20.23	25.24	22.62	17.96	21.78
RRIC 100	21.07	23.34	22.04	18.80	27.34	22.16	19.39	22.02
RRIC 101	25.63	22.91	26.85	22.53	28.76	24.34	22.41	24.78
RRIC 103	23.19	25.89	28.64	22.06	31.06	24.68	22.29	25.40
RRIC 52	23.31	24.06	27.22	19.93	33.81	26.28	23.26	25.41
RRIM 600	22.88	22.04	23.88	20.10	26.91	21.12	18.86	22.26
RRIC 36	18.92	19.59	20.58	17.53	26.79	22.04	19.11	20.65
RRIM 623	24.42	24.92	24.02	18.08	27.01	23.8	18.90	23.02
RRIC 102	25.61	22.65	27.86	17.24	27.23	20.63	18.45	22.81
IAN 45/71	21.57	22.76	23.41	20.52	24.04	21.10	20.85	22.04
SITE MEAN	22.69	23.07	24.81	19.70	27.82	22.88	20.14	

Clone means indicate that RRIC 101, RRIC 103 and RRIC 52, on the average, performed better than the other clones. RRIC 36 had the lowest average girth. (*N. E. M. Jayasekera, P. Samaranayake and K. B. Karunasekera*).

Rootstock trial (1976)

Rootstock seedlings of RRIC 52, RRIC 100, 104 and RRIC 111 have been budded with RRIC 52, RRIC 100, 104 and RRIC 111, in all possible combinations. Budded plants have been planted in two sites, Gasnawa Estate and Ratmehera Estate.

The time of shooting of budded stumps has been recorded. In addition to this, one height measurement was recorded six months after planting. (*N. E. M. Jayasekera, P. Samaranayake and K. B. Karunasekera*).

Diallel crossing programme

During the 1978 flowering season, clones RRIC 100, 101, 102 and 103 have been artificially crossed, in all possible combinations, to obtain a 4 x 4 diallel progeny. The families, number of pollinations carried out, number of pods of first examination and seedlings desired are given in Table 4. (*N. E. M. Jayasekera, P. Samaranayake* and *A. K. M. S. Senaratne*).

Table 4. *1978 Diallel Crossing Programme*

Family	No. of pollinations	Number of seedlings	Number of pods at 1st examination
100x100	3720	21	19
100x101	2831	70	75
100x102	3219	17	86
100x103	2688	40	49
101x100	2037	111	50
101x101	2002	50	26
101x102	2740	110	50
101x103	2019	69	32
102x100	1919	47	35
102x101	1386	49	28
102x102	1821	19	10
102x103	1653	24	16
103x100	2608	55	56
103x101	2713	113	63
103x102	4216	67	55
103x103	3439	24	15
Total	41011	886	665

Selection of hand pollinated seedlings

Seedling progenies derived from 1974 and 1975 hand pollination programmes have been screened for early vigour and yield potential. Micro-tapping and estimates of latex content in petioles have been used as two indices of yield potential. Rate of increase in girth was used as an index of early vigour.

Promising genotypes which had both vigour and yield potential (at least one of the indices of yield potential) better than their progeny means were selected. For this purpose scatter diagrams obtained by plotting yield indices separately against vigour index were used.

Number of seedlings selected from each hand pollination progeny is given below:

Year	Total No. of seedlings	No. of seedlings selected	No. selected as % of total
1974	224	77	34
1975	295	78	26

A multiplication nursery has already been established using selections from 1975 progeny and arrangements have been made to multiply 1974 selections. When budwood is available in sufficient quantities from these selections small scale, trials will be established for evaluation purposes. (*N. E. M. Jayasekera, K. W. Rupatunga and T. S. Gamage*).

Optimum plot size

An experiment has been planned to test-tap RRIC 100, 101, 102 and 103 to determine the optimum plot size for *Hevea* experiments under Sri Lanka conditions. This will be done at Hedigalla State Plantation where large scale plantings of all these 4 clones are available in extents at least for one tapping task.

As a preliminary step, experimental trees have been numbered and the following data have been collected from each tree to be test tapped:

Girth
Length of tapping cut
Height at lower tapping cut
Bark thickness

Trees will be test tapped and individual yields will be recorded during 1979.

This experiment was initiated as a result of the research discussions held in 1978. (*N. E. M. Jayasekera, K. B. Karunasekera and W. D. Armon*).

Routine Hand Pollination Programme 1978, Matale

This programme was directed towards SALB resistance and was conducted at Matale. RRIC 119 was crossed to IAN 710 and 97 seedlings obtained. RRIC 119 was also crossed to RRIC 116 and 25 seedlings obtained. These seedlings will be further screened for yield and disease resistance. (*D. M. Fernando and D. S. Gamage*)

Mutation breeding: Pollen was again irradiated and a few pollinations made (*P. Samaranayake and N. E. M. Jayasekera*).

South American Leaf Blight: One yard each of 15 clones, including RRIC 120, RRIC 121, RRIC 123, RRIC 130, RRIC 131 and other selections from the 1971, 1972, 1974 and 1976 programmes were sent to the RRIM Station at Trinidad for SALB resistance testing. Three clones failed completely and only one success was obtained from each of the other clones on budgrafting. The despatch of budded stumps as adopted in 1969 appears to be a better proposition. (*D. M. Fernando and P. Samaranayake*).

Budwood Multiplication: RRIC 111 to RRIC 131 were multiplied at Kuruwita for release of nucleus budwood and for experimental purposes. (*D. M. Fernando, and B. M. S. G. Peiris*).

CLONE TRIALS

Matale District

Experiment No. 10 1965-Kaikawela - The yields of RRIC 119 and 6004, which showed appreciable resistance to South American Leaf Blight at Trinidad, were below economic levels when tapped at Matale. RRIC 116, which had less resistance to SALB at Trinidad, than RRIC 119, showed an average yield of 24 g per tapping in three plots totalling fifty nine trees. RRIC 103 and RRIC 118 averaged 30.4 and 31.1 g per tapping, respectively, during the year. (*D. M. Fernando, and D. S. Gamage*).

Experiment No. 25, 1968-Wariyapola - RRIC 101 showed the best yields with 45 g/t/t followed by RRIC 102, RRIC 100 and RRIC 103 with 28.9, 24.6 and 18.1 g/t/t respectively. IAN 710 showed the best growth followed by RRIC 103. (*D. M. Fernando, and B. M. S. G. Peiris*).

Moneragala and Bibile Districts

Field Experiment No. 9, 1956 65 *- Kumarawatte* - RRIC 103, RRIC 104, IAN 710 and the control clones RRIC 45 showed the best yields, from 24 to 28 g per tree per tapping, on S/2, d/2, 100% intensity. With 75% of the trees in tapping this would approximate over 1000 kg/ha per year. The yields of RRIC 101, 112 and RRIM 623 were appreciably lower in this area. (*D. M. Fernando, and D. S. Gamage*).

Field Experiment No. 13, 1966 - Kumarawatte - Large scale plots of RRIC 103 totalling 518 trees averaged 25.9 g per tapping in contrast to RRIM 623 - 19.9 g/t/t/. The girth of RRIC 103 was 67 cm (26 in) as against 58 cm (22 in) for RRIM 623. (*D. M. Fernando and D. S. Gamage*).

Experiment No. 20, 1967-Bibile: A change from 100% intensity to 67% intensity in 1977 nearly doubled the intake in RRIC 101, RRIC 103 and RRIC 100 which averaged 45.9, 39.4 and 39.3, g per tapping during 1978. The number of dry trees was highest in RRIC 101 and negligible in the other clones. Cyclonic winds damaged RRIC 112 and RRIC 45 more than the other clones. (*D. M. Fernando* and *B. M. S. G. Peiris*).

Kalutara District

Field Experiment No. 8, 1965 - Dartonfield : In this small scale clone trial, with 3 replicates of 5 trees each, RRIC 121 showed a combination of the best yields (55.8g/t/t) and girth (80.8 cm). The SALB resistant clone RRIC 117 and RRIC 120, RRIC 102, RRIC 114, followed with averages 50.8, 48.3, 43.1 and 39.1 g per tree per tapping, respectively. Both S. L. S. P. C. and J. E. D. B. estates were issued nucleus budwood of RRIC 117. (*D. M. Fernando and D. S. Gamage*).

Field Experiment No. 12 - 1966 Nivitigalakele: The tapping intensity was changed to S/2, d/2, 100% in 1978. RRIC 103 and control clone RRIC 45 showed average yields of dry rubber of 73.1 and 39.3 g per tapping and girths of 71 cm (27 in) and 62.1 cm (24 in), respectively. (*D. M. Fernando, K. W. Rupatunga, and S. Sumanadasa*).

Experiment No. 50, 1974 Grafted Selection - Nivitigalakele: In this experiment selections from hand pollinated progeny were budgrafted and the grafts were cut back in the nursery and allowed to shoot. The plants were then micro-tapped again and plots of the higher yielding budgrafts planted as stumped buddings in the field along with plots of the lower yielding selections of the same clones. Budded stumps of the vigorous clones RRIC 103 and RRIC 110 were used as additional controls. Plants in the selected plots showed better growth with an average girth of 46 cm as against 40 cm girth of the other budgrafts of the same clone. Some trees of the selected plots were of tappable girth. The results are of sufficient interest to repeat this experiment on a larger scale. (*D. M. Fernando and W. D. Gunadasa*).

Experiment No. 16, 1967 - Gikiyanakande: With improved rubber prices in 1978 there was a greater amount of 'recovery' tapping, resulting in near 200% intensities. Under these conditions RRIC 103, RRIC 102 and the control clone RRIM 623 showed 10%, 8% and 7% incidence of dry trees; yields continued to be high and averaged 2426,2234 and 1727 kg per hectare, respectively, for the 3 clones. (*D. M. Fernando, and S. S. Senaratne*).

Experiment No. 14, 1967 - Nivitigalakele : - RRIC 102 and RRIC 101 gave similar yields (37.0 and 36.8 g/t/t); 1.8% dry trees were recorded for RRIC 101 and 0.6% for RRIC 102. The tapping intensity in this clearing was increased from 67% to 100% in 1978. (*D. M. Fernando, W. D. Gunadasa and K. Sumanadasa*).

Experiment Nos. 19 and 23 - 1967 and 1968 clone trials - Hedigalla: In both these experiments RRIC 103 yielded more than RRIC 101 and was 10 cm more in average girth. (*D. M. Fernando and W. D. Armon*).

Experiment No. 23 - 1969 clone trial - Hedigalla: RRIC 103 again showed the best yield and girth followed by RRIC 101 and RRIC 100, when tapped on S/2, d/3, 67%. From August 1978 when intensity was increased to S/2, d/2, 100%, RRIC 101 showed higher yields followed by RRIC 103, RRIC 100 and RRIC 102. Results from the randomized single tree plot area corresponded closely with a duplicate experiment (No. 29) planted at Eladuwa. (*D. M. Fernando and W. D. Armon.*)

Experiment No. 26 - 1969 clone trial - Sirikandura: RRIC 102 yields (30,0/g/t/t) were best in this clearing subject to so much recovery tapping that it is difficult to assign intensity. RRIC 103, RRIC 101 and RRIC 45 showed yields of 26.0, 26.9 and 23.6 g/t/t, respectively. (*D. M. Fernando and K. Sumanadasa*).

1969 Experiment No. 29 - Eladuwa : In this fully randomized trial of 31 plots of each clone, RRIC 101 averaged the best yields (37.8 g/t/t) followed by RRIC 103 and RRIC 112 (35.8 and 35.6 g/t/t); RRIC 100 and the control clone RRIC 45 averaged 32.1 and 30.8 g/t/t. Observations from the 1967 planting at Bibile, point to susceptibility to wind damage in RRIC 112 almost equivalent to RRIC 45. (*D. M. Fernando and S. S. Senaratne*).

Commercial clearings - 1972 Planting - Eladuwa: Five acre plots monitored for yields found RRIC 101 leading with 44.7 g/t/t in the second year of tapping followed by RRIC 100, RRIM 623 and PB 86 with 32.9, 30.6 and 27.3 g/t/t, respectively. RRIC 100 and RRIM 623 showed the best growth. (*P. Samaranayake and D. Rodrigo*).

Experiment No. 51, 1978 clone trial - Neboda: A replicated clone trial of randomized replications of 60 plants each according to International Clone Trial Standards were planted in 1978 South West Monsoon. Clones planted were RRIC 100, RRIC 103, RRIC 105, RRIC 110, RRIM 600, RRIM 703, RRIM 722 and PR 306. (*D. M. Fernando and S. Senaratne*).

Sabaragamuwa District

Experiment No. 17 - 1967 Peenkande: RRIC 100 showed the best yields followed by RRIC 111 and RRIC 101. In the second year of tapping at 100% intensity, after 4 years of tapping on 67% intensity, the number of dry trees increased in all clones. The two control clones RRIM 623 and RRIC 45 had 13% and 6% dry trees; RRIC 111, RRIC 100 and RRIC 101 had 12.2%, 12.3 % and 10.4% dry trees, respectively. (*D. M. Fernando* and *W. D. Armon*).

Experiment No. 6 - 1963 Kuruwita: RRIC 109 again led on yields and girth in this area closely followed by RRIC 118. (*D. M. Fernando* and *W. A. C. Wijesinghe*).

Experiment No. 7 - 1964 Kuruwita: RRIC 102 showed nearly double the yields of PB 86. RRIC 110 showed the best girth and satisfactory yields.

Smallholding Assessment - Ratnapura 1970 planting: RRIC 103 with an average yield of 51.7 g/t/t and 71% of the trees in tapping yielded over 2000 kg/ha in the third year of tapping on S/2, d/2, 100% as against 1200 kg/ha from RRIC 100 (*D. M. Fernando and W. A. C. Wijesinghe*).

Experiment No 15 - 1967 Small scale clone trial - Kuruwita: RRIC 121 (PB 28/59x IAN 873) showed the best combination of yield, girth and percentage trees tapped. Clone 10570 (RRIC 45 x PB 28/59) came second; dry trees of this clone were tapped again but sensitivity in the first year was too high for commercial distribution. (*D. M. Fernando and W. A. C. Wijesinghe*).

Experiment No. 21 - 1968 Small scale clone trial - Kuruwita: RRIC 130 (IAN 710 x RRIC 52) yielded best in the third year of tapping followed by RRIC 102, RRIC 131, RRIC 121, RRIC 123, RRIC 110 and RRIC 104. Branches were cut from most clones for despatch abroad and for first multiplication; this tended to depress yields. RRIC 121 showed the best combination of growth and yields. (*D. M. Fernando and B. M. S. G. Peiris*).

Experiment No. 28 - 1969 Small scale clone trial, Kuruwita: RRIC 127 (Ch 26x1458) showed a relatively small increase of girth after tapping and a high incidence of dry trees. RRIC 128 (RRIC 102 x Ch 26) showed the best combination of girth and yields without any dry or wind damaged trees. (*D. M. Fernando and B. M. S. G. Peiris*).

Kelani Valley District

Experiment No. 22 - 1968 - Pannagula : RRIC 103 showed the best yields with 1161 kg/ha in this large scale replicated trial. (*D. M. Fernando* and *W. A. C. Wijesinghe*).

Experiment No. 52 - 1978 - Hanwella: Randomised plots of 60 trees each, conforming to International Clone Trial Standards for Rubber, were planted during the North East Monsoon in 1978 at Belmont Estate. The clones planted were RRIC 100, RRIC 103, RRIC 105, RRIC 110, RRIM 600, RRIM 703, RRIM 722 and PR 306. (*D. M. Fernando and W. A. C. Wijesinghe*).

INDEX TO FIELD EXPERIMENTS

Field Experiment No.	*Description*	*District/site*
6	1963 clone trial	Kuruwita
7	1964 clone trial	Kuruwita
8	1965 small scale clone trial	Dartonfield
9	1965 clone trial	Moneragala
10	,, ,, ,,	Matale
11	1966 ,, ,,	Kuruwita
12	,, ,, ,,	Nivitigalakele
13	,, ,, ,,	Moneragala
14	1967 ,, ,,	Nivitigalakele
15	1967 small scale clone trial	Kuruwita
16	,, clone trial	Gikiyanakande
17	,, ,, ,,	Peenkande
19	,, ,, ,,	Hedigalla
20	,, ,, ,,	Bibile
21	1968 small scale clone trial	Kuruwita
22	,, clone trial	Pannagula
23	,, ,, ,,	Hedigalla
24	,, ,, ,,	Bibile
25	,, ,, ,,	Wariapola
26	1969 clone trial	Sirikandura
28	,, small scale clone trial	Kuruwita
29	,, clone trial	Eladuwa
30	,, ,, ,,	Hedigalla
34	Stock/scion experiment	Nivitigalakele
35	1972 seedling trial	,,
39 to 48	Genotype/Environment Experiments	9 sites
49	1976 diallel stock/scion	Nivitigalakele
50	1974 selection trial	,,
51	1978 S. W. clone trial	Neboda
52	1978 NE clone trial	Hanwella
53	1978 S. W. root stock trial	Ratmehera
54	1978 S. W. root stock trial	Gasnawa
55	Optimum plot size assessment	Hedigalla

REVIEW OF THE PLANT PATHOLOGY DEPARTMENT

By

A. de S. Liyanage

SUMMARY

Incidence of *Oidium* and *Gloeosporium* leaf diseases was mild except in isolated instances where susceptible clones succumbed to heavy attacks. Although *Phytophthora* leaf fall occurred in isolated pockets, the incidence of Bark Rot was negligible. White Root disease continues to be the most virulent disease on Sri Lanka rubber, especially in mature clearings where large areas are left bare due to infection. Immature plants were shown to be affected by the Black Root disease. A new root disease caused by *Fusarium solani* f. sp. *heveae* was recorded for the first time in Sri Lanka.

RRIC 7 appears to be the most susceptible clone to secondary leaf fall caused by *Oidium heveae*. RRIC 52 was resistant. Two peaks of secondary leaf fall and spore distribution were also observed. Under field conditions, artificially inoculated rubber leaves took 5-11 days to sporulate. Retention of water as minute droplets for 5 h did not affect spore germination of *O. heveae*. In a preliminary trial Bayleton was as effective as sulphur in controlling *Oidium* under field conditions.

Thirty new cultures of *Phytophthora* spp., were isolated from several locations for studies on nomenclature. Virgin panels were more susceptible to Bark Rot infection than renewed panels. It took nearly two years for a circular wound of 9 cm to completely callus. Bark of clone PB 86 calluses faster than other clones. RRIC 7 is the slowest to callus. Shell TB 192 appears to be superior to other products in enhancing the rate of callusing. Kankerdood and Barkosan were also effective. Santar was inferior. Some of the local and introduced clones showed a high degree of resistance to Bark Rot. There were significant differences in the susceptibiiity of different clones to Bark Rot when grown at several locations. Moisture content in the bark and height of tapping have no effect on the spread of Bark Rot. A concentration of 10 zoospores/ml was sufficient to cause Bark Rot infection in panels of mature trees in the field. Panels tapped on S/2, d/2 and S/2, d/3, were susceptible to infection, while those tapped on S/2, d/4 were not affected. There was a reduction in the size of the lesion when tapped with the Jebong knife than the Michie Golledge knife.

The leachate of clone RRIC 100 significantly depressed germination of conidia of *Colletotrichum gloeosporioides*, 3 h after inoculation. However, they germinated equally well in leachates of all clones at 9 h. Maximum and minimum colony growth was recorded in leachates of clone PB 86 and RRIC 100, respectively. The growth of the fungus in the leachates of clone RRIC 52 and 103 was less than that of PB 86 but more than in RRIC 100. The appressoria were formed 9 h after inoculation in leachates of all clones, except PB 86. However, by 24 h quite a high percentage of conidia formed appressoria. Sucrose favoured more fungal growth than glucose, fructose and maltose. Leaves of clone PB 86 supported maximum growth of the fungus while the least growth was recorded in clone RRIC 52. However, the progenies of these two clones; RRIC 100 and 103, showed an intermediate type of growth. The appressoria were first observed on leaves about 6 h after inoculation. They were dark brown and relatively large compared to the conidium. Appressoria were commonly found along the junctions of epidermal cells. The

infection hyphae penetrate directly into the measophyll tissue through the epidermis, 48 h after inoculation. Well developed acervuli were formed by rupturing the upper and lower epidermal cells at 72 h after inoculation. At this stage some disorganisation of mesophyll cells was also evident.

Sporocarps of *Rigidoporus lignosus* produced viable spores from a very early stage of their development and continued to produce viable spores in abundance at maturity. A bimodel spore release pattern was evident with maximum spore release being in the early hours of the morning. Free water was essential for basidiospore germination, while exposure to ultra violet rays was lethal. Maximum germination occurred at room temperature, the viability being adversely affected by low and high temperature. The germinability varied greatly with the source from which they originated. Successful spore inoculation was possible only under laboratory conditions, but basidiospores failed to cause infection in the field under natural conditions. Isolates of *R. lignosus* obtained from a single locality differed in their pathogenicity. Most isolates grew well in Agalawatta and Matale soils. The total number of distinct rhizomorphs was high in Matale soils but the spread was slow. Increased acidity of the soil treated with sulphur appears to be one of the ways of limiting the spread of *R. lignosus*, H_2S gas inhibited mycelial growth of the fungus in closed containers under laboratory conditions. Four species of fungi which cause rapid decay of rubber wood under laboratory conditions were isolated. *R. lignosus* could not replace saprophytic fungi in root pieces. LCB 1320, IRCI 9, RRIC 101 and 45 were more resistant to *R. lignosus* than most other root stocks tested.

Fusarium wilt of rubber, a new root disease caused by *Fusarium solani* f. sp. *heveae* was reported from an estate in Akuressa. It was observed that the fungus has gained entry into the host through the wounds caused by pruning of roots. The casual fungus grew well at room temperature and at a pH of 6. Derosal and Bavistin were very effective in arresting the growth of the fungus under laboratory conditions. Benlate was also effective up to 5 ppm but at a concentration of 1 ppm and below it was ineffective.

Contamination of rubber sheets with various species of fungi significantly affected the Plasticity Retention Index, Plasticity, Volatile Matter and Dirt Content. Nitrogen and Ash Contents were unaffected.

DETAILED REVIEW

STAFF

Dr. A. de S. Liyanage, Head of the Department, was on duty throughout the year. Mr. G. W. Liyanage, Plant Pathologist resigned his post on the 31st March 1978, to join the Agricultural Development Authority.

Dr. O. S. Peries, Director, worked in the Department, with the assistance of the Departmental staff, on Phytophthoras and soil fungi.

The Experimental Officer, Mrs. N. I. S. Liyanage, Senior Technical Assistants Mr. Z. E. Irugalbandara and Mr. D. M. Dantanarayana, who was promoted as Senior Technical Assistant on 1st January 1978, Technical Assistants Messrs. W. Amaratunga, S. Wettasinghe, A. Dharmaratna, B. Fernando, S. S. Warnapura and Miss J. L. P. Chandrika, who assumed duties on 1st February 1978, were on duty throughout the year. Messrs N. Fernando and N. W. Dissanayaka left the Institute on the 12th June and 6th August 1978 to join the Coconut Cultivation Board and Faculty of Medicine, University of Sri Lanka, respectively.

Mr. P. K. Samaradeeva joined the Institute on the 1st November 1978, to undertake a research project leading to a M.Sc. degree on "Mechanisms of Resistance to *Gloeosporium* Leaf disease of rubber." He is financed by the National Science Council.

Mr. Pongthep Kajornchaiyakul, Plant Pathologist from the Rubber Research Centre, Thailand, spent four weeks in the Plant Pathology Department studying the diseases caused by *Phytophthora* spp.

VISITS

The following visits were paid by the Departmental staff during the period under review.

Experimental	-	337
Advisory	-	39
Miscellaneous	-	36
Total		412

MEETINGS

A. de S. Liyanage attended the following meeting:-

Agricultural Committee Meeting — 1

SEMINARS

A. de S. Liyanage participated in the following Seminars:-

Organised by Section B of the Sri Lanka Association for the Advancement of Science - 'The control of White Root Disease'.

In-Service Training Course for Agricultural Instructors organised by the Department of Agriculture - 'Diseases affecting the rubber tree'.

For Janatha Estate Development Board Estates Superintendents of Kegalle and Kelani Valley Districts - "White Root disease control".

O. S. Peries participated in the following Seminars :

Training for Estate Managers organised by the Post Graduate School of Agriculture for Searca - "Personnel Management".

Transfer of Technology organised by the Sri Lanka Association for the Advancement of Science - "Transfer of technology in the raw rubber industry".

LECTURES

A. de S. Liyanage conducted a 30 h and 10 h course of lectures on Epidemiology to M.Sc. (Agriculture) students at the Post Graduate Institute, Peradeniya Campus and M.Sc. (Plant Pathology) students at the Department of Botany, Colombo Campus, respectively.

COMMITTEES

A. de S. Liyanage has been appointed to the following:-

The Academic Syndicate of Agricultural Biology at the Post Graduate Institute, Peradeniya Campus, University of Sri Lanka.

Supervision of post-graduate students handling pathological aspects in the multidisciplinary investigation on perennial cropping systems conducted by the Department of Minor Export Crops.

RESEARCH STUDENTS

The following research students were supervised by A. de S. Liyanage and worked in the Plant Pathology Department, on the subjects given below:

Mr. G. Munasingha, Advanced course in Plant Pathology, Final year B.Sc. (Agriculture). "Biology of *Fusarium solani* f. sp. *heveae*, the casual organism of the wilt disease of rubber (*Hevea brasiliensis*)."

Mr. W. D. L. Gunaratna, Advanced course in Plant Pathology, Final year B.Sc. (Agriculture) - "Host parasite relationships and the control of *Fusarium solani* f. sp. *heveae* in rubber (*Hevea brasiliensis*)".

Mrs. K. de Alwis (M.Sc., Plant Pathology) "Studies on host-parasite relationships of *Colletotrichum gloeosporioides* on Rubber (*Hevea brasiliensis*)".

Mrs. R. Jayasingha (M.Sc., Plant Pathology) - "Observations on Endogonaceae in rubber soils of Sri Lanka"(supervised jointly by Dr. U. P. de S. Waidyanatha, Botanist & Dr. A. de S. Liyanage).

PUBLICATIONS

The following papers were prepared for publication by the staff of the Department, during 1978.

Annual Review of the Plant Pathology Department for 1978.

A. de S. Liyanage and D. M. Fernando

Nursery methods for screening leaf and panel disease resistance in *Hevea*. (Paper presented for the IRRDB Symposium, Kuala Lumpur, Malaysia, 15-18 May, 1978).

A. de S. Liyanage, O. S. Peries, D. M. Dantanarayana and A. Dharmaratna

Environmental factors that influence the establishment and sporulation of *Phytophthora* spp., on rubber pods. (Paper presented at the Third International Congress of Plant Pathology, München, West Germany, 16-23 August 1978).

A. de S. Liyanage, W. D. L. Gunaratne, G. Munasingha and J. M. R. S. Bandara

Studies on a new disease of rubber (*Hevea brasiliensis*) caused by *Fusarium solani* f. sp. *heveae*. (Paper presented at the 34th Annual Session of the SLAAS).

O. S. Peries and N. I. S. Liyanage

Observations on spore production, release, biology and colonization of *Hevea* by basidiospores of *Rigidoporus lignosus*, the casual organism of White Root disease. (Paper presented at the 34th Annual Session of the SLAAS).

O. S. Peries

Studies on the relationship between weather and incidence of leaf diseases of *Hevea* - *Planter*, Malaysia.

O. S. Peries

The etiology of 'Bark Cracking' disease of *Hevea brasiliensis*. *Plant Disease Reporter*, *61*, 946 - 948.

GENERAL

Secondary leaf fall caused by *Oidium heveae* was negligible throughout the rubber growing districts, except in areas planted with susceptible clones. The weather conditions at the time of refoliation were dry and did not favour the establishment and propagation of the causal organism.

Phytophthora leaf fall was seen in a number of estates in the wet low country districts, during the South West monsoon period, but such areas were confined to isolated pockets. Extensive defoliation did not occur in any of the estates to warrant control measures. However, the incidence of Bark Rot was negligible.

Gloeosporium leaf disease caused by *Colletotrichum gloeosporioides* (*G. alborubrum*) remained a problem in some estates especially in the immature clearings. The flushes of leaves produced soon after planting, during the South West monsoon period, succumbed to this disease and occasionally shoot die back occurred killing the budded stumps.

White Root disease caused by *Rigidoporus lignosus* appears to be the most serious disease, particularly in the wet rubber growing areas. The damage was extensive in mature clearings.

Xylaria sp., which causes the Black Root disease is still a problem in the Kegalle District. It was mainly confined to mature clearings but immature clearings were also affected by this disease.

A new root disease caused by *Fusarium solani* f. sp. *heveae* was detected in an estate in Akuressa. It was clearly established that the fungus has gained entry into the host through wounds caused by root pruning.

LABORATORY INVESTIGATIONS

Diseased specimens

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

Identity of the disease	*Number of specimens*
(a) Fungi	
Colletotrichum gloeosporioides	2
(b) Other causes	
Cockchafer grub damage	1
Wind damage	1
Peeling of bark	1

Oidium heveae

Free water on germination - The effect of free water on spore germination of *O. heveae* on rubber leaves and glass slides was studied. Assessments were taken 24 h after inoculation.

Retention of fine droplets of water on leaves of rubber for periods up to 5 h after inoculation do not appear to inhibit spore germination of *O. heveae*. A high germination percentage was recorded even without water, but in the presence of water the conidial germination was relatively higher. However, on glass slides, conidial germination was poor in the presence of water. (*A. de S. Liyanage and N. W. Dissanayake*).

Phytophthora spp.

Nomenclature - The nomenclature of *Phytophthora* spp., was studied using the rubber isolates No. 86, 126, 361, 379 and *P. palmivora* isolates No. 404 and 405. The slide cultures were examined a fortnight after inoculation, to study the different morphological features. The technique employed to study the caducity of sporangia and their pedicel length did not yield satisfactory results. A culture of *P. palmivora* obtained from the C. M. I. failed to sporulate.

Thirty new cultures of *Phytophthora* spp., were isolated from rubber pods, petioles and twigs collected from a number of estates in the Galle, Kalutara, Kelani-Valley and Ratnapura Districts. Thirty two cultures contaminated with bacteria were purified using a medium containing some antibiotics. (*O. S. Peries and D. M. Dantanarayana*).

Collection of rubber pod diffusates - Pod diffusates were collected from clones RRIC 52, 100 and PB 86; 1, 24 and 48 h after incoculation, for further studies on isolation and characterisation of compounds reported earlier. (*A. de S. Liyanage, O. S. Peiris, N. I. S. Liyanage in collaboration with P. A. J. Yapa*).

Colletotrichum gloeosporioides

Germination of conidia - Conidia of *C. gloeosporioides* showed 100% germination in 3 h after inoculation (Table 1). In 24 h there was profuse branching with the production of clusters of secondary conidia borne on simple conidiophores. Appressoria were not observed even after a 24 h incubation period. (*A. de S. Liyanage and L. R. S. de Alwis*).

Table 1. *Germination and germ tube length* of conidia of *C. Gloeosporioides on agar coated slides at* different periods.

Incubation period (h)	Germination (%)	Germ tube length (μm)
3	100	35.0
6	100	110.7
9	100	130.0
24	100	NM

NM - Not measured

Effect of leachates of different clones on germination–The leachate of clone RRIC 100 significantly depressed the germination of conidia at 3 h, when compared to other clones, and maximum germination occurred in the leachate of clone PB 86. A similar pattern of germination was observed in the leachate of clone RRIC 100 even after 6h of incubation. However, after 9 h of incubation conidia germinated equally well in leachates of all the clones. (*A. de S. Liyanage* and *L. R. S. de Alwis*).

Table 2. *Germination of conidia C. Gloeosporioides in leachotes of different clones incubated for varying periods*

Leachate of clone	Incubation period (h)			
	3	6	9	24
RRIC 52	23.3	99.8	100.0	100.0
RRIC 100	7.0	87.0	100.0	100.0
RRIC 103	21.3	99.3	100.0	100.0
PB 86	33.3	100.0	100.0	100.0
LSD(P=0.05)	2.8	2.4	—	—

Effect of leachates of different clones on germ tube growth Conidia germinated well in the leachate of clone PB 86 from 3 h to 24 h after inoculation, after which colony growth could not be measured due to the extensive ramification of the mycelium (Table 3). The increase in germ tube length was gradual in the leachate of clone PB 86 up to 9 h after inoculation, but thereafter a sharp increase in the colony growth was observed. On the other hand, the conidia in leachates of clones RRIC 52 and 103 showed a rapid increase in length between 6 to 9 h and at later stages the increase in growth was comparatively small. At 24 h, maximum colony growth was observed in the leachate of clone PB 86. There was a significant reduction in the length of germ tubes in the leachate of clone RRIC 100 at all stages of growth. (*A. de S. Liyanage and L. R. S. de Alwis*).

Table 3. *Effect of leachates of different clones on the growth (μm) of conidia of C. Gloeosporioides incubated for varying periods*

Leachate of clone	Incubation period (h)			
	3	6	9	24
RRIC 52	2.5	21.1	104.7	121.0
RRIC 100	1.9	17.3	26.3	81.2
RRIC 103	2.7	17.5	105.8	122.7
PB 86	4.9	36.6	57.8	158.5
LSD (P=0.05)	0.5	2.2	8.1	12.6

Studies on the effect of leachates of clones PB 86, RRIC 52, 100, 101, 102 and 104 on spore germination and germ tube growth were commenced. These studies are in progress. (*A. de S. Liyanage* and *P. K. Samaradeeva*).

Effect of different sugars on germ tube growth : Sucrose was significantly more effective in promoting growth of the fungus than glucose and fructose, at 6 and 18 h after inoculation. Conidia failed to germinate in maltose until 24 h after inoculation. It was not possible to measure the colony growth in solutions of sucrose, glucose and fructose at 24 h, due to extensive overlapping of the mycelium of the fungus. (*A. de S. Liyanage and L. R. S. de Alwis*).

Rigidoporus lignosus

Variability of isolates - Four isolates each were collected from two estates. Their pathogenicity was determined using fresh rubber root pieces. Analysis of data obtained14 days after inoculation showed significant differences within isolates (Table 4). This showed that within a locality there were *Rigidoporus* isolates which differed in their pathogenicity. (*G. W. Liyanage, A. de S. Liyanage and J. L. P. Chandrika*).

Table 4. Mean *linear growth (mm) of eight isolates obtained from two locations on healthy rubber roots, 14 days after inoculation*

Mean growth (mm) 14 days after inoculation							
Peenkande Estate				Woodend Estate			
Isolate				*Isolate*			
1	2	3	4	1	2	3	4
22.3	21.5	21.4	14.8	15.4	22.1	22.3	20.7

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

Variability of cultures of basidiospores - Twenty single basidiospore cultures were obtained from a single basidiocarp to study the variability. There was no marked difference in the growth of these isolates. Rhizomorph production was absent in these isolates. (*O. S. Peries and N. I. S. Liyanage*).

Basidiospore germination - Basidiospores of *R. lignosus* begin to germinate 8-10 h after their release. 50-60% germination was achieved 18 h after the release of spores. Spores deposited on slides with a film of fine water droplets germinated more rapidly than spores shed on free water. Also, spores shed on to dry slides did not germinate at all. At 35°C the germination of basidiospores was accelerated compared to room temperature and at 30°C. At 15° and 20°C spores do not germinate even after 48 h (Table 5). In 48 h extensive growth of germ tubes was seen on slides kept at room temperature, 30°and 35°C, very often with lateral branching.

Table 5. *Mean percentage germination of basidiospores of Rigidoporus lignosus at different temperatures*

Temperature (°C)	Germination (%)	Mean germ tube growth (μm)
15	0	0
20	0	0
25	26.6	37.2
R.T (28±2)	58.7	87.1
30	56.0	75.8
35	28.0	98.0

Only 6.2% of basidiospores germinated when they were exposed to the mid day sun for 1 h, but no germination was recorded when basidiospores were exposed for ultra violet rays for a similar period. However, best germination and good germ tube growth was observed in basidiospores kept in moist chambers at room temperature. (*O. S. Peries & N. I. S. Liyanage*).

MISCELLANEOUS

Mould contamination of sheet rubber - Several species of fungi were isolated from mouldy sheets obtained from a number of Commodity Purchase Stores located in different rubber growing areas and also from the Central Stores in Mattakkuliya. The temperature and relative humidity of some of the Stores were monitored using thermohygrographs. (*A. de S. Liyanage & B. Fernando*).

Effect of mould on quality of rubber - It was shown for the first time that contamination of rubber sheets with mould significantly affected the PRI, plasticity, dirt content and volatile matter. Nitrogen, and ash contents were not affected. These studies are being repeated to confirm the findings of the previous trial. (*A. de S. Liyanage in collaboration with P. A. J. Yapa, L. M. K. Tilakaratne & M. D. C. Seneviratne*).

Mycorrhizal studies - All four genera of the endomycorrhizas occur in rubber soils of Sri Lanka, *Glomus* spp. (16 types) being the most abundant. Other species that were recorded include *Gigaspora* (2 types) *Aculospora* (3 types) *Sclerocystis* (5 types). Soils in the dry zone showed high numbers of spores. *Pueraria* appears to be the most favoured host. Exotic inoculum proved to be more effective in causing infection than local materials. A detailed account is given in the Botany Department report. (*U. P. de S. Waidyanatha* and *R. Jayasinghe in collaboration* with *A. de S. Liyanage*).

Fusarium solani f. sp. heveae

Effect of temperature on the growth - It was observed that at 15°C the growth was very slight and the fungus did not grow at all at 40°C (Table 6). The maximum growth was observed at room temperature. Good mycelial growth was also recorded at 25° and 30°C.

Table 6. *Effect of temperature on the growth (mm) of Fusarium solani from rubber**

Days after inoculation	Temperature (°C)						
	15	20	25	28±2	30	35	40
1	4.2	5.7	8.5	9.6	10.3	6.9	4.0
2	4.6	10.4	16.3	19.1	18.4	9.0	4.0
3	5.5	15.1	25.2	27.2	25.5	10.2	4.0
4	6.8	20.1	32.3	34.8	32.3	10.9	4.0
5	8.0	26.6	41.8	40.3	41.2	14.2	4.0
6	9.3	32.3	49.8	53.8	49.5	16.0	4.0

* Size of the inoculum plugs was 4 mm

It was observed that at low temperatures macrospores were more abundant than microspores and at higher temperature microspores were exclusively produced. (*A. de S. Liyanage and G. Munasinghe*).

Effect of pH *on the growth* - The growth of the fungus was slightly better throughout at pH 6 (Table 7), and the least amount of growth was recorded at pH 4. (*A.de S. Liyanage and G. Munasingha*).

Table 7. *Effect of* pH *on the growth (mm) of Fusarium solani*

Days after inoculation	pH adjusted after autoclaving						
	4	5	6	7	8	9	10
1	7.9	9.2	9.8	9.8	9.3	9.3	9.2
2	16.7	17.6	18.8	18.4	17.9	17.4	17.6
3	25.1	27.5	27.8	27.6	26.1	26.3	25.4
4	33.4	36.7	36.9	36.0	35.5	35.0	34.2
5	41.7	45.5	45.7	45.5	43.8	43.6	41.8
6	50.1	53.7	54.4	53.2	51.9	51.8	49.9
7	57.7	62.1	62.9	61.4	59.6	59.2	57.4
8	66.9	70.2	69.9	69.4	67.7	67.5	64.2

Effect of light - At 25°C the fungus grew best when exposed to alternate light and dark regimes. When continuous lighting was supplied fungal growth was reduced. However, at 28°C continuous dark conditions favoured the growth of *Fusarium* while the least amount of growth was recorded when alternate light and dark conditions were provided. At 32°C, up to 4 days after inoculation, colony growth was better when continuous lighting was provided, but on the 6th day, alternate light and dark regimes showed the maximum growth while in continuous darkness the colony growth was reduced. (*A. de S. Liyanage and G. Munasingha*).

Table 8. *The effect of light on the growth (mm) of F. solani*

Days after inoculation	Continuous light			Continuous dark			Alternate light/dark		
	25°C	28°C	32°C	25°C	28°C	32°C	25°C	28°C	32°C
1	6.9	8.4	8.0	8.0	9.4	8.9	7.3	8.3	8.5
2	7.4	16.6	15.6	15.5	18.1	17.3	15.5	16.4	16.5
3	18.3	26.4	23.5	23.2	28.4	25.2	24.2	26.4	24.5
4	26.9	35.6	30.4	32.1	38.2	33.1	33.3	35.3	32.5
5	34.3	44.8	36.5	40.4	46.9	38.3	41.3	43.8	39.8
6	41.2	54.4	42.3	48.7	56.2	38.9	50.3	53.2	46.9
7	49.3	63.4	48.7	58.9	65.3	39.1	58.0	61.6	48.8
8	58.0	72.3	56.4	67.0	74.3	40.5	67.5	69.5	53.5

HOST-PARASITE RELATIONSHIPS

Oidium heveae

Histological basis of resistance - Disease free copper brown and apple green leaves of the clones RRIC 52, RRIC 103, PB 86, and IAN 710 were inoculated with 24 h old inoculum to examine pre and post-penetration behaviour of the pathogen at 2, 4, 6, 12, 24, 48, 72, 96 and 120 h after inoculation. Leaf discs were also removed to be fixed in formalin-acetic-alcohol. These studies are in progress. (*A. de S. Liyanage, A. Dharmaratna and B. Fernando*).

Phytophthora spp.

Histology of host penetration in petioles, stems and bark - These studies were restarted to confirm the observations already reported. (*O. S. Peries and N. I. S. Liyanage*).

Colletotrichum gloeosporioides

Susceptibility of different clones - Maximum germ tube growth occurred on leaves of clone PB 86, while the lowest was recorded in RRIC 52 (Table 9). However, at early stages of growth, these differences were not clearly distinguishable. There was a rapid increase in colony growth of all clones, up to 9 h, beyond which only a slight increase in growth was evident in all clones; except in the clone PB 86. There was no significant difference in colony growth of clones RRIC 100 and 103 at 24 h after inoculation.

Table 9. *Colony growth (μm) of C. Gloeosporioides in leaves of different clones incubated for different periods.*

Clone	Incubation Period (h)			
	3	6	9	24
RRIC 52	11.0	25.8	49.0	71.4
RRIC 100	12.0	36.5	59.9	90.4
RRIC 103	9.6	41.7	78.8	95.6
PB 86	10.1	30.9	57.8	117.3
LSD (P=0.05)	1.5	3.7	4.2	7.4

The appressoria were first observed on leaf discs only 6 h after inoculation. They were oval in shape with a hard granular covering. Appressoria were dark brown in colour and measured 7-10 x 4-6/μm. They were formed between anticlinal walls of adjoining epidermal cells. The maximum number of appressoris at 24 h after inoculation, was observed on clone RRIC 52 and the least number was seen in the clone RRIC 100. (*A. de S. Liyanage & L. R. S. de Alwis*).

Histology of host-penetration - Although appressoria were not readily seen on the leaf tissue sectioned 9 h after inoculation, by 12 h it was possible to easily recognise them in sections. The mature appressoria possessed thick olive-brown walls that underwent no further differentiation. These were found in between the anticlinal walls of adjoining epidermal cells. Each appressorium produced a thick and rigid infection hypha at the point where it comes into contact with the cuticle of the host tissue. A septum was formed in the thick walled appressorium, separating it from the infection hypha, which gained entry into the host tissue through the cuticle and epidermal cell wall. The infection hypha penetrated usually between the epidermal cells and this process occurred within 24 h after inoculation. Examination of sections, removed at 48 h after inoculation, showed the ramifying mycelium within the mesophyll tissue. In early stages, the branched hyphae were seen in the palisade cells and later extended to the spongy parenchyma as well. It was not possible to clearly determine whether the mycelium was inter or intracellular. Well developed acervuli were observed 72 h after inoculation. In some instances acervuli were produced by rupturing the lower epidermal layer, although the inoculations were done on the adaxial surface. The tissue beneath the acervuli had collapsed at this stage and was darkly stained. This made it difficult to observe the progress of infection in the host. (*A. de S. Liyanage & L. R. S. de Alwis*).

Clones PB 86, RRIC 52, 100, 101, 102 and 104 have been inoculated with a spore suspension of *C. gloeosporioides* to examine the pre-penetration behaviour of the pathogen on different clones. These studies are in progress. (*A. de S. Liyanage & P. K. Samaradeeva*).

EPIDEMIOLOGY

Phytophthora spp.

Susceptibility of pods of different maturity - Different sizes of pods were inoculated with *Phytophthora* spp., at 10^4 zoospores/ml. It was observed that pods of all sizes succumbed to the disease including the pods which were only 2.5 cm in circumference. The fungus was reisolated from the greyish lesions. However, when the infected pods were left for a week, secondary fungi invaded the smaller pods faster than the mature green pods. (*A. de S. Liyanage, O. S. Peries & N. I. S. Liyanage*).

Rigidoporus lignosus

Viability of sporocarps - Detached sporocarps continued to shed viable spores under humid conditions up to 4 days after removal. Sporocarps that were kept on the laboratory bench for one day produced viable spores on the following day. However, the number of basidiospores shed and the percentage germination were higher when such sporocarps were moistened. Sporocarps that were allowed to dry on the laboratory bench for one week did not release spores on the eighth day. (*O. S. Peries & N. I. S. Liyanage*).

Release of basidiospores in detached sporocarps of different sizes - It was observed that medium sized sporocarps are capable of releasing more spores that showed a high percentage germination (Table 10). There is a sharp decline in the number of spores released and the percentage germination when sporocarps increase in size. The young sporocarps also followed a similar pattern. The basidiospores released from medium sized sporocarps grew better than those shed from small or large sporocarps. (*O. S. Peries and N. I. S. Liyanage*).

Table 10. *Mean percentage germination of basidiospores of R. lignosus from sporocarps of different sizes*

Size of sporocarp (sq. cm)	Mean No. basidiospores released per ml ($\times 10^4$)	Germination (%)	Mean germ tube length (μm)
38.7 (6 sq. in)	13.8	13.2	53.6
103.2 (16 sq. in)	141.2	65.2	170.4
225.8 (35 sq. in)	4.0	28.8	101.6

Release of basidiospores from different areas of the sporocarps - The middle region of the sporocarp released the maximum number of spores when compared to the number released from the basal and pheripheral regions (Table 11). A high percentage of germination and longer germ tubes were noted from those released in the mid region. (*O. S. Peries and N. I. S. Liyanage*).

Table 11. *Mean percentage germination of basidiospores of R. lignosus from different areas of the sporocarp*

Position of sporocarp	Mean No. basidiospores released per ml ($\times 10^4$)	Germination (%)	Mean germ tube length (μm)
Growing edge	2.0	11.5	67.2
Middle region	34.5	72.7	187.2
Basal region	10.2	20.0	69.6

Spread of different isolates in soils - Isolates B, G, K. and L grew well in all soils at 50% moisture holding capacity. Generally all the isolates grew well in Agalawatta and Matale soils. The total number of distinct rhizomorphs was higher in Matale than in Agalawatta (Table 12). In Agalawatta soils rhizomorphs were longer than with the other soil types. Although the number of distinct rhizomorphs was high in Matale soils, the spread was slow, with most rhizomorphs being short and thick. The H isolate did not produce any rhizomorphs in all four types of soils. The B isolate obtained from Dartonfield produced the largest number of distinct rhizomorphs and also spread rapidly in all four types of soils. (*O. S. Peries and N. I. S. Liyanage*).

Table 12 *Mean total length (cm) and number of distinct rhizomorphs of different isolates of R. lignosus in different soils., 7 days after inoculation*

Soil series	Isolates																					
	length of distinct rhizomorphs											No. of distinct rhizomorphs										
	A	B	C	D	E	G	H	J	K	L	Total	A	B	C	D	E	G	H	J	K	L	Total
Agalawatta	52.3	100.3	62.4	7.7	11.6	47.4	0	49.3	60.0	36.6	427.6	17	31	20	4	5	18	0	18	17	12	142
Boralu	25.8	41.1	6.6	3.0	19.5	4.0	0	12.3	62.3	23.7	198.3	10	19	3	2	8	2	0	7	27	12	90
Matale	22.3	23.3	22.4	16.8	17.8	40.3	0	43.2	22.1	23.2	241.4	15	13	15	13	12	22	0	20	13	21	144
Ratnapura	25.7	41.0	19.4	9.1	28.0	53.7	0	19.1	19.2	56.7	271.9	11	18	9	4	13	20	0	8	9	26	118
Total	126.1	205.7	110.8	36.6	76.9	145.4	0	123.9	163.6	150.2		53	81	47	23	38	62	0	53	66	71	

Spore colonization (*a*) The exposed ends of 2 cm diameter root lengths buried in sterile sand maintained at 10% MHC were colonized by basidiospores of *R. lignosus*, a month after inoculation. Only 30% of the roots were infected. (*G. W. Liyanage and S. S. Warnapura*).

(b) Preliminary experiments were initiated in the laboratory using detached sporocarps to determine whether basidiospores are capable of causing infection. Different treatments singly and in combination were tried as shown in Table 13. These studies showed that basidiospores are capable of causing infection of rubber roots under laboratory conditions within two weeks. There was no evidence of basidiospores colonising the soil.

Table 13. *Effect of different treatments on colonization of rubber wood by basidiospores*

Treatment	Observations
Sulphur treated moist soil	No fungal growth
Sulphur treated dry soil	" " "
Untreated moist soil	" " "
Untreated dry soil	" " "
Autoclaved root pieces with bark	*R.lignosus*
Autoclaved root pieces without bark	" " "
Non-autoclaved root pieces with bark	" " "
Non-autoclaved root pieces without bark	No fungal growth
Sulphur treated moist soil + non-autoclaved root pieces with bark	*Trichoderma* spp.
Sulphur treated moist soil+non-autoclaved root pieces without bark	*Aspergillus* spp.
Untreated moist soil + non-autoclaved root pieces with bark	*R. lignosus*
Untreated moist soil+non-autoclaved root pieces without bark	*Trichoderma* spp.
Untreated dry soil+non-autoclaved root pieces with bark	No fungal growth
Untreated dry soil and non-autoclaved root pieces without bark	" " "
Sulphur treated dry soil + non-autoclaved root pieces with bark	" " "
Sulphur treated dry soil + non-autoclaved root pieces without bark	" " "
Fresh Pueraria leaves	No fungal growth
Dried Pueraria leaves	" " "
Fresh grass leaves	" " "
Dried grass leaves	" " "
2% malt agar	*R. lignosus*

In another experiment basidiospores were allowed to shed onto a freshly cut stump of *Hevea* by placing fresh detached sporocarps on the cut end. A thick mat of white mycelium was seen in two weeks, when this was incubated under moist conditions. (*O. S. Peries and N. I. S. Liyanage*).

Effect of drying on basidiospore viability - Basidiospores were shed onto large test tubes containing air dried sterile soil. Sterile distilled water was added to these tubes 1 day, 3 days, 1, 2, 3, 4, and 8 weeks after exposure to spores. After each period 15 tubes were taken out and moisture adjusted to 50% moisture holding capacity. Autoclaved rubber root pieces with and without bark were introduced to ten tubes and the rest were kept as controls to see whether the spores could colonize the soil.

Basidiospores left under dry conditions for 24 h were able to germinate and colonize autoclaved wood pieces, while those that were left for longer periods were unable to germinate and colonize root pieces or soil, on wetting. (*O. S. Peries and N. I. S. Liyanage*).

CONTROL

R. lignosus

Wood decaying fungi - Twenty four species of wood decaying fungi were collected and purified. It was observed that most of these isolates showed a rapid rate of growth in malt agar, reaching 9 cm in three days, while a few were slow growing. These isolates were grown in rubber root pieces and from these, four isolates were selected for further studies, as they caused rapid decay of the roots. The percentage decay on a dry weight basis ranged from 12.7 to 19.3 for these four isolates. One of these isolates that showed slow growth in malt agar was able to colonise root pieces causing rapid decay. Studies on antagonism between *Rigidoporus* and other fungi are also in progress with these isolates. (*O. S. Peries and N. I. S. Liyanage*).

Saprophytic colonization of rubber wood - Rubber roots in different stages of decay were collected from the field and placed in flasks containing actively growing cultures of *R. lignosus*. The observations taken two months later showed that *Rigidoporus* could not replace the saprophytic fungi in the root pieces. (*G. W. Liyanage*).

Effect of soil acidity - Soils were mixed with sulphur to give the equivalent of 4 oz per sq. meter per application. Amended soils were also mixed with different amounts of $CaCO_3$.

Sulphur lowered the acidity of the soil but when $CaCO_3$ was mixed, the acidity and the SO_4 ion concentration were not affected. The fungus grew well in all treatments except in sulphur treated soil where the pH was lowered, suggesting that acidity is one of the actors controlling the growth of *Rigidoporus* in the soil (Table 14).

Effect of Hydrogen sulphide - *R. lignosus* was exposed to H_2S gas to examine whether it could inhibit the growth of the fungus. Growth measurements taken 5 days after commencement of the experiment revealed that there was no growth in sulphur treated soil while a growth of 31 mm was recorded in the control. This showed that H_2S can inhibit the growth of the fungus. The inoculum plug removed from the plates exposed to H_2S was replated, the fungus did not grow indicating that the fungus was killed. These experiments were done in sealed containers and field experiments will have to be done before firm conclusions can be made.

Table 14. *Effect of soil acidity on the growth of R lignosus in soils amended with sulphur five days after inoculation*

Days after amendment	Sulphur			Sulphur + 0.5% $CaCO_3$			Sulphur + 2% $CaCO_3$			0.5% $CaCO_3$			0.5% $CaCO_3$			2% Control $CaCO_3$		
	pH	SO_4 (ppm)	Growth (mm)	pH	SO_4 (ppm)	Growth (mm)	pH	SO_4 (ppm)	Growth (mm)	pH	SO_4 (ppm)	Growth (mm)	pH	SO_4 (ppm)	Growth (mm)	pH	SO_4 (ppm)	Growth (mm)
—	6.7+	—	—	6.5+	—	—	6.5+	—	—	6.5+	—	—	6.7+	—	—	6.3+	—	—
20	3.8	—	—	7.3	—	—	7.7	—	—	7.3	—	—	7.8	—	—	6.5	—	—
30	3.8	1185	3.6	7.3	1193	41	7.7	1265	38.7	7.2	38	44.3	7.7	24	45	6.5	3	44.3
45	3.5	*	0	7.1	*	65.6	7.2	*	62.0	7.6	1	63.2	7.6	*	64.2	6.5	*	65.8

\+ pH before amendment
* analysis still being done

In another experiment soils were amended with sulphur to have the equivalent of 113g and 226g per sq. meter per application. The H_2S liberated was scored on a colour intensity code 0-3. It was observed (Table 15) that a colour change was only black - grey indicating that the amount of H_2S liberated was insufficient. This indicates that a minimum amount of H_2S is required to inhibit the growth of the fungus.

Table 15. *Effect of soil amendment with sulphur on H_2S liberation*

Intensity	Control	1 g/750 g soil (113 g)	2 g/750 g soil (226g)
0 (No change)	5	0	0
1 (Slight grey black)	0	1	1
2 (Black + grey)	0	4	3
3 (Deep black)	0	0	1
Total	5	5	5

The bottle assembly was used to examine the effect of H_2S on the viability of the fungus using wood chips (0.2 cm^2), infected with *Rigidoporus*.

These were removed at monthly intervals to examine their viability. It was observed that the wood chips in the control bottles were colonized probably by a species of *Penicillium* and in some bottles the fungus grew over the soil surface, but in the case of sulphur amended soil, the fungus did not grow over the soil and colonization by other fungi was not observed.

These experiments were all done in closed containers where H_2S gas was not allowed to escape. However, the situation under natural conditions is different and it would be interesting to examine the effect of H_2S on the growth and viability of the fungus. (*G. W. Liyanage & S. S. Warnapura*).

Effect of sulphur on the pH - Sulphur was mixed with soil to give the equivalent of 57,85,113,284g per sq. meter per application. Untreated soils served as the control. The moisture was adjusted to 50% moisture holding capacity. pH and SO_4 ion concentration were determined 10,20,30,45 and 60 days after the addition of sulphur (Table 16).

Table 16. *Effect of amendment of soil with sulphur on the pH and acidity different periods*

Days after amendment	113 g		85 g		57 g		28g		Control	
	pH	SO_4^{--} (ppm)	pH	SO_4^{--} (ppm)	pH	SO_4^{--} (ppm)	pH	SO_4^{--} (ppm)	pH	SO_4 (ppm)
	6.6+	180	6.5+	178	6.6+	160	6.6+	178	6.6+	190
10	4.3	1517	4.7	1426	4.7	1208	5.2	960	6.4	193
20	4.0	1747	4.1	1426	4.2	1436	5.0	1100	6.5	222
30	3.9	1479	3.9	806	4.3	666	5.0	376	6.5	45
45	—	—	—	—	—	—	—	—	—	—
60	3.3	*	3.5	*	4.0	*	4.8	*	6.2	*

\+ pH before amendment of soil

* SO_4^{--} analysis in progress

\- Not done.

The pH obtained with 85g was comparable to that of the 113g rate. However, the SO_4 ion concentration at the 85g rate was observed to decrease with time which could result in increasing the pH. (*G. W. Liyanage & S. S. Warnapura*).

Suitability of Pentachloronitrobenzene - The diffusability and contact action of Pentachloronitrobenzene (PCNB) in pure form was determined in the laboratory, using several concentrations. PCNB in pure form is insoluble in water at room temperature. At higher temperatures, 40°C, it dissolves but recrystalises on cooling. Hence other solvents were used. Concentrations of 40 and 50% inhibited the growth of *R. lignosus* completely. 30% was partially active. The radial growth at 3 days after treatment being 17.79 mm compared with the control 47.30 mm, on malt agar plates. Similar results were obtained with other solvents.

Diffusibility studies also showed that the higher concentrations, of 40% and 50%, the fungicide diffused rapidly through the agar, completely inhibiting the growth of the fungus, whereas at other concentrations the fungicide diffused relatively slowly through the medium thus enabling the fungus to grow for sometime.

The growth of the fungus on treated root pieces (with and without bark) was also tested. At 40% and 50% there was complete inhibition of growth of the fungus. Similar results were obtained when PCNB was incorporated in other solvents. (*A. de S. Liyanage, O. S. Peries* and *N. I. S. Liyanage in collaboration with M. Nadarajah*).

Fusarium Solani

Effect of fungicides on radial growth - To study the effect of fungicides on the radial growth of the fungus, appropriate amounts of the fungicides were added to Potato Dextrose Agar (PDA) to give a final concentration of 0.5, 1.5, 10, 50 and 100 ppm active ingredient of the fungicides. It was observed that the fungicides Derosal and Bavistin were very effective in arresting the radial growth of the fungus at all concentrations tested (Table 17). On the other hand, Benlate was also highly effective up to 5 ppm but at concentrations of 1 ppm and below, it was ineffective. Incorporation of Vondozeb, Vitavax and Plantvax did not have any effect on fungal growth. The growth in the presence of these fungicides was comparable to that of the control. (*A. de S. Liyanage & W. D. L. Gunaratne*).

Table 17. *Effect of Different Concentrations of Fungicides on the Growth (mm) of F Solani, 6 days after Inoculation*

Fungicides	Concentration ppm (a.i.)					
	0.5	1	5	10	50	100
Bavistin	29.8	23.5	20.0	18.3	18.4	18.0
Benlate	53.9	52.5	24.7	23.2	17.5	16.3
Derosal	28.0	24.0	19.5	18.5	16.7	16.0
Plantvax	52.7	51.6	52.0	56.3	51.3	52.1
Vitavax	54.3	54.2	53.0	54.0	51.2	49.3
Vondozeb	52.5	52.5	51.3	50.7	46.0	44.5
Control	52.7	52.7	52.7	52.7	52.7	52.7

Effect of fungicides on mycelial dry weight - It was shown in Table 18 that Benlate and Bavistin were highly effective in controlling mycelial growth at both 10 and 100 ppm, with very little difference between these two treatments. However, at a concentration of 1 ppm the fungus grew more in the presence of Benlate than Bavistin. Derosal on the other hand, appears to be less effective than both Benlate and Bavistin in reducing the mycelial weight. These three fungicides have been more effective when compared to the control. There appears to be very little difference between Plantvax, Vitavax and Vondozeb and these show no inhibitory effect on the growth of the fungus. At some concentrations Plantvax and Vondozeb supported a greater mycelial growth in culture. (*A. de S. Liyanage & W. D. L. Gunaratne*).

Table 18. *Mycelial growth (mm) of F. solani with various concentrations of different fungicides*

Fungicide	Concentration (a.i.) (ppm)	Mycelial weight (mg)
Bavistin	100	31.3
	10	31.0
	1	43.0
Benlate	100	27.3
	10	26.3
	1	47.6
Derosal	100	38.7
	10	48.0
	1	54.0
Plantvax	100	74.0
	10	65.0
	1	70.3
Vitavax	100	66.6
	10	64.6
	1	59.0
Vondozeb	100	50.6
	10	64.0
	1	64.0
Control	—	67.1

Effect of fungicides on spore germination - Bavistin appears to be highly effective in inhibiting germination of microconidia of *F. solani*. Although Derosal also gave good retardation of spore germination, Benlate proved somewhat ineffective. A high percentage of spore germination was evident in the presence of Plantvax, Vitavax and Vondozeb and at lower concentrations a higher germination percentage was recorded in their presence than in the control. (*A. de S. Liyanage & W. D. L. Gunaratne*).

FIELD INVESTIGATIONS

Host - Parasite Relationships

Phytophthora spp.

Spread of infection on virgin and renewed bark - Five mature PB 86 trees inoculated on the virgin and renewed bark were examined monthly. The results shown in Table 19 indicate that the rate of spread in the virgin bark is greater than that in the renewed bark. (*A. de S. Liyanage, O. S. Peries, B. Fernando & N. I. S. Liyanage*).

Table 19. *Mean lesion area (cm²) in virgin and renewed panels of PB 86.*

Month of exposure	Lesion area (cm²)	
	Virgin panel	Renewed panel
January	33.9	0.7
February	30.7	2.6
March	11.7	3.1
April	9.3	6.4
May	35.1	10.3
June	39.0	21.0
July	14.8	16.1

Bark renewal of different clones - The rate of callusing of a circular wound in clones PB 86, RRIC 7, 45, 52, and RRIM 513 was recorded at regular intervals. The results given in Table 20 indicate that it had taken approximately 2 years to achieve complete callusing of a circular wound of 9 cm diameter in 18 year old trees. The bark of clone PB 86 calluses much faster than the other clones, the clone RRIC 7 being the slowest to callus. (*O. S. Peries, N. I. S. Liyanage & B. Fernando*).

Effect of different formulations on the rate of callusing - Several proprietory formulations were compared with some local formulations to determine their effect on the rate of callusing of a circular wound on bark of PB 86 (Table 21). At the end of 16 months after treatment, Shell TB 192 was superior to the other formulations in enhancing the rate of callusing. At this stage complete callusing of the circular wound was observed in five trees treated with this formulation and four and three trees showed complete callusing in trees treated with Kankerdood and Barkosan, respectively. Santar A proved inferior, resulting in initial scorching of bark. (*O. S. Peries, N. I. S. Liyanage & B. Fernando*).

Clonal susceptibility - Sixty plants each of 124 clones grown in the nursery at Dartonfield were inoculated by the method described previously. The results are tabulated in order of increasing resistance (Table 22). It was observed that some of the local clones and some introduced clones were resistant to Bark Rot. (*A. de S. Liyanage, A. Dharmaratna and S. Wettasingha in collaboration with D. M. Fernando*).

Table 20. *Rate of bark renewal in different clones*

Date of wound measurement	RRIC 52		RRIC 45		RRIC 7		PB 86		RRIM 513	
	SW	AC	SW	AC	SW	AC	SW	AC	SW	AC
20 - 4 - 78	2.97	—	4.62	—	6.02	—	0.71	—	2.79	—
21 - 4 - 78	1.28	1.69	2.17	2.49	4.50	1.52	0	0.71	1.71	1.08
20 - 12 - 78	0	1.28	0.86	1.31	3.48	1.02	0	0	0.80	0.91

SW - size of wound
AC - area callused

Table 21. *The mean size of circular wound (cm) and the rate of callusing over different periods in the Clone PB 86.*

Date of wound measurement	Shell TB 192		Kankerdood		Santar A		Candarsan		Barkosan		Control	
	SW	AC	SW	AC	SW	AC	SW	AC	SW	AC	SW	AC
21 - 2 - 78	3.56	—	4.19	—	6.31	—	4.93	—	3.90	—	5.94	—
27 - 4 - 78	1.87	1.69	2.77	1.42	5.44	0.97	3.86	1.07	2.90	1.90	5.21	0.73
21 - 6 - 78	0.64	1.23	1.91	0.86	4.96	0.48	3.15	0.71	2.32	0.58	4.69	0.52
20 - 8 - 78	0	0.64	0.41	1.51	2.87	2.09	1.15	2.00	0.35	1.97	2.60	2.09

SW - size of wound
AC - area callused

Table 22. *Susceptibility of different clones to Bark Rot Infection*

Clone	Mean lesion area (cm^2)	Clone	Mean lesion area (cm^2)	Clone	Mean lesion area (cm^2)
FX 3221	9.40	RRIC 22	16.36	PR 253	23.13
RRIC 31	10.23	RRIC 87	16.66	IAN 710	24.61
RRIC 60	10.61	RRIM 604	16.67	FX 2473	24.85
RRIC 91	11.68	RRIC 9	16.73	FX 2417	25.18
RRIC 99	12.03	RRIM 628	16.80	RRIM 600	25.37
RRIC 52	12.13	RRIM 620	16.82	FX 2427	26.75
Wg. 6278	12.18	IRCI 2	16.85	PR 255	26.80
RRIC 92	12.41	RRIC 64	16.96	RRIC 41	27.78
RRIC 100	12.53	RRIC 55	17.11	F 351	28.01
RRIC 105	12.59	RRIC 32	17.18	RRIC 42	29.54
RRIC 59	12.91	RRIC 109	17.29		
RRIC 39	12.92	RRIC 6	17.37		
AV 1328	12.97	RRIC 63	17.45		
RRIC 85	12.99	RRIC 4	17.50		
TJ 1	13.09	AV 385	17.61		
RRIC 75	13.18	RRIM 623	17.63		
GL 1	13.32	RRIC 3	17.70		
RRIM 526	13.32	RRIC 108	17.78		
RRIC 65	13.34	RRIC 110	17.78		
AV 1734	13.42	RRIC 66	18.12		
RRIC 33	13.47	RRIM 621	18.12		
RRIC 48	13.49	RRIC 5	18.18		
FX 6306	13.54	RRIC 54	18.20		
FX 2418	13.83	F 409	18.43		
RRIM 701	13.92	IRCI 10	18.56		
RRIC 106	13.95	RRIC 104	18.60		
IAN 873	14.04	IAN 717	18.64		
NAB 12	14.05	RRIC 38	18.72		
PB 28/59	14.18	IRCI 6	18.90		
RRIC 86	14.27	RRIC 90	18.96		
RRIC 88	14.27	RRIC 17	19.23		
RRIC 40	14.42	RRIC 49	19.55		
AV 1735	14.43	RRIC 7	19.64		
IRCI 1	14.60	PB 86	19.73		
PR 252	14.63	RRIM 707	19.75		
RRIM 608	14.69	PR 107	20.03		
LCB 1320	14.72	FX 1305	20.06		
NAB 15	14.86	CH 32	20.09		
RRIC 103	15.09	PR 251	20.46		
RRIC 89	15.10	RRIC 69	20.59		
RRIM 605	15.12	IRCI 7	20.65		
RRIC 102	15.17	RRIM 602	20.66		
FX 714	15.31	RRIC 46	20.73		
RRIC 62	15.40	RRIC 47	20.74		
MK 3/2	15.42	GT 1	20.74		
RRIC 101	15.48	RRIC 45	20.00		
RRIC 67	15.50	RRIC 37	21.18		
RRIC 107	15.50	RRIC 70	21.19		
WR 101	15.61	RRIC 13	21.34		
RRIC 82	15.66	RRIM 603	21.79		
NAB 17	15.80	RRIC 95	21.82		
IRCI 9	15.87	RRIC 36	21.97		
PB 5/51	15.96	AV 1349	22.20		
RRIM 609	16.01	RRIC 50	22.23		
RRIC 76	16.09	F 4542	22.32		
RRIC 57	16.25	RRIM 607	22.56		
RRIC 94	16.29	RRIC 68	22.58		

Influence of environment and genotype on infection - Ten trees from each of the clones RRIC 36, 52, 100, 101, 102, 103 RRIM 600, 623, PB 86 and IAN 710 were inoculated about 2 m from the ground, using a standardized concentration of 10^4 zoospores/ml, after removing 2.5 cm diameter bark plugs. This inoculation was done at Bibile, Hunuwella, Pimbura, Golinda, Monrovia, Bentota and Densworth Estates (Table 23). The infection is generally higher in estates located in wet areas, compared to those in dry districts. RRIC 52 and 100 appear to be more resistant than other clones. Statistical analysis of the results showed that there were significant differences between clones and between environments. The clone x environment interaction was also significant. This shows the importance of selecting clones on a regional basis depending on the environmental conditions. No correlation was observed between bark thickness and lesion area and diameter and lesion area. (*A. de S. Liyanage, S. Wettasingha in collaboration with N. E. M. Jayasekera*).

In another experiment 10-15 plants of the clones RRIC 36, 45, 52, 100, 102, 103, 104, 105, 107, RRIM 513, 600 and 623, PB 86 and GL 1 were inoculated about 2 m from the ground, using standardised methods. This incoculation was done in Padukka, Stokesland, Urumutta, Kiribathgalla, Nakiadeniya, Pitiyakanda, Moralioya and Udabage Estates. The results shown in Table 24 are similar to that obtained in the previous experiment. Girth measurements and microtapping were also done in this experiment. (*A. de S. Liyanage, A. Dharmaratna, S. Rupatunga in collaboration with D. M. Fernando*).

Pathogenicity of different isolates - Ten trees each of the clones RRIC 31, 35, 39, 60, 92, 99, PR 107, F 351, PB 86, and Tjir 1 were inoculated using standard methods. Isolate No. 126 and 379 were both used. The lesion measurements were taken one month after inoculation. The results await analysis. (*A. de S. Liyanage and B. Fernando*).

In another experiment four isolates (No. 126, 361, 362 and 379) were used to inoculate 20 trees of the clone PB 86. The lesions were measured a month after inoculation. The results are being processed. (*A. de S. Liyanage and B. Fernando*).

Effect of different factors on the incidence of Bark Rot - The effect of different ages, height of tapping, depth of tapping, tapping panels (virgin and renewed) cultivars, topography, climate, zoospore concentration, moisture and tapping knives on the spread of Bark Rot in mature PB 86 trees was done at Gallawatta estate. Moisture in the bark and height of tapping cut do not appear to influence the rate of spread of the fungus. Virgin panels were more susceptible than renewed panels. There was a reduction in the lesion size when tapped with the Jebong knife than the Michie Golledge knife. 10 zoospores/ml was sufficient to cause infection of tapping panels, and the area affected tended to increase with increase in concentration. Panels tapped daily were more susceptible to infection than those tapped on every third day. Panels tapped on every fourth day did not show any infection. (*A. de S. Liyanage* and *B. Fernando*).

Rigidoporus lignosus

Clonal resistance of rootstocks - Seedlings of 36 clones were evaluated using a virulent isolate of *R. lignosus* in a pot trial. It was observed that LCB 1320, IRCI 9, RRIC 101 and RRIC 45 were more resistant to the disease than other clones (Table 25). This trial was repeated. (*A. de S. Liyanage and W. Amaratunga*).

Table 23. *Effect of different environments on the mean lesion (cm) development of Bark Rot caused by Phytophthora spp in several clones*

Clone	Estate						
	Pimbura	Bentota	Monrovia	Moralioya	Golinda	Hunuwella	Bibile
RRIC 36	13.45	17.31	11.96	13.85	13.58	8.04	4.84
RRIC 52	11.37	12.66	9.67	13.69	9.59	6.83	5.26
RRIC 100	10.16	10.07	9.30	13.66	9.61	5.92	4.94
RRIC 101	13.49	15.37	10.41	13.40	13.69	8.98	5 29
RRIC 102	11.26	12.98	11.25	13.19	9.65	6.38	5.98
RRIC 103	12.59	13.01	10.66	11.65	10.34	8.77	5.32
PB 86	12.72	13.15	11.43	15.83	15.23	7.09	4.53
RRIM 600	15.43	13.78	10.58	14.16	12.26	6.87	5.46
RRIM 623	14.02	13.12	10.55	13.85	8.86	6.89	4.61
IAN 45/710	13.47	18.13	11.30	15.45	15.38	7.52	5.17

Table 24. *Effect of different environments on the mean lesion (cm²) development of Bark Rot caused By Phytophthora spp in several clones*

Clone	Estate							
	Stokesland	Urumutta	Pitiyakanda	Udabage	Ambadeniya	Padukka	Kiribathgalla	Moralioya
RRIC 36	16.05	9.77	—	8.26	9.98	9.20	—	14.93
RRIC 45	17.37	12.03	13.06	9.64	9.58	12.85	17.13	14.43
RRIC 52	14.56	9.41	6.57	9.48	8.74	9.59	—	11.17
RRIC 100	8.57	10.85	7.10	8.21	5.72	7.16	6.76	7.63
RRIC 101	10.65	12.09	8.53	7.86	8.17	8.65	7.65	13.65
RRIC 102	13.69	8.18	8.09	10.02	7.63	8.95	5.37	14.06
RRIC 103	14.00	10.48	8.43	11.46	8.38	8.92	6.22	9.38
RRIC 104	13.35	12.56	9.32	10.13	7.65	11.16	8.47	14.12
RRIC 105	13.40	13.21	8.75	11.71	7.23	7.73	7.59	11.69
RRIC 107	12.17	12.98	10.23	8.79	10.24	10.56	6.41	13.68
RRIM 513	16.32	12.36	10.44	10.86	10.03	8.36	9.09	12.85
RRIM 600	12.83	9.57	12.54	8.55	8.52	9.28	9.92	10.04
RRIM 623	13.00	10.59	8.92	8.80	8.33	9.07	7.38	13.01

Table 25. *Mean percentage mortality of seedlings of different clones to R. lignosus*

Clone	Dead seedlings (%)
RRIC 7	76
,, 9	73
,, 36	100
,, 37	67
,, 40	76
,, 43	64
,, 45	40
,, 46	51
,, 52	51
,, 87	47
,, 100	56
,, 101	40
,, 102	91
,, 111	67
RRIM 501	56
,, 513	56
,, 600	93
,, 623	31
PB 5/51	73
PB 5/63	51
PB 5/78	83
PB 86	84
LCB 1320	29
GT 1	67
AV 231	80
AV 255	87
PR 252	64
IRCI 9	33
TR 1548	76
GPM	36
GPM 300	71
PTB 137	89
1004	96
1010	55
1108	93

EPIDEMIOLOGY

Oidium heveae

Pattern of wintering and incidence of Oidium - The pattern of wintering and the incidence of secondary leaf fall caused by *O. heveae* were recorded on clones PB 86, RRIC 7, 45 and 52 from November 1977 to the end of May 1978 (Table 26). Although wintering commenced almost together in all the clones, the progress was rapid in clones RRIC 7 and 52, which completed wintering at the same time on the 11th February. PB 86 and RRIC 45 completed wintering only on the 25th February and 12th March, respectively.

Table 26. *Pattern of wintering and incidence of Oidium secondary leaf fall*

Clone	Onset of wintering	Completion of wintering	Onset of secondary leaf fall	Completion of secondary leaf fall	Date of maximum secondary leaf fall	
					1st peak	2nd peak
PB 86	Dec. 1977	25 Feb.	11 Feb.	4 April	27 Feb.	9 March
RRIC 45	Dec. 1977	12 March	18 Feb.	14 May	12 March	4 May
RRIC 7	Dec. 1977	11 Feb.	18 Feb.	6 May	27 Feb.	27 April
RRIC 52	Dec. 1977	4 Feb.	22 Feb.	7 March	24 Feb.	—

Secondary leaf fall (SLF) due to *Oidium* occurred first on clone PB 86, immediately followed by RRIC 7 and 45, which showed maximum leaf fall on the 27th February and 12th March, respectively. SLF in RRIC 52 was negligible. A small 2nd peak of SLF was observed in clones RRIC 7, 45 and PB 86. (*A. de S. Liyanage*).

Trapping of Oidium *spores* - Rod traps were used with sellotape as the trapping surface. The highest number of spores were trapped on the day of highest SLF. A second peak was noticed on the 28th April. Generally a greater number of conidia germinated when the number of conidia trapped was high. (*A. de S. Liyanage*)

Phenology of different clones - The development of the buds was assessed on ten shoots selected from each of the clones RRIC 7, 45, 52, and PB 86. The pattern of disease development was also studied. (*A. de S. Liyanage*).

Development of the pathogen under field conditions - When disease free copper brown leaves were artificially incoculated with conidia of *O. heveae* under field conditions, conidial germination and secondary branching were evident within 24 h but sporulation occurred between 5-11 days after inoculation depending on the environmental conditions during the interim period. (*A. de S. Liyanage, N. W. Dissanayake* and *W. Amaratunga*).

Phytophthora spp.

Establishment of infection and sporulation on rubber pods - Several rubber pods of clone PB 86 were inoculated. It was observed that pods inoculated on the 19th June took 11 days to produce sporangia. This was probably due to the poor establishment of the fungus as the weather conditions were unfavourable. These pods yielded sporangia only for a short period. However, the pods inoculated on the 30th June, produced sporangia in 4 days as the weather condition were favourable for the establishment of the fungus and these pods continued to produce sporangia for 3 weeks. (*A. de S. Liyanage and A. Dharmaratna*).

Rigidoporus lignosus

Spread from a known source of inoculum - When the inoculum was buried in the planting row, none of the plants were infected with *R. lignosus*, eight months after laying down the experiment. The assessment of infection was based on foliar symptoms. (*O. S. Peries, A. de S. Liyanage, N. I. S. Liyanage* and *W. Amaratunga*).

Natural spread - The fourth census of the number of infected and dead trees was taken (Table 27). Although the percentage infection was higher at Muwankanda Estate, relatively few trees have been killed. The highest mortality rate was observed in Stokesland. (*G. W. Liyanage, A. de S. Liyanage* and *S. S. Warnapura*).

Table 27. *The rate of spread of White Root disease in serveral estates during the period 1976-1978*

Estate	Cumulative infection (%)	Increase (%)
Muwankanda	57.8	4.3
Peenkanda	3.0	0.9
Doloswela	21.9	5.4
Moralioya	28.5	5.2
Mahaoya	14.0	9.9
Urumuttu	10.0	2.2
Ambadeniya	25.1	2.2
Golinda	18.7	6.1
Galewatta	13.2	8.0
Dartonfield	18.1	7.2
Kiriwanaketiya	27.7	5.5
Padukka	17.4	9.7
Stockesland	19.3	10.4

Size of food base or infection - When different sizes of root pieces were buried in the planting hole (Table 28), infection was detected only when large and small laterals, diam 2.5 - 5.7 cm, were placed in the planting hole and not with small roots, diam 0.6-1.2 cm. (*O. S. Peries, A. de S. Liyanage, N. I. S. Liyanage* and *W. Amaratunga*).

Table 28. *Effect of different sizes of infected roots on the incidence of White Root disease*

Size of inoculum (30.5 cm lengths)	% infection
Large laterals (Diameter 5.1 cm)	20
Small laterals (Diameter 2.5 cm)	20
Small roots (,, 1.2 cm)	0
Small roots (,, 0.6 cm)	0
Control	0

Sporocarp development - Sporocarps of *R. lignosus* were labelled in the field as soon as they appeared on infected stumps. It was observed that most of them shrivelled and dried up during dry weather. This experiment is being repeated. (*O. S. Peries* and *N. I. S. Liyanage*).

Release of basidiospores - A bimodel pattern of spore release was observed with peaks between 0300 h to 0500 h and 1700 to 1900 h, with minimum number of spores being released in the former. (*O. S. Peries* and *N. I. S. Liyanage*).

Basidiospore colonization - Untreated pieces of roots buried in moistened sterile soil in test tubes were placed directly under young sporocarps for 24 h in the field before transferring to be incubated in the laboratory for 7 days. Six isolates similar in morphology to *R. lignosus* were obtained. The pieces of roots treated in different ways such as boiling in tap water, 0.5% malt and 0.05% urea yielded only species of *Trichoderma* and *Penicillium*. (*G. W. Liyanage* and *S. S. Warnapura*).

In another experiment, when 1 ml of the basidiospore suspension was added to exposed 2 cm diameter root lengths, buried in sterile sand, maintained at 10% moisture holding capacity, 30% of the root pieces were infected in one month. (*G. W. Liyanage* and *S. S. Warnapura*).

Ten infected stumps of *Hevea* were placed in the field under mature rubber trees alongside 10 healthy stumps, to see whether basidiospores are capable of causing infection under field conditions. So far healthy stumps were not colonised by the fungus. (*O. S. Peires* and *N. I. S. Liyanage*).

A pot experiment was conducted to determine whether basidiospores could gain entry through the injured roots and cause infection in the field. None of the plants treated in this manner showed foliar symptoms five months after the commencement of the experiment. However, one dead plant in the treatment in which the spore suspension was added to injured plants grown in non-sterile soil, showed mycelial strands, similar to *R. lignosus* on the tap root when uprooted. The remaining plants were allowed to remain in the pots, for further observations. (*O. S. Peries* and *N. I. S. Liyanage*).

Xylaria spp.

Natural spread - Black Root caused by *Xylaria* spreads rather slowly. The percentage increase ranged for 2.2% to 11.6% over a period of 18 months (Table 29). The number of plants killed during this period was negligible. (*A. de S. Liyanage* and *S. Wettasinghe*).

Table 29. *Natural spread of Black Root disease*

No. of sizes	Total No. surveyed	Total trees infected		Infection (%)		Dead (%)	Increase infection (%)
		30/5/77	29/11/78	13/5/77	29/11/78	29/11/78	
1	138	83	16	60.2	71.7	0.7	11.6
2	47	13	4	27.7	36.2	—	8.5
3	48	17	1	35.4	37.5	—	2.1
4	45	20	1	44.5	46.7	—	2.2

CONTROL

Oidium heveae

Nitrogen on the incidence of Oidium - Nitrogenous fertilizer has been applied to the experimental area at Kiribathgala, Hunuwella, Ambadeniya and Parambe Estates. However, fertilizer could not be applied at the time of refoliation, in some estates. Leaf and soil samples were analysed for nutrients. Yield assessments were also taken. The secondary leaf fall caused by *Oidium* was negligible. (*A. de S. Liyanage in collaboration with N. Yogaratnam*).

Economics of controlling Oidium leaf fall - Twenty five and ten acres selected at Gallawatta and Frocester Estates, respectively, were given three rounds of sulphur dust, at weekly intervals using 9kg/ha/round. Secondary leaf fall caused by *Oidium* was negligible. Also, the number of trees damaged by wind was also low in both dusted and undusted areas. (*A. de S. Liyanage and Z. E. Irugalbandara*).

Efficacy of fungicides - A new dust formulation, Bayleton was compared with sulphur dust, with an undusted area serving as the control. This observational trial was laid out at Malaboda Estate, Matugama. Three rounds of dust at the rate of 9 kg/ha/round was done and four leaf counts were also taken at weekly intervals (Table 30). Bayleton appears to be effective in reducing the incidence of *Oidium* when compared to the control. There is only a slight difference between sulphur and Bayleton. In view of the increased cost of sulphur, Bayleton should be tested in a large scale trial. (*A. de S. Liyanage and A. Dharmaratna*).

Table 30. *Effect of fungicides on the incidence of secondary leaf fall caused by O. heveae*

Number of leaf counts	Control	Sulphur	Bayleton
1	9840	7806	5546
2	11785	5016	5936
3	4838	3878	3473
4	341	210	417
Total	26804	16910	15372
Mean	6701.0	4227.5	3843.0

Micronutrients on disease incidence - A trial has been laid out in Dartonfield to examine the effect of different micronutrients on the incidence of leaf diseases. (*A. de S. Liyanage* in *collaboration* with N. *Yogaratnam*).

Defoliation on the yield of rubber - Yield assessments were continued in this trial at Eladuwa Estate, until the end of August. The trees subjected to various levels of defoliation were allowed to recuperate and test tapping was resumed in December. (*A. de S. Liyanage and Z. E. Irugalbandara*).

Phytophthora spp.

Rainguards and Bark Rot - The incidence of *Phytophthora* leaf fall was low and no useful observation could be made in this trial. The rainguards were refitted as tapping panels were changed. However, records were kept on the yield and number of tappings days. (*O. S. Peries, D. M. Dantanarayana* and *N. I. S. Liyanage*).

Rigidoporus lignosus

Effect of sulphur on soil pH at different levels - An experiment was initiated to study the change in acidity after amendment with sulphur in five soil types located in various districts. Sulphur dust was mixed at the rate of 113 and 226g per planting hole in five soil types in seven estates. Soils were removed at monthly intervals from 0-10 cm and 30-40 cm depths. The pH, So_4^{--} ion concentration and growth of the fungus were studied. All estates except Muwankanda Estate received heavy

rain after amendment with sulphur. The pH in the soils of all the estates, except in Muwankanda decreased, to cause inhibition of the growth of the fungus at 0-10 cm depth. At lower depths pH was less affected by the addition of sulphur. There was also no marked difference in the acidity when sulphur was added to the planting hole at the rate of 113 and 226g except in some instances. In the Ratnapura and Agalawatta soil types, the change in the pH was more rapid than in other soil types. Also, the fungul growth was more in the Boralu soils. (*G. W. Liyanage, A. de S. Liyanage, S S. Warnapura and N. Fernando*).

The change in soil pH after the addition of sulphur to undisturbed soil was studied at Dartonfield. The lowest pH was recorded in the top soil at 4 weeks and thereafter the pH increased. However, at 15 and 30 cm depths the lowest pH was recorded at 8 weeks. The fungal population, before amendment of soil and 4 weeks after amendment, was determinined by the soil dilution plate method using malt agar. *Penicillium* spp. was the predominant fungus. (*O. S. Peries, N. I. S. Liyanage and B. Fernando*).

Microflora under leguminous covers - The fungal population under different leguminous covers was assessed using the soil dilution plate method. This experiment is in progress. (*A. de S. Liyanage, O. S. Peries, N. I. S. Liyanage and B. Fernando*).

Rhizosphere in healthy and infected rubber roots - The plants were grown in pots in soils collected from Dartonfield. One set of plants was artificially infected by incorporating 1 kg of wood dowels containing viable inoculum of *R. lignosus* in the soil. Rhizosphere mycoflora was determined 1 year 3 months after planting. *Penicillium* spp., were predominant in both healthy and infected plants. More types of fungi were present in healthy roots than with infected roots, which only had *Penicillium* species and *Aspergillus* spp., in addition to some sterile fungi and a few unidentified fungi. However, there was a marked difference in the number of different types of fungi present in the healthy (192.5×10^4/g dry soil) and infected (40.7×10^4/g dry soil) roots. (*O. S. Peries and N. I. S. Liyanage*).

Detection of infection - The use of rubber wood stakes to detect *Rigidoporus* infection was done at Eladuwa and Milleniya Estates. It was observed that some of the stakes planted around healthy rubber plants showed the presence of *R. lignosus* or fungi resembling *Rigidoporus*. Even when the infection was seen on stakes driven near infected plants, it was not possible to trace the source of infection. In many instances the infection was seen on stakes at the level at which cover crop roots were present. (*O. S. Peries, N. I. S. Liyanage and B. Fernando*).

Methods of clearing on the incidence of Rigidoporus - The trials laid out in Woodend (2 experiments), Yogama, Moralioya, Hatbawa, Muwankanda and Gallewatta Estates are in progress. Growth assessments, incidence of the disease and rate of decay of stumps were taken at regular intervals. (*A. de S. Liyanage and W. Amaratunga.*)

Root development - Experiments have been initiated in five different soil types (Agalawatta, Boralu, Parambe, Homagama and Ratnapura) using root stocks of RRIC 45, 52, 100 & LCB 1320 to study the root development and distribution pattern. This trial is in progress. (*A. de S. Liyanage, O. S. Peries, B. Fernando and N. I. S. Liyanage.*)

Effect of Pentachloronitrobenzene (PCNB) on growth of seedlings - Two month old seedlings of clone BP 86 and RRIM 623 were treated with PCNB at concentrations of 30, 40 and 50%. The treated plants were then grown in pots containing half a kg of viable inoculum, maintained on wood dowels. At these concentrations the roots were scorched. The mortality ranged from 80-100%. (*A. de S. Liyanage, O. S. Peries and N. I.S. Liyanage jointly with M. Nadarajah*).

Fusarium solani

Testing efficacy of fungicides - A fungicide trial using systemic fungicides Bavistin, Benlate and Derosal at two concentrations (100 and 500 ppm) was carried out at Galagawa Estate. The fungicides (2 gallons per plant) were given as a soil drench. This trial is in progress. (*A. de S. Liyanage and D. M. Dantanarayana*).

SURVEYS

R. lignosus

Incidence of White Root disease in different districts - It was observed that the incidence of the disease was higher in the wet rubber growing districts of Ratnapura, Galle, Kalutara and Kelani Valley than in the dry districts of Kegalle and Kurunegala (Table 31).

Table 31. *Assessment of the incidence of White Root disease in different districts*

District	No. Estates Surveyed	Area Surveyed ha	Area Infected ha	Area Infected (%)
Ratnapura	10	4893.09	432.87	8.85
Kellani valley	13	7456.16	622.78	8.36
Kalutara	21	8538.71	595.69	6.98
Galle	11	5156.11	339.55	6.59
Kegalle	11	2505.24	121.28	4.85
Kurunegala	2	495.75	13.23	2.67
Matale	4	920.68	2.66	0.29

When the percentage infected area in different districts is classified according to the year of planting as shown in Table 32, it is clear that the incidence is low during the immaturity period, but it tends to increase with the age of the plantation. This clearly indicates that negligence or inadequate control measures has led to this situation. (*A. de S. Liyanage, W. Amaratunga and J. L. P. Chandrika*).

MISCELLANEOUS

Exploitation of bare patches - Several bare patches in Galewatta and Dartonfield Estates have been planted with coffee, cacao, pepper, ramie, clove and *Alstonia spp.* All the planting material except Alstonia were supplied by Dr. B. V. P. Bavappa of the Department of Minor Export Crops, Matale. Similar patches were utilized in Padukka Estate to plant several varieties of sugar cane. (*A. de S. Liyanage in collaboration with U. P. de S. Waidyanatha*).

Identification of diseases - A disease caused by thread blight was detected for the first time on leaves and twigs of Nutmeg. The dead leaves were matted together by threads and such leaves occurred in characteristic chains. The twigs devoid of leaves were observed to die back. The fungus *Botryodiplodia theobromae* was isolated from such shoots. (*A. de S. Liyanage* and *D. M. Dantanarayana*).

A *Fusarium* spp. has been isolated from wilted mulberry plants grown at the Sericulture Station, Ganegoda, Elpitiya. Various fungicides have been tried in pot experiment to determine their efficacy in controlling this disease. (*A. de S. Liyanage and D. M. Dantanarayana*).

Table. 32 *Percent Infection in fields classified according to age*

District	No. estates surveyed	Year of planting 1977-72	1971-67	1966-62	1961-57	1956-52	1951-47	1946-42	1941-37	Over 1936
Ratnapura	10	1.19	2.15	2.87	9.19	24.73	61.49	22.76	17.75	9.12
Kellani valley	13	1.50	2.77	4.06	7.85	16.72	18.85	8.84	31.61	—
Kalutara	21	0.59	1.32	3.22	6.82	14.15	16.06	9.57	19.95	3.88
Galle	11	0.93	2.35	2.61	5.17	13.80	22.85	13.99	8.55	—
Kegalle	11	1.76	2.35	3.20	5.20	7.55	8.08	11.28	14.93	1.25
Kurunegala	2	0.35	1.29	1.29	2.33	4.70	19.15	14.68	—	—
Matale	4	0.20	0.20	0.26	0.34	0.56	0.12	0.63	0.55	0.35

REVIEW OF THE SOILS CHEMISTRY DEPARTMENT

by

C. G. SILVA

SUMMARY

An intensive mineralogical study of the rubber soils has shown that they can be divided into three categories. a) the highly weathered soils, which require high levels of fertilizer, specially potassium. b) the medium weathered and the c) less weathered soils which required lesser amounts of fertilizer for optimum yields.

The main concern of the Department is the study of the responses of rubber tree to factors affecting the supply of nutrients and water to it. In general, the nutrient requirements of the RRIC 100 series clones although they grew more vigorously than PB 86, did not appear to be different from these of the latter. Applications of N, P, and K have in general resulted in higher yields in all clones tested.

Results from a long term experiment showed that urea is as effective as ammonium sulphate as a source of nitrogen for rubber in production. Imported rock phosphate appeared to be superior to Eppawela apatite. Efficiency of applied nutrients could be further improved by applying them either at defoliation or at refoliation.

Soil management practices such as establishment of legumes and fertilizing them with phosphate continued to show beneficial effects in increasing the growth of immature rubber. Inadequate ground cover during the early stages of growth of young rubber can result in run-off and soil losses. Mulching with Guatamala grass loppings reduced run-off and soil erosion markedly, compared with leaving the land clean weeded and bare. The delay in the establishment of leguminous cover crops resulted in the loss of soil that was comparable to that in clean weeded land. Latex-oil emulsions gave effective protection against erosion, but this treatment does not promote infiltration of incident rains.

Foliar application of some micro-nutrients such as zinc and boron increased growth of immature rubber in the field.

The soil and foliar survey has shown that the discriminatory approach to fertilizer application could be adopted for economic use of fertilizer on rubber.

DETAILED REVIEW

STAFF

The Soil Chemist Mr. C. G. Silva returned on the 15th of May after spending 12 months at the University of Missouri, Columbia, U. S. A. on an IAEA fellowship. Dr. N. Yogaratnam attended an interregional training course on the use of N_{15} in soil plant studies held in West Germany from 2nd May to 2nd June. Mr. M.K. S. A. Samaraweera continued working for his Ph. D at Long Ashton Agricultural Research Station in U. K.

Mr. W. C. Dayaratne was appointed as Experimental Officer from 1st March 1978. Mr. Lewis Singho was promoted as Laboratory Attendant from 1st September 1978.

Messrs K. U. C. Perera and V. Ravindran Technical Assistants resigned from the services of the Institute to join the Faculties of Medicine and Engineering, respectively, at the University of Sri Lanka. Mr. H. A. Seeman, Technical Assistant retired in November after serving the Institute for 38 years. Mr. A. D. M. Karunaratne Field Assistant resigned from the services of the Institute to better his prospects by joining the Ceylon Fertilizer Corporation. All other staff were on duty throughout the year.

VISITS

The Soils Chemist, Dr. N. Yogaratnam, paid 82 visits to experimental sites and 23 other visits during the year. Mr. C. G. Silva made 7 visits to experimental sites and 9 advisory visits, since he resumed duties. Routine visits to experimental areas and 9 advisory visits were made by the Experimental Officer, Mr. F. P.W. Silva. Other departmental staff paid regular visits to their respective experimental areas.

MEETINGS OF WOKING GROUPS AND COMMITTEES

The Officers named in each case, served on the following committees:

1. Working group on soil moisture studies, sponsored by the Atomic Energy Authority of Sri Lanka (N. Yogaratnam).

2. Working group on phosphate fertilizer efficiency studies, sponsored by the Atomic Energy Authority of Sri Lanka. (N. Yogaratnam)

3. Sub-committee on fertilizer mixtures, sponsored by the Sri Lanka/West German fertilizer promotion project (N. Yogaratnam).

4. Executive committee of the Soil Science Society of Sri Lanka. (N. Yogaratnam).

5. Co-ordinating committee on fertilizer supplies at the Ministry of Plan Implementation (C. G. Silva).

6. Technical committee for the evaluation of fertilizer tenders at the Ceylon Fertilizer Corporation (C. G. Silva).

7. Sub-committee to draw up an internal co-ordinated programme on the use of N-15 in Agriculture sponsored by the Atomic Energy Authority of Sri Lanka (N. Yogaratnam).

PUBLICATIONS

1. *C. G. Silva, B. P. M. Aresecularatne and L. J. Wickremasinghe.* (1978). Radiotracer studies for determining the active root distribution of *Hevea brasiliensis* using 32P. *International Symposium on the Use of Isotopes and Radiation in Research on Soil-Plant Relationships, December 1978.*

2. *C. G. Silva and E. R. Graham (1978)*
Labile pools and distribution coefficients for soil calcium, magnesium and potassium determined with exchange equilibria and radioisotopes. *Missouri Agricultural Experimental Station, Journal Series No. 8228.*

SEMINARS, CONFERENCES AND WORKSHOPS

The following papers were presented at the 34th Annual Sessions of the SLAAS held in December:

1. *N. Yogaratnam and F. P. W. Silva*
   Standardization and improvement of soil testing methods for the rubber soils of Sri Lanka with emphasis on soil phosphate.
2. *N. Yogaratnam, M. Nadarajah and W. C. Dayaratne.*
   Soil erosion and run-off studies in rubber plantations.

N. Yogaratnam participated in the Inter-regional training course on the use of N15 in soil science and plant nutrition organised by the FAO/IAEA held in G. D. R. C. G. Silva and N. Yogaratnam participated in the International symposium on the use of isotopes and radiation in research in soil-plant relationships organised by the FAO/IAEA, held in Sri Lanka where the former presented a paper entitled "Radiotracer studies for determining the active root distribution of Hevea using 32 P."

VISITORS

Dr. Y. Barrada of the International Atomic Energy Agency who was in Sri Lanka as the Scientific Secretary of the International FAO/IAEA Symposium on soil plant relationships, visited the Department and discussed with us the progress we have made in the projects initiated with IAEA assistance and our requirements for the future.

RESEARCH STUDENTS

Mr. M. A. Lathiff worked in the Department, studying the distribution of different forms of phosphorus in the rubber soils, and submitted a report in partial fulfilment of the requirements of the Advanced Course in soil science for the Bachelor of Science Degree in Agriculture. Mr. S. A. Prathapar, a final year research student from the Faculty of Agriculture, University of Sri Lanka, Peradeniya, worked on "Some factors influencing the molybdenum content of soils and leaves in rubber plantations." Mr. B. D. Pathinayake worked in the Department on the different forms of soil phosphorus and Mr. N. Athapathu on some micronutrients.

NEWSPAPER ARTICLES

An article entitled "Fertilizer for rubber" by N. Yogaratnam and another on "Fertilizer Recommendation based on leaf analysis" by S. Wasanthadeva were published in the *Ceylon Daily News* and *Dinamina* paper respectively.

RESEARCH

A soil classification system. The mineralogical studies on the major rubber soils was continued. This is part of a comprehensive investigation into the chemical, physical and mineralogical properties of the major rubber soils, aimed at assessing their origin, genesis and fertility status for the purpose of arriving at a low level of classification for practical use in the management of these soils.

Based on the mineralogy of the sand fractions, the rubber soils could be classified into three groups of weathering stages.

Group 1. The oxic stage, characterised by the presence of material which is highly weathered. To this group would belong the Boralu, Cabook and Homagama series.

Group II. The demi-oxic stage where the solum contains about 10-20% weatherable minerals. The oxic nature diminishes with depth. The Agalawatte series is a member of this group.

Group III. The inceptic stage. The soils of this group still contain up to 50% weatherable minerals and lower quartz contents. The Ratnapura, Parambe and Matale series are members of this group.

It is to be expected that only those soils with appreciable amounts of potash releasing weatherable minerals would have significant amounts of potassium for use by plants. Soils of the inceptic group are expected to have this property. However, only the soils of the micaceous Parambe have the necessary capacity to replenish the potassium which is necessary for a perennial crop such as *Hevea*.

Studies on the pF analyses of these soils have shown that Boralu has very low water storage properties. The calculated amounts of available water in the top 1 m using the pF measurements are as follows:-

84.6 mm for Boralu
96.3 mm for Homagama
152.7 mm for Agalawatta
183.9 mm for Parambe

It is therefore to be expected that any condition of moisture stress would effect Boralu soils first and Parambe soils last and would suggest early wintering in Boralu areas. (*C. G. Silva, J. P. Andriesse,[1] F. P. W. Silva and S. Wasanthadeva*).

Fertilizers

Growth of immature rubber: Four experiments to assess the effects of fertilizers on nutrient uptake and growth of immature rubber were in progress. The results indicate that application of nitrogen, phosphorus and potassium increase, growth of immature rubber, during the early stages of the immature phase. Moreover in Experiment F/76/5 the rate of growth of some of the RRIC 100 series clones, such as 100, 101 and 102 (Table 1) were generally greater than that of PB 86 (*N. Yogaratnam, F. P. W. Silva and S. Wijeratne*).

Table 1. *Effect of three levels of Potassium on growth of PB 86, RRIC 101 and 102 on Boralu soils*

Clone		Mean girth (cm)	Levels of potassium		Mean girth (cm)
PB 86	-	17.76	K_0	-	17.93
RRIC 101	-	20.33	K_1	-	20.64
RRIC 102	-	21.53	K_2		21.03

1 Soil Scientist, Royal Tropical Institute, Amsterdam, Holland.

Growth and yield of mature rubber: Eight experiments to study the effects of fertilizers on growth and yield of mature rubber were in progress covering *Boralu, Agalawatte, Ratnapura* and *Parambe* series soils. Experiments F/61/1 and F/61/2, which have been in progress at the Kuruwita sub-station for seventeen years, have confirmed the previous years findings that applications of nitrogen, phophorus and potassium increased growth and yield (Table 2) of rubber, the effect of potassium being more pronounced than the other nutrients. (*N. Yogaratnam, F. P. W. Silva, M. A. Mendis, K. S. A. C. Peiris and M. Abeysinghe*).

Table 2. *Responses to applications of nitrogen, phosphorus and potassium in Boralu soils.*

Treatments	F/61/1 Yield (g/tree/tapp.)	Increase Over the control (%)	Treatments	F/61/2 Yield (g/tree/tapp.)	Increase over the control (%)
N_0	40.24	100	N_0	36.08	100
N_1	41.35	103	N_1	32.81	105
P_0	40.07	100	N_2	38.36	106
P_1	41.52	104	P_0	35.71	100
K_0	37.98	100	P_1	38.19	107
K_1	44.61	117	P_2	38.34	107

In general, there were indications of the possibility of obtaining greater yields with applications of N, P and K, from experiments started in 1976, covering the *Boralu, Agalawatte, Ratnapura* and *Parambe* soil series (Table 3). Yield increases ranging from 3 to 19% have been recorded (*N. Yogaratnam, F. P. W. Silva, M. A. Mendis, M. Abeysinghe, K. S. A. C. Peiris and S. Wijeratne*).

Table 3. *Yield responses to applications of fertilizers in different soils*

Treatments	F/76/11 *Parambe soils*		F/76/8 *Agalawatte soils*		F/76/9 *Ratnapura soils*	
	Yield (g/tree/ tapping)	Increase over the control (%)	Yield (g/tree/ tapping)	Increase over the control (%)	Yield (g/tree/ tapping)	Increase over the control (%)
N_0	28.98	100	21.34	100	30.57	100
N_1	30.63	106	22.11	104	29.74	98
N_2	32.70	113	23.51	110	32.87	108
P_0	30.77	100	21.71	100	29.53	100
P_1	30.68	100	22.31	103	30.85	104
P_2	32.67	106	23.01	106	32.79	111
K_0	31.01	100	21.8	100	27.59	100
K_1	30.88	100	22.5	103	32.84	119
K_2	31.23	101	22.6	104	32.75	118

Bark renewal (Experiment F/71/1) A study of the effects of three levels of N,P and K on bark regeneration in clone RRIM 623 showed (Table 4) that application of phosphate is likely to improve bark renewal (*N. Yogaratnam and M. A. Mendis*).

Table 4. *Effect of phosphate on bark renewal*

Bark thickness (mm)			Relative thickness (%)
P	-	7.95	100
P	-	8.78	110
P	-	9.24	116

Stimulation: Three experiments (F/60/1,F/78/1 and F/78/2) studying the effects of different levels of N,P and K in relation to stimulation with Ethrel were in progress. Pre-treatment yield assessments were completed and treatments were applied (*N. Yogaratnam, F. P. W. Silva, M. A. Mendis and M. Abeysinghe*).

Efficiency of fertilizer utilization :- Full benefits from fertilizers can only be achieved if they are correctly applied. Experiments were in progress to study the effects of sources of nutrients, methods and time of thier application.

Sources and placement of nutrients

Phosphorus: Experiment F/73/1, comparing the effects of imported rock phosphate and Eppawela apatite on growth of immature rubber showed (Table 5) that girth of trees in plots that received imported rock phosphate and Eppawela apatite was 8% and 2% higher than the control trees.

Two other experiments (F/76/2 and F/76/17) also showed similar tendencies with regard to the effectiveness of Eppawela apatite. (*N. Yogaratnam, F. P. W. Silva and S. Wijeratne*).

Table 5. *Effects of phophate fertilizers on growth of immature RRIC 101 in Agalawatta soils*

Treatment	Mean Girth (cm)	Increase over the control (%)
Nil phosphorus	40.29	100
Imported Rock phosphate	43.57	108
Eppawela apatite	41.25	102

Nitrogen: The effectiveness of Urea as a source of nitrogen for rubber was studied in experiment, F/72/2 and F/76/7. Results obtained from Experiment F/72/2, which has been in progress for the last six years, appear to show (Table 6) that Urea is as effective as sulphate of ammonia with regard to its effect on yield of rubber. Experiment F/76/7 also showed similar results (*N. Yogaratnam, F. P. W. Silva, M. Abeysinghe, J. Wijanayake and M. A. Mendis*).

Table 6. *Effects of nitrogenous fertilizers on yield of PB 86 in Boralu soils*

Treatment	Yield (g/tree/tapp.)	Increase over the control (%)
Nil nitrogen	36.54	100
Sulphate of ammonia	40.90	112
Urea, broadcast	39.79	109
Urea, forked-in	42.03	115

Timing of fertilizer application

Two experiments, F/76/13 and 16, studying the effects of N,P and K application at defoliation, at refoliation and after hardening of leaves, on nutrient uptake of mature rubber, confirmed the previous year's findings that, for efficient uptake of nutrients, fertilizers should be applied either at defoliation or at refoliation (*N. Yogaratnam, F. P. W. Silva and B. Arsecularatne*).

Foliar nutrition

Experiments, FN 77/1, 2 and 3 were started in August 1977 to study the effects of foliar nutrient sprays containing Zn, B, Fe, Mu and Mn on nutrient uptake and growth of immature rubber (PB 86). Results obtained up to end 1978 show (Table 7) that foliar sprays of Zinc and Boron are effective in increasing the growth of immature rubber plants in the field. (*N. Yogaratnam and W. C. Dayaratne*).

Table 7. *Effect of foliar sprays of Zinc and Boron on growth of immature PB 86*

Treatments	Mean diameter (cm)	Increase over the control (%)
Zn_0	2.52	100
Zn_1	2.70	107
Zn_2	2.76	109
B_0	2.53	100
B_1	2.61	103
B_2	2.85	112

Covers and cover management

Ten experiments were in progress to study the effects of covers and management practices on growth of immature *Hevea*.

In experiment, C/72/2, started in 1972, an attempt is made to determine whether legumes are superior to naturals in promoting growth of immature rubber. If so, whether application of extra nitrogen to non-legume covers could improve growth during immaturity and yield during early maturity. Girth measurements made in November 1978, showed that girth of trees (Table 8) in the sown legume plots was greater than the trees in the plots under naturals. But, the relative girth increments for the period 1977 to 1978 showed that trees in areas under naturals had grown more than those in legume areas, during the last one year. (*N. Yogaratnam and G. A. Mendis*).

Table 8. *Effect of covers on growth of immature rubber*

Treatments	Mean Girth, 1978 (cm)	Relative Girth increment 1977 to 1978 (cm)	Girth Increase 77/78 over the control(%)
Naturals (Control)	44.00	33.71	100
Legumes	53.83	15.42	46
Elimination of non-legumes	50.68	21.04	62
Naturals with extra N	49.25	25.19	75
Naturals with exra N based on leaf analysis	45.25	27.14	81

Studies on the effects of various leguminous covers viz. *Pueraria phaseoloides, Calapagonium muconoides, Desmodium ovalifolium, Mimosa invisa, Centrosema pubescens* and *Stylosanthus gayanensis (gracilis)* on growth and production of *Hevea* were in progress at several sites. The control plots in these experiments are in naturals. Girth measurements made in November 1978 showed (Table 9) that all legumes were superior to naturals in promoting growth of immature rubber (*N. Yogaratnam, F. P. W. Silva, S. Wijeratne* and *S. A. .C. Peris*).

Table 9. *Influence of leguminous covers on growth of immature rubber*

Treatments	Mean girth (cm) C/77/1 Agalawatte	C/77/2 Boralu	C/77/3 Boralu	C/77/4 Parambe
Naturals	7.38	9.06	10.74	6.93
Pueraria	8.76 *	10.30 *	12.40 * *	8.65 * *
Calapogonium	8.36 *	10.29 *	12.89 * *	8.80 * *
Desmodium	8.82 *	10.50 *	13.40 * *	9.35 * *
Mimosa	8.10 *	10.59 *	12.18 * *	8.55 * *
Stylosanthus	8.12 *	10.04 *	12.98 * *	8.13 * *
Centrosema	8.66 *	10.55 *	—	9.80 * *
L. S. D.	0.78	0.86	0.81	1.03

The influence of potassium on the N status of leguminous covers and its effect on the N status and growth of *Hevea* was studied in an experiment, C/77/8, *Boralu* series soil. Results, obtained in November 1978 show (Table 10) that application of potassium to rubber trees improves their girthing, but it has no significant effect on tree growth when applied to ground covers. (*N. Yogaratnam, F. P. W. Silva* and *B. Arsecularatne*).

Table 10. *Effect of potassium on growth of immature rubber*

Treatments		Mean girth (cm)
Nil potassium		9.68
Potassium to rubber only		12,22 ***
Potassium to cover only	- level 1	10.28
Potassium to cover only	- level 2	10.55
Potassium to rubber and cover	- level 1	12.37 ***
Potassium to rubber and cover	- level 2	12.43
L. S. D.		0.96

Soil survey of the Alutgama topographical map

The low intensity detailed soil survey of the Alutgama map was continued. Field work of the North Eastern quadrant was started. A fair amount of this area is undeveloped land mostly in secondary jungle and forest. The collaborating scientist from the Land Use Division of the Irrigation Department, was not available during the last part of the year; consequently, field work could not be continued. The likelihood of the field work being continued is remote because this joint project has received low priority from the Land Use Division. The chemical. physical and mineralogical analysis of the soils, already identified, were therefore initiated. (*C. G. Silva, S. E. Jayasooriya*[1], *T. A. C. S. Wasanthadeva, and F. P. W. Silva*).

Soil and foliar survey for discriminatory fertilizer recommendations

This programme, which was initiated in 1973, with the soil and foliar survey of all the mature PB 86 areas of 9 Agency House managed estates in the Kalutara District, and covering an acreage of about 2840 acres, has been expanded to include all clones and all the planting districts. The total acreage surveyed and resurveyed up to the end of 1978 is 523,672 acres. The progress of this scheme up to the end of 1978 is given in Table 11. (*C. G. Silva, F. P. W. Silva and T. A. C. S. Wasanthadeva*).

Table 11. *The progress of the Soil and foliar survey scheme*

	Number of estates surveyed		
Year	*New Surveys*	*Re-Surveys*	*Total acreage*
1973	09		2841.5
1974	24		7048.75
1975	33		9218.75
1976	29	03	13570.0
1977	02	10	4871.25
1978	09	39	19456.85
Total	106	52	57007.10

[1] Soil Surveyor, Land Use Division, Irrigation Department.

Analytical Chemistry

The number of chemical analysis carried out for the foliar survey, experimental and advisory work was 3526; consisting of 3400 leaf and 126 soil samples. 250 soil samples and 5015 leaf samples were collected during the year.

A Technicon Auto Analyzer II was installed in the Department in September. Since installation it has been used for the routine analysis of leaf samples. Development work has been undertaken to ascertain the feasibility of using a common digest to determine N, P, K, Ca and Mg. (*N. Yogaratnam, A. M. A. Perera, H. A. Seemon, L. J. Wickremasinghe, D. R. Denawaka and P. S. R. A. Samarakone.*).

Radio Tracer Studies

Root activity pattern: The results of this experiment P 32/76/2 were presented at the joint FAO/IAEA Symposium on the use of Isotopes and Radiation in Research on Soil-Plant relationships, held in Sri Lanka, 11-15 December 1978.

The work done at the University of Columbia, Missouri, was submitted for publication. The title of the paper is given under publications. (*C. G. Silva and E. R. Graham*[2]).

Soil calcium: Ca_{45} was used to study the labile pool Ca equilibria in the more important rubber soils. (*C. G. Silva and B. P. M. Arsecularatne*).

Trace elements

Molybdenum: Factors influencing the Molybdenum content of soils and leaves in a rubber plantation is being studied. It shows (Table 12) that the Molybdenum content of Boralu soils decreases with depth, but that there is no significant difference with regard to distance from the tree. Exposed intermediate leaves reflect the soil molybdenum status best. Leaf molybdenum content (Table 13) is higher in shaded mature leaves than in exposed young leaves. (*N. Yogaratnam S. A. Prathapar*[3] and *N. Athapathu*)

Table 12. *Influence of distance from the base of the tree and depth on soil molybdenum*

Depth of sample (cm)	Mean to content (ppm)	Distance from the tree (ft)	Mean to content (ppm)
0 - 10	15.71	2	14.48
10 - 20	13.73	3	14.62
20 - 30	13.16	4	13.50
L. S. D.	2.17	L. S. D.	2.17

2 Professor of Soil Science, University of Missouri, Columbia, U. S. A.

3 Research student from the Faculty of Agriculture University of Sri Lanka.

Table 13. *Variation in leaf molybdenum with relation to maturity and distance from the tree*

Stage of maturity	Distance from the tree (ft) 2	3	4
Tender	−0.1341	−0.2618	+0.2857
Inter	−0.0784	−0.1123	+0.4951 *
Mature	−0.1236	+0.2624	+0.0228

Evaluation of locally available apatite

A pot experiment was initiated to evaluate the relative efficiency of locally available Eppawela apatite, compared to the imported rock phosphate. In this experiment two levels of monocalcium phosphate apatite and saphos are compared using buckwheat plants as an indicator. The soil is of Homagama series (*C.G. Silva* and *L. J. Wickremasinghe*).

Oil Palm

The analytical data of the leaves collected In 1977 were studied and a manuring schedule was submitted for the entire Oil Palm acreage at Nakiadeniya State Plantation. Leaf samples were also removed from the experimental areas so that we may formulate the required leaf critical values instead of seeking he assistance of overseas scientists for interpretation of leaf analytical data. The leaf analytical data of the mature commercial areas indicated a sharp drop in potassium levels and extra amounts of potash were recommended for such areas. (*C. G. Silva, N. Yogaratnam* and *F. P. W. Silva*).

Soil conservation

Inadequate ground cover during the early stages of growth of young rubber results in run-off and soil losses. Investigations were therefore undertaken to study the influence of ground cover crops, mulch and consolidation with natural rubber formulations on run-off and soil losses. Run-off plots were constructed at slopes of 35 to 40%. Each plot contained four planting points of clone PB 86. At the bottom end of the slope, a conveyance channel helped the water to flow through a 'H-flume' device into a collection tank *via* a multislot diviser. Run-off recorders fixed along the 'H-'flume' measured the rate of flow of water. The collection tank at the end, measured the total volume of water and weight of soil collected.

Results obtained in 1978 showed that mulching with Guatemala grass loppings reduced run-off and soil erosion markedly, as compared to clean weeded, and bare land. The delay in the establishment of leguminous cover crops resulted in the loss of soil that was comparable to that in clean weeded land, in the early stages. No appreciable soil losses were evident in the plots in naturals (weeds). Of the natural rubber treatments, latex-oil emulsion gave effective protection against erosion. It appears that the effect of NR formulations in reducing soil erosion may have been due to mere physical and /or chemical entanglement between rubber and soil particles and not due to greater infiltration. (*N. Yogaratnam, M. Nadarajah* and *W. C. Dayaratne*).

Weed control

No work was done in this field. But, observations were made from experiments started under covers and cover management on weed competition and succession. Use of herbicides does not appear to be an economic proposition, at today's prices. (*N. Yogaratnam*).

INDEX TO FIELD EXPERIMENTS

F/60/1 Fertilizers and stimulation on yield, Eladuwa Estate, Paiyagala *Boralu*, PB 86, 1949.

F/61/1 Fertilizers on yield, RRISL Sub-station, Kuruwita, *Boralu*, PB 86, 1961.

F/61/2 Fertilizers on yield, RRISL Sub-station, Kuruwita, *Boralu*, PB 86, 1961.

F/71/1 Fertilizers on bark renewal, Lowmont Division, St. George Estate, Kalutara, *Boralu*, RRIM 623, 1964.

F/71/2 Fertilizers on growth, Neuchatel Estate, Neboda, *Boralu* PB 217 1971.

F/72/1 Sources of nitrogen on yield, Pahan, Sorana, Lowmont, Clyde, Neuchatel and Nellunuyana Estates, Kalutara District, *Boralu*, PB 86.

F/73/1 Sources of phosphorus on growth. Dartonfield Group, Agalawatta, *Agalawatta*, 1973, RRIC 101.

F/76/1 Fertilizer on growth, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1976.

F/76/2 Sources of nutrients on growth, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1976.

F/76/3 Fertilizers on growth, Elpitiya Estate, Elpitiya, *Agalawatta*, PB 86, RRIC100, RRIC 101, 1976.

F/76/4 Fertilizers on growth, Sorana Estate, Horana, *Homagama*, PB 86, RRIC 100,

F/76/5 Fertilizers on growth, Eladuwa Estate, Paiyagala, *Boralu*, PB 86, RRIC 100 101, 1976.

F/76/6 Fertilizers on yield, Annasigalla Division, St. George Estate, Matugama, *Boralu*, RRIC 45, 1969.

F/76/7 Sources and method of placement of nitrogen on yield, Annasigalla Division, St. George Estate, Matugama, *Agalawatta*, RRIC 45, 1969.

F/76/8 Fertilizers on yield, Rayigam Estate, Ingiriya, *Agalawatta*, RRIC 45, 1967.

F/76/9 Fertilizers on yield, Kiribathgala Estate, Ratnapura, *Ratnapura*, Wagga, 1965.

F/76/10 Fertilizers on yield, Hathbawe Estate, Rambukkana, *Parambe*, PB 86, 1964.

F/76/11 Fertilizers on yield, Muwankande Estate, Mawatagama, *Parambe*, RRIM 623, 1967.

F/76/12 Sources of nutrients on yield , Glassel Division, Maha Oya Estate, Dehlowita, *Parambe*, PB 86, 1961.

F/76/13 Time of fertiliser application on nutrient uptake and yield, Vincit Estate, Waharaka, *Boralu*, RRIM 623, 1968.

F/76/14 Discriminatory application of fertilizers on yield, Pembroke Estate, Kalutara *Boralu*, PB 86, 1968.

F/76/15 Fertilizers (economics), Pembroke Estate, Kalutara, *Boralu*, RRIM, 1959.

F/76/16 Time of fertilizer application on nutrient uptake and yield, Padukka Estate, Padukka, *Boralu*, RRIM 623, 1967.

F/76/17 Sources of phosphorus on growth, Eladuwa Estate, Paiyagala, *Boralu*, PB 86, 1974.

C/70/1 Covers and cover management practices, on growth and yield, Pussella Estate, Parakaduwa, *Boralu*, RRIM 623, 1970.

C/70/2 Covers and cover management practices, Hedigalla Estate, Agalawatta, *Boralu*, RRIC 101, 1970.

C/72/1 Covers and cover management practices on growth, Sorana Estate, Horana, *Boralu*, PB 28/59, 1972.

C/77/1 Types of covers on growth, Mirishena Estate, Mahagama, *Boralu*, PB 86, 1977.

C/77/2 Types of covers on growth, Eduragalla Estate, Ingiriya, *Agalawatta*, PB 86, 1977.

C/77/3 Types of covers on growth, Lowmont Division, St. George Estate, Kalutara, *Boralu* & *Agalawatta*, PB 86, 1977.

C/77/4 Types of covers on growth, Moraliya Estate, Ruwanwella, *Parambe*, (*low mica*) & *Homagama*, PB 86, 1977.

C/77/5 Types of covers on growth, Parambe Estate, Undugoda, *Parambe*, PB 86, 1977.

C/77/6 Types of covers on growth, Muwankande Estate, Mawathagama, *Parambe* (*Low mica*) & *Homagama with low mica*, PB 86, 1977.

C/77/7 Types of covers on growth, Artherfield Estate, Avissawella, *Homagama*, PB 86, 1977.

C/77/8 Potassium nutrition of covers on nitrogen fixation and growth, Lowmont Division, St. George Estate, Kalutara, *Boralu*, PB 86, 1977.

FN/77/1 Foliar nutrient sprays on growth, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1977.

FN/77/2 Foliar nutrient sprays on growth, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1977.

FN/77/3 Foliar nutrient sprays on growth, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1977.

FN/77/4 Foliar nutrient sprays on nutrient uptake, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1977.

FN/77/5 Foliar nutrient sprays on nutrient uptake, Pembroke Estate, Kalutara, *Boralu*, PB 86, 1977.

REVIEW OF THE RUBBER CHEMISTRY DEPARTMENT

By

M. Nadarajah

SUMMARY

The results of research and promotional work done by the Rubber Chemistry Department were reported in sixteen papers presented at Conferences in Sri Lanka and abroad. Three Sri Lanka patents were filed during the year and the Staff of the Department assisted the various University campuses by delivering two hundred and ninety one hour lectures to undergraduate students.

The Rubber Technology Section continued to give assistance to local industrialists in setting up both small and medium scale industries. The work in the Section included analysis of raw materials, testing of compounds and standardisation of products.

Sri Lanka is the World's largest producer of latex crepe, which is sold only on Green Book Specifications and the main specification is its colour. There was a steady decline in the World demand for latex crepe in 1978. The causes for this may be due to lack of uniformity, variability in properties resulting chiefly from the method of preparation, which information is not communicated to the consumer, and the fact that it is not presented in block form. To overcome these defects and to ensure that there is an increase in the demand for Sri Lanka light coloured rubbers, the RRISL has actively promoted the production and export from Sri Lanka of blocked latex crepe sold to technical specifications and the grades approved by the Bureau of Ceylon Standards are: SLR EQ, SLR L, SLR WF and SLR 5F.

Since RPA 3 would not be commercially available in the near future, work was done to find substitutes. Preliminary experiments have shown that a dispersion of titanium dioxide at dosages of about 0.01% to 0.03% of the rubber may mask the yellow caratenoid pigment colour. It is necessary that the concentration of titanium dioxide does not exceed 0.03%; as the crepe could get an unwanted white pigmented colour with high dosages of titanium dioxide. Calcium stearate in tread formulations was found to have a synergistic antioxidant action with amine antioxidants and could thus replace some of the expensive antioxidants normally used in tyre trends. Cetyl trimethyl ammonium bromide can be commercially used to improve the mod value of fractionated lace crepe, without altering the colour of the crepe. Experiments were done on reclaiming vulcanised rubber and the most effective solvent was a mixture of chlorobenzene and toluene. No major problems in the handling of HCl was experienced in its use as an alternative coagulant, over a period of two years in several Group Processing Centres. The substitution of 75% of formic acid by hydrochloric acid in its use as a coagulant gave good quality RSS and a cost saving of 1.5 cts /Kg rubber can be obtained.

Cyclised rubber can be used commercially in Banbury mixes, but to obtain satisfactory reinforcing properties in two roll mixers, special mixing procedures will have to be adopted. The use of room temperature and sunlight curing latex formulations, in backing candle wick mats for export, was developed by us and is now being used commercially. Latex from clones RRIC 100, and 103 was found to be suitable for latex crepe manufacture.

Assistance was given to the Sri Lanka Drafting Committee for TSR standards to draw up specifications for blocked latex crepe.

DETAILED REVIEW

STAFF

Mr. M. Nadarajah, Head, Rubber Chemistry Department, Mr. S. W. Karunaratne Chief Rubber Technologist, Dr. P. A. J. Yapa, Biochemist, Mr. R. Tharmalingam, Chemical Engineer, Dr. L. M. K. Tillekeratne, Specifications Officer and Drs. A. Coomarasamy, M. R. N. Fernando, A. M. A. Amarapathy and W. S. E. Fernando, Rubber Chemists, were on duty throughout the year.

It is with deep regret that we record the death of Mr. D. S. Muthukuda, Development Officer, on 16th May 1978. Mr. Muthukuda was a quiet efficient Officer, well liked by all sections of the staff.

Dr. A. Coomarasamy and Dr. M. R. N. Fernando visited Malaysia in May and December, respectively, to attend the IRRDB Seminar and the Rubber Technology Conference. Dr. A. M. A. Amarapathy visited the U.K. in November to attend the International Polymer Latex Conference. Dr. P. A. J. Yapa visited India in December to attend the IRMRA Conference.

Mr. K. Silva proceeded to the U.K. to do a course on the care and maintenance of instruments, for ten months, on a Colombo Plan Scholarship. Mr. M. C. S. Perera followed the one year course leading to the M.Sc degree in Polymer Science and Technology, at the University of Sri Lanka, Vidyodaya Campus.

The following Officers were promoted: Dr. W. S. E. Fernando to the post of Rubber Chemist, Mr. S. Kasinathan to Senior Technical Assistant, Mr. G. Dodangoda to the post of Technical Asst. and Mr. R. Wickremaratne to the post of Specification Asst. Messrs E. G. Mendis, V. K. Jayasiri, D. R. Pieris, P. V. A. G. Perera, N. Pieris, W. Kobawaka, A. J. S. K. de Silva and Miss S. Lokuge resigned from the services of the RRISL. Mr. Anura de Silva assumed duties during the year as a Technical Assistant.

Conferences

The following five papers were presented at the IRRDB Seminar held in Kuala Lumpur, Malaysia, in May 1978:-

Self reinforced granular rubber, by W. S. E. Fernando, R. Tharmalingam, and M. C. S. Perera.

Some aspects of chemical modification of NR, by W. S. E. Fernando, A. Coomarasamy, and L. M. K. Tillekeratne.

Production of high quality rubber from skim latex, by P. A. J. Yapa, M. Nadarajah and W. A. Lionel.

Some practical uses of low temperature and sunlight curing of natural rubber compounds, by M. R. N. Fernando and M. Nadarajah.

Manufacture of high quality rubberised fabrics, using natural rubber latex by A. M. A. Amarapathy, M. Nadarajah and M. G. Manel.

The following two papers were accepted for presentation at the International Rubber Conference, Kiev, U.S.S.R. in October 1978:

Recent developments in Sri Lanka for increased natural rubber usage, by M. Nadarajah, A. Coomarasamy and R. Tharmalingam.

Vulcanising systems for low temperature and sunlight curing of natural rubber compounds, by M. R. N. Fernando and M. Nadarajah.

The following paper was presented at the International Polymer Latex Conference, at London; in October 1978:

Mechanisms of antioxidant action — Improved ageing performance of latex products containing bound antioxidants by A. M. A. Amarapathy and G. Scott.

The following two papers were presented at the Indian Rubber Manufacturers' Research Association Conference, held in Ahamadabad, India, in December 1978.,

Methods of purifying waste engine oil and studies on black loaded natural rubber mixes containing this ingredient. by A. M. A. Amarapathy.

Use of papain treatment of NR latex to produce superior quality rubber. by P. A. J. Yapa, M. Nadarajah and K. S. Loganathan.

The following six papers were presented at the 34th Annual Sessions of the Sri Lanka Association for the Advancement of Science.

Use of palmyrah seed distillate as a coagulant for NR latex. by A. Coomarasamy, P. A. J. Yapa and S. Kasinathan.

Ageing properties of natural rubber with cashew nut shell liquid incorporated into latex. by R. A. Rajapakse and M. Nadarajah.

Methods of purifying waste engine oil and studies on black loaded natural rubber mixes, containing this ingredient. by A. M. A. Amarapathy.

Further progress in the use of rubber for improvement of impact resistance in ferrocement boats. by M. U. G. Fernando, M. R. N. Fernando, M. Nadarajah and P. Dahanayake.

Efficient vulcanisates of liquid rubber with similar mechanical properties as conventional rubbers. by L. M. K. Tillekeratne and S. A. R. D. Sebastian.

Soil erosion and run-off studies in rubber plantations. by N. Yogaratnam, M. Nadarajah and W. C. Dayaratne.

The following article was published in the Dinamina (Sinhala): Implications of renewed interest in Guayule rubber on *Hevea* rubber. by P. A. J. Yapa.

Lectures in Polymer Chemistry and Rubber Technology

The following Officers delivered one hour lectures for the M.Sc. course at the Vidyodaya Campus; M. R. N. Fernando (30) S. W. Karunaratne (4) A. Coomarasamy (14) A. M. A. Amarapathy (20), L. M. K. Tillekeratne (15) M. Nadarajah (4) P. A. J. Yapa (2), R. Tharmalingam (12) and W. S. E. Fernando (8).

M. Nadarajah delivered forty eight one hour lectures for the LPRI Course; L. M. K. Tillakeratne delivered sixteen one hour lectures for the NDT (Rubber) Course; R. Tharmalingam delivered fifty L. M. K. Tillekeratne ten and W. S. E. Fernando eight one hour lectures to the B.Sc. Applied Science Course at the Katubedda Campus.

A. Coomarasamy delivered (10), W. S. E. Fernando (12), S. W. Karunaratne (8), A. M. A. Amarapathy (13) and M. R. N. Fernando (6) one hour lectures for the TPRI course organised by the PRI (Sri Lanka section).

Boards and Committees :

M. Nadarajah served as a member of the Board of Directors of the State Rubber Manufacturing Corporation and on Ceyesta. Dr. P. A. J. Yapa served as a member of the Committee of Section B of the SLAAS.

Patents

The following Sri Lanka Patent applications were made:-

1. No. 7713 in the names of P. A. J. Yapa, M. Nadarajah and W. A. Lionel on "The manufacture of high quality rubber from skim latex".

2. No 7733 in the names of M. R. N. Fernando and M. Nadarajah on "The use of a room temperature vulcanising natural rubber latex compound in carpet backing."

3. No 7790 in the name of W. S. E. Fernando on "Use of metal salts of fatty acid activator to improve aging, flex and abrasion resistance of black reinforced natural & synthetic rubber vulcanisates".

Research Students

Mr. S. P. Prematilleke commenced studies in the Biochemistry Section, funded by a research grant from the National Science Council. He is working on: "The biochemical characterisation of *Hevea* clones with special reference to latex proteins." His work is being supervised by P. A. J. Yapa.

Miscellaneous

S. W. Karunaratne, Chief Rubber Technologist, performed the following functions during the year: As Chairman of the Plastics and Rubber Institute of Sri Lanka he participated in twelve meetings of the general committee and thirteen lecture meetings. He served as chairman of the drafting Committee on NR set up by the Bureau of standards. Altogether five meetings were held during the year. He also served as the Chairman of the committee appointed by the National Apprentice Board to draw up a scheme of in plant training in rubber technology. A draft of the final report was drawn up at the last meeting held in December. He attended two meetings of the drafting committee on cycle tyres and tubes, set up by the Bureau of Standards. He was co-opted to the interviewing panel set up by Vidyodaya Campus to examine a batch of five M.Sc students who had completed their course in polymers. He delivered a lecture at the SLAAS/SLSPC Agricultural Seminar held in Galle on the subject: Rubber based Industries.

Cyclised rubber: Cyclised rubber was produced on a semi-commercial scale in three crepe factories using the process developed by the RRISL. The product was used mainly in microcellular formulations as a reinforcing filler by one leading rubber product manufacturer in Sri Lanka. They were able to obtain satisfactory reinforcing properties by Banbury mixing. To obtain a satisfactory quality masterbatch by two roll mill mixing, it is desirable to add masticated natural rubber to the cyclised rubber melt on a hot two roll mill. Calcium oxide can be added on the mill to neutralize the excess acidity of the cyclised rubber resin, prior to the addition of masticated rubber.

Trial batches of cyclised rubber samples were prepared with constant viscosity papain coagulated rubber, together with antioxidants such as nonox WSP, Accinox BL and fillers and pigments such as china clay, titanium dioxide and silica with a view to obtaining an easily dispersible/soluble grade of cyclised rubber. Although there was some improvement in the dispersibility of the cyclised rubber, prepared with CV rubber, there was not much improvement in the reinforcing properties, compared to the normal grade of cyclised rubber. (*A. Coomarasamy, M. Nadarajah, R. Surendrakumar* and *L. B. K. Silva*).

Modification of NR by graft copolymerization: Work on graft copolymerization was carried out in order to produce toughened plastic materials and oil resistant rubbers. Most of the experiments were carried out with deammoniated field latex. The emulsion polymerization technique with redox catalysts was used to effect grafting. For the preparation of toughened plastic materials, up to 70% monomers (on total modified polymer), such as styrene and acrylonitrile, were used in the grafting experiments. It was found that these modified latices could be spray dried to form dry polymers in powder form at 110°C. Alternatively these latices could be coagulated with dilute sulphuric acid to form the dry powder. Studies on processing behaviour and properties of these materials have been initiated.

It has been found that the grafting efficiency of acrylonitrile monomer on to NR latex is low and in order to obtain a grafted rubber with a higher percentage of grafts, experiments were conducted with binary mixtures of acrylonitrile and acrylamide, using redox initiator systems. The raw rubber properties and oil resistance of these grafted rubber samples are being studied. (*A. Coomarasamy, W. S. E. Fernando, T. Nirmala and R. Surendrakumar*).

Preparation and uses of polymers containing carboxyl groups:

a. *Encapsulating agents for granular rubber*: Polymers containing carboxyl groups were prepared by copolymerizing acrylic acid with ethyl acrylate, methyl methacrylate and vinyl acetate by emulsion polymerization and solution polymerization techniques. Preliminary results obtained have shown that the granular form of natural rubber could be obtained if the synthetic polymer in the mix, prior to coagulation, is 10% or more. It has also been found that the derivatives of 1 : 1 alternating copolymer of styrene and maleic anhydride could also be used as excapsulating agents for granular rubber.

b. *Creaming agents for NR latex*: A creamed latex of 60% DRC could be prepared by using the sodium salt of styrene/maleic acid 1:1 copolymer as the creaming agent at 0.1 - 0.2% of latex. Soaps could be used as secondary creaming agents. Properties of this creamed latex are being studied.

c. *Preparation of polymeric antioxidants*: Use of styrene/maleic anhydride 1:1 copolymer as an intermediate in the synthesis of polymeric antioxidants is being investigated. Polymeric antioxidants have been prepared by reacting 4 amino-diphenyl amine and 2,6 ditertiary 4 methylol phenol with styrene/maleic anhydride copolymer. The antioxidant efficiency and compatibility of these new compounds with natural rubber, neoprene rubber and nitrile rubber are being studied. (*A. Coomarasamy, W. S. E. Fernando, R. Surendrakumar*).

Preservation of latex adhesives: Preliminary evaluation on the effectiveness of the low toxicity bactericides/fungicides such as Proxel CRL, Proxel HL2, Panacide CA, Vancide 51, on the long term preservation of formaldehyde stabilized centrifuged latex was carried out during the latter half of the year. The results so far obtained have shown Proxel grades to be quite satisfactory for this use. Further work is being carried out. (*A. Coomarasamy, I. Liyanage* and *T. Nirmala*).

Use of CNSL as an antioxidant for raw rubber: Work done in collaboration with Dr. R. A. Rajapakse of the CISIR shows that CNSL is not an antioxidant for raw rubber. However, it is an antioxidant in sulphur cured vulcanisates and the results are the same whether it is added to dry rubber or mixed with rubber at the latex stage. (*M. Nadarajah*).

Formaldehyde stabilised centrifuged latex: Field latex was treated with 0.15% NaOH, 0.4% HCHO and 0.05% TMTD on the latex kept overnight and centrifuged. The centrifuged latex was mixed with 0.2% HCHO and 0.05% TMTD and divided into two parts. One part was mixed with 0.1% NaOH and it was found to have an MST of 550 secs and a pH of 7.9. To the other part was added 0.2% NaOH and it was found to have an MST of 1100 secs and a pH of 8.9. The method therefore at present recommended for the manufacture of formaldehyde stabilized centrifuged latex is to add 0.15% NaOH, 0.4% HCHO and 0.05% TMTD to field latex and to add 0.2% NaOH, 0.2% HCHO and 0.05% TMTD to the centrifuged latex. (*M. Nadarajah*).

Uses of Rubber seed oil: Lever Brothers (Ceylon) Ltd. has purchased 200 tons of Rubber Seed Oil at Rs. 4,000/- per ton for use in their washing soap manufacture. Rubber Seed Oil at this price is cheaper than coconut oil and can be used as a substitute at 5 to 10% with no significant change in properties of the soap. (*M. Nadarajah*).

Extraction of rubber seed oil and manufacture of Alkyd Resins: The manufacture of light coloured paints and meaningful utilisation of rubber seed cake were the two aspects looked into. Experiments were carried out using freshly collected seeds. In a trial with 10 cwts of seeds, it was found that the seeds, when stored in a heap, show an increase in temperature of about 10°F over room temperature. This effect is at its maximum after about 14 days of storage. Then the temperature gradually drops to room temperature.

Oil was solvent extracted from crushed kernel in a large soxhlet apparatus. Various types of solvents, such as hydrocarbon fractions, acetone, etc. were found to be suitable for the extraction. It was possible to obtain high yields (40% to 50% on weight of kernel) of very light coloured oil and almost white shell-free cake. This is in contrast to the poor yield of a dark coloured oil (yield of about 20% to 25% and a very dark cake containing some oil and pieces of shell) obtained by the expeller process, which is currently used. The colour of the oil extracted deteriorates with prolongation of seed storage time. It was also found that methanol washing of extracted oil makes the latter less sensitive to heat and therefore leads to light coloured alkyds. As it is very clear that solvent extraction is very essential

if light coloured oils and a high protein shell-free cake (suitable as an animal-feed) are to be produced, work is being done to study the possibilities of using simple batch type solvent extractors for rubber seed oil extraction. This is being done in collaboration with Ceylon Resinoplastics. Designing and evaluation of simple batch type extractors is being carried out. (*M. R. N. Fernando* and *K. A. R. M. Perera*).

Network bound antioxidants: An amine type antioxidant containing a thiol group, viz. 4-mercapto acetamido diphenyl amine was prepared by reacting 4-amino diphenyl amine with thiofycollic acid. The product was added to natural rubber latex by the earlier developed method of free radical addition, and an antioxidant bound rubber was prepared by a Masterbatch Technique. (*M. R. N. Fernando* and *N. D. Dharmadasa*).

CNSL as an antioxidant: The suitability of a sample of modified CNSL (Cashewnut shell liquid, supplied by CIC Ltd.), as an antioxidant in Natural rubber was investigated in detail. Properties such as cure characteristics of compounds as well as Continuous Stress Relaxation at 70°C and 100°C, Abrasion Resistance, Resilience, Hardness, Tensile Strength, Elongation at Break, Modulus and Oven Ageing at 70°C and 100°C of vulcanizates were compared with those of compounds and vulcanizates containing PBN, IPPD, WSP and no antioxidant. Modified CNSL showed comparatively poor antioxidant properties. (*M. R. N. Fernando and K. A. R. M. Perera*).

Use of metal salts of fatty acids in sulfur vulcanization: The use of calcium stearate in tread formulation in place of stearic acid was investigated. Laboratory scale trials indicated (a) A synergistic antioxidant activity in the presence of amine derivatives of antioxidants, (b) Antiflex cracking activity, and (c) Improved abrasion resistance. These were accompanied by a slight reduction in the 300% modulus of the vulcanizates.

Preliminary trials were conducted at the Tyre Corporation. The aim of the project was to investigate the possibility of complete removal of antioxidants HS (0.5 parts) and antiflex cracking agent, santoflex IP (2.0 parts) from the formulation. Important aspects of the test formulation and the results are highlighted below. (*W. S. E. Fernando, W. Kobawaka and M. G. Manel*).

	Tyre tread formulation	*Test formulation*
NR	100	100
Antioxidant HS	0.5	—
Santoflex AW	2	—
Santoflex IP	1.0	1.0
Stearic Acid	2.5	—
Dutrex R	8	—
Calcium stearate/Dut. R. mix (2-5 : 8)		10.5
Retention of TS on ageing at 100°C for 3 days	73%	87%
Crack initiation Kilo cycles	33.75	39.38
Crack growth Kilocycles	157.5	185.0

Metal salts of fatty acids as heat stabilizers for PVC: Calcium, barium, and cadmium salts of rubber seed oil and castor oil were prepared for use in PVC compounds as heat stabilizers. Chemical Industries (Ceylon) Limited has undertaken to send these samples abroad to their principals for testing. (*W. S. E. Fernando and L. M. K. Tillekeratne*)

Modification of cure behaviour of fractionated lace crepe: Cetyl trimethyl ammonium bromide at concentrations of 0.1 - 0.2 phr improved the cure behaviour of fractionated lace crepe from slow to fast curing rubber. The use of this surfactant, before coagulation in fractionated latex, improves the Mod value of fractionated lace crepe without altering the color of crepe. (*W. S. E. Fernando and M. G. Manel*).

Creaming of field latex: The normal creaming of field latex involves the use of high amounts of ammonia which increases the cost of the cremed latex considerably. Further, the creamed latex has to be deammoniated in the manufacture of latex products. Field latex with 0.35% ammonia and 0.025% TMTD/ZnO (1:1), was creamed with 0.2% ammonium alginate and 0.05% ammonium soap of coconut oil fatty acid. The serum was removed after 15 days. The drc was 53% and the ammonia content was 0.18%. The latex was further stabilised with 0.025% TMTD/ZnO on the latex. This appears to be a convenient method of preparing low ammonia creamed latex with TMTD/ZnO. (*M. Nadarajah and N. R. Munamalpe*).

Liquid rubber analysis and modifications: Research work on this project was continued and an application made for a full Sri Lanka Patent for the manufacture and vulcanisation of the liquid rubber. A paper was presented at the SLAAS Sessions this year on efficient vulcanising systems of this product. (*L. M. K. Tillekaratne, S. Weeraman and R. Sebastian*).

Epoxidised liquid NR: Research on this project to develop an efficient room temperature vulcanising system is still in progress. (*W. S. E. Fernando, L. M. K. Tillekaratne, S. Weeraman and R. Sebastian*).

Bound antioxidant: It was found that only "Topanol A" gives a reasonable ageing resistance towards oxidation of NR, when grafted on to a natural rubber molecule. The experimental work on this project is over, and pilot scale trials were done. A 10kg sample of latex crepe with bound antioxidant was sent to Mr. Ken W. Knight of Messrs. Easthampton Rubber Thread Co., for evaluation of properties. (*A. M. A. Amarapathy and N. R. Munamalpe*).

Chemical modification of cashewnut shell liquid: The object of this study is to prepare a water insoluble sulphur containing phenol, which could act as an antioxidant for rubber. The method under investigation is a two stage process.

a) Chlorination of CNSL

b) Coupling of the chlorinated product in the presence of sodium di-sulphide.

This work is in progress. (*A. M. A. Amarapathy, W. S. E. Fernando and N. R. Munamalpe*).

P V C - N R blends: Polyvinyl chloride being a chlorinated polymer, straight blending of NR cannot result in a fully compatible blend. To overcome the incompatibility of the two polymer grafts, copolymers of NR with polar monomers were made. Preliminary studies show that methyl methacrylate grafted NR can be blended with PVC in a Banbury to give a fairly consistant product which can be compression moulded at 180°C. Further experiments are in progress. (*A. M. A. Amarapathy, W. S. E. Fernando & N. R. Munamalpe*).

Production and testing of reclaimed rubber: Experiments were initiated to find out a suitable solvent system to soften vulcanised waste rubber for easy granulation. Several solvent systems were tried out and the most effective system was found to be a mixture of chlorobenzene and toluene. With this mixture it was possible to cut down the soaking time to about two hours before granulation into a fine powder. Reclaimed rubber manufactured by a local firm was evaluated by physical tests such as extrudability, ability to accept fillers and vulcanization tests and compared with samples obtained by the above method. Ground reclaimed rubber, after washing and drying, were incorporated into a typical rubber compound up to 10 parts per 100 parts of rubber, without impairing the cure behaviour and physical properties. Addition of the ground reclaimed scrap also improved the processability of the compound. The extent of vulcanization of a series of batches of partially vulcanised rubber compounds was determined by a swelling method using a calibration graph indicating cross link density as a measure of swelling intensity. Selected batches of partially vulcanised compound could be further milled and processed but the product obviously has poor technological properties. Possible applications are in the manufacture of floor mats and paddings for packaging purposes, where high technological properties are not required. (*S. W. Karunaratne, P. P. Jayasinghe, R. Mendis & N. Pieris.*)

Use of low viscocity (LV) rubber in rubber band manufacture: The use of 4phr mineral oil and hydroxylamine at 0.15% phr gives a LV rubber. Chemicals for rubber band manufacture were added on a two roll mill and the Wallace Plasticity brought down to 17. When extruded for rubber bands, there was considerable die swell indicating that though the correct plasticity was obtained, the nerve of the rubber is not sufficiently broken and hence the compound is not suitable for rubber band manufacture. (*M. Nadarajah*).

Room temperature curing systems

a) *Wirecon Boats:* Further trials were carried out to evaluate bond strength and impact resistence of Wirecon test-slabs lined with a room remperature curing system. Values obtained for the above parameters exceed the required minimum levels. (*M.R. N. Fernando, M. Nadarajah and K. A. R. M. Perera*).

b) *Custom compounding of natural rubber for rubber band manufacture:* Custom compounded rubber of satisfactory quality was made at Mawanella Block Rubber Factory and was evaluated at Richard Peiris & Co., Ltd. Further work on this project is in progress. (*A. M. A. Amarapathy, W. S. E. Fernando* and *V. K. Jayasiri*).

Advisory work on medium and large scale latex based industries: Two project reports on the manufacture of foam rubber were given to Metropolitan Industries Ltd. and to Seeduwa Mills. On these reports they were able to obatin D. F. C. C. loans of Rs. 600,000/- and Rs. 400,000/-, respectively. The total capital investment for the above two projects is about Rs. 2.5 million. Seeduwa Rubber Mills is sited at Katunayake and the machnery was imported and installed, under our advice and supervision. They are hoping to go into production by April, 1979.

Metropolitan Industries is also putting up their factory and importing machines, in consultation with us.

Another project report was given to Coirform Industries Ltd. on the manufacture of rubberised coir. This is an investment of 1.3 million rupees, out of which Rs. 900,000/- will be on D. F. C. C. and Bank of Ceylon loans.

In addition to the above:,

a) A factory was set up at Aludeniya Estate, Dehiowita, to cream 80 gallons of field latex per day. The workers in the Estate were trained for this work by the RRI.

b) The necessary advice was given to Relax Industries, Kuliyapitiya, to improve the quality and to increase the production output of rubberised coir mattresses.

c) M/s Richard Peiris & Co., Ltd., D. Samson Industries and several other industrialists were given assistance in solving some of their technical problems and testing of samples. (*A. M. A. Amarapathy and N. R. Munamalpe*).

Advisory work on small scale latex based industries: Training and advice on the setting up of small industries were provided to about 250 people to manufacture:

a) Dipped rubber products
b) Rubberised coir cushions and mattresses
c) Latex castings
d) Foam rubber
e) Creaming of latex.

Most of the people who have had this training have started small scale industries. In addition to this, several demonstrations were held in schools and at exhibitions. (*A. M. A. Amarapathy, W. D. Dharmasena and N. R. Munamalpe*).

Latex supplies: Different types of latex were supplied to small scale rubber product manufacturers in limited quantities and they were charged only the cost of the material. The quantities of each supplied were as follows:-

60% centrifuged latex	- 190 gallons
Compounded centrifuged latex	- 35 gallons
60% HCHO preserved latex	- 15 gallons
30% HCHO preserved latex	- 20 gallons
30% NH_3 preserved latex	- 25 gallons

Advisory work on rubber technology: The rubber Technology Division continued to give assistance to local industrialists. This included analysis of raw materials, testing of compounds and standardisation of products. One of the officers, Mr. W. D. Dharmasena, devoted most of this time in conducting lecture demonstrations on the manufacture of latex-based products. Many students, mainly from the adult education centres of the Education Department, have followed these classes. Further lecture demonstrations were conducted in the outstations and the one conducted at Dedigama Adult Education centre was the most extensive. (*A. M. A. Amarapathy* and *W. D. Dharmasena*).

A proposal to set up a technical services centre was discussed at various levels both in the Ministry of Plantation Industries & the Ministry of Finance. A brief report has been submitted to the Ministry of Plantation Industries outlining the role that should be played by the RRI in developing the centre. Several project reports on the manufacture of both dry rubber and latex based products were submitted to interested parties on request. (*S. W. Karunaratne*).

Room temperature curing systems: A study on combinations of accelerators to obtain low temperature curing formulations was started in 1977. This work was continued further in 1978, covering a wider range of combinations. Binary and tertiary combinations of 2-mercaptobenzthiazole, mercaptobenz-thiazolyl disulphide, tetramethyl thiuram disulphide, diphenyl guanidine, zinc diethyl dithiocarbamate and N-oxydiethylene benzthiazolyl sulphenamide were evaluated. Total accelerator dosage of 4.0 parts and sulphur at 1.0 part per hundred parts of rubber were used in gum compounds. More than 150 different combinations were evaluated using a Monsanto R100 Rheometer at 100°C.

By using these rheogrammes a compound with any given scorch time, rate of cure, ultimate modulus etc. can be easily selected for any desired application.

The use of room temperature and sunlight curing formulations for backing of "candlewick" mats was extensively tested. This process is now being used commercially. Further trials on rubberizing cart-wheels, manufacture of sole crepe, concrete roof-sealing etc. were carried out. Work on these aspects is being continued. (*M. R. N. Fernando, M. Nadarajah, K. A. R. M. Perera* and *N. D. Dharmadasa*).

Evaluation of locally available fillers: The performance of black coir dust as a filler in natural rubber was compared with HAF black. The tested filler level was 45 pphr. Compounds containing HAF black (A), coir dust (B) and a mixture of 50% coir dust with 50% HAF black (C) were evaluated. Aging properties of all the three vulcanizates were found to be comparable when tested by continuous stress relaxation. Compound B was very much inferior to A in all other physical properties but considerable improvement was seen in compound C, where half the dosages of coir dust is replaced by HAF black.

Properties of another locally available waste material, viz. paddy husk ash, was compared with those of Vulcasil-L, a standard silica filler, in butadiene styrene rubber. Compounds containing filler at 100 pphr were tested. Compounds containing paddy husk ash show poor failure properties compared to those containing vulcasil-L. This work was done in collaboration with the Industrial Development Board. (*M. R. N. Fernando* and *K. A. R. M. Perera*).

Rubber carbon black blends: Rubber-carbon black blends were obtained by mixing carbon black with rubber latex using carboxy methyl cellulose (CMC) as the wetting agent. Only 0.5% of CMC was required to incorporate 45% black into the rubber. Following a few small scale experiments in the laboratory, a large scale factory trial was carried out to obtain the blend in black form. The latex-black blend was coagulated at the Dartonfield factory and the coagulum was milled, granulated and dried at the Cenat factory. Samples of this rubber have been sent to the Ceylon Tyre Corporation for evaluating the reinforcing properties. Further, these samples will be sent to M/S Richard Peiris & Co., Ltd. for evaluation.

From the large scale trial it was observed that the percentage of black during processing into block rubber is greater compared to processing into crepe, because of the size reduction process in block rubber manufacture. It is now planned to do another trial in a sheet factory. As less milling is involved in sheet manufacture compared to crepe and block, a greater percentage of black is expected to be retained in the blend in sheet form. (*R. Tharmalingam, W. S. E. Fernando* and *K. P. N. de Silva*).

Powdered rubber - self reinforced granular rubber ((SRGR): SRGR is based on encapsulating rubber particles using the aluminium salt of carboxy methyl cellulose. Technically the commercial implementation of this project is viable, but economically it is not so, due to the high cost of production. (*W. S. E. Fernando, R. Tharmalingam* and *M. C. S. Perera*).

Spray Drying: Satisfactory results were obtained in spray drying modified NR latices in the laboratory spray dryer. This experiment is being continued. (*R. Tharmalingam and K. P. N. de Silva*).

ADVISORY SERVICES TO PRODUCERS

Titanium dioxide dispersion in latex crepe manufacture: RPA3 is used to bleach the yellow carotenoid pigment present in latex crepe and sole crepe manufacture. Since RPA3 will not be commercially available in future, because its manufacture is being discontinued, work was done to find whether the dispersion of titanium dioxide will mask the yellow colour due to carotenoids. It was found that titanium dioxide, added at 0.01% to 0.03% may do so. The titanuium dioxide is made up as a 30% dispersion, and is diluted with water to make a 1% dispersion and is well mixed with some field latex, which is then added to the remaining field latex. It is necessary to ensure that excess titanium dioxide is not used as this will cause a white pigmentation of the latex crepe or the sole crepe. (*M. Nadarajah, M. R. N. Fernando* and *P. K. Withane*).

Routine Advisory Work: The following advisory visits were done by Mr. D. S. Muthukuda, Development Officer in the first Quarter 1978:

RSS. manufacture	-	17
Latex Crepe manufacture	-	9
Sole Crepe manufacture	-	1
Latex weighing and preservation	-	4
Others	-	1
Total	-	32

Coagulation of NR latex with HCL: Trials on HCl coagulation were continued in 3 GPCs throughout the year and no major problems were encountered in the long term handling of this chemical, provided the necessary precautions were taken, and plastic utensils were used in the preparation of stock solutions. HCl used in a mixture with formic acid, where about 75% of the formic acid is replaced by HCl, gave better results than using HCl alone; and the RSS obtained was of a high quality without any blemishes such as bubbles, which were more likely to appear when only HCl was used. In the preparation of the stock solution, 10 parts by volume of HCl (30%) is mixed with 1 part by volume of HCOOH (60%). 300 cc of the stock solution is then diluted to 18 litres and approximately 500 cc of the diluted mixture is sufficient to coagulate one sheet of rubber (0.5 kg).

At the present price of HCl, which is rated at Rs. 2100/- per tonne, the cost saving in the use of the HCl/HCOOH mixture works out to about 1.5 cents per Kg of rubber which is not attractive, taking into account the disadvantages in handling HCl. Its viability as an alternative coagulent system will therefore depend to a large extent on the price factor. (*S. W. Karunaratne & D. D. Medagama*).

Crepe Rubber Development Unit:

1978 has been an year of very great success for the Unit. Two research programmes have been commercially implemented during this year.

Blocking of laces: Technically Specified Rubbers were introduced in Sri Lanka as far back as the late 1960s, on a very small scale. The growth of SLR production has been very sluggish since them. During the year 1977 only 2,000 MT of SLR were produced. During the year 1978, on the advice of the RRI, the State Rubber Manufacturing Corporation and M/s. C. W. Mackie & Co., Ltd. introduced the system of blocking crepe laces into compact bales, resembling the conventional block rubber. This method of blocking was originally suggested by us in 1974. Commercial implementation only became possible in early 1978 due to economic reasons. The growth of SLR production has been comparatively rapid since the introduction of this process and for 1978, block production from laces accounts for more than 50% of the total TSR production in Sri Lanka. The total SLR production for 1978 is estimated to be more than 5,000 MT, compared to 2,000 MT in 1977.

M/s C. W. Mackie & Co., Ltd. have just completed a factory to block laces on a large scale. M/s Sherman Sons & Co., Ltd. are setting up a plant to block laces into TSR. A feasibility report has been sent to the JEDB on the same for commercial implementation. The advantages of this process were highlighted in a Seminar organised by the JEDB for Kegalle and Ratnapura Districts in December, 1978. (*R. Tharmalingam*).

Electrical heating for drying towers: The fin heater blower for drying crepe laces, introduced by us in 1976, has been adopted in several crepe producing factories and more factories have sought assistance for the introduction of this system. It has technical as well as economic advantages over the conventional system of boiler-radiators. (*R. Tharmalingam* and *K. P. N. de Silva*).

Feasibility reports: Technical and economic feasibility reports on setting up a remilled sole crepe factory and for blocking of laces, submitted to M/s C. W. Mackie & Co., Ltd., were accepted by that firm. Now their factory is nearing completion at the Industrial Estate at Horana. (*R. Tharmalingam*).

RRIC, 100 Series Clones: A short term programme was undertaken to evaluate the suitability of RRIC 100 series clonal latices for latex crepe manufacture. RRIC 100, and 103 clones were tested and found suitable for crepe manufacture. It was also revealed from these experiments that latex crepe of the highest quality (IX) can be manufactured by taking a fraction without using RPA 3.

Mr. M. C. S. Perera, Assistant Rubber Chemist, who was following the M.Sc. course in Polymer Science at Vidyodaya Campus, was given a research project to evaluate the physical properties of latex crepe, prepared from different clonal latices with special reference to the RRIC 100 series clones. More detailed information, could be obtained from this project work in due course. (*R. Tharmalingam, M. C. S. Perera* and *K. P. N. de Silva*).

Colour Coding Scheme for Latex Crepe: The Colour Coding Scheme that was put forward at the Seminar in May, 1977 was further discussed in 1978. This scheme which introduced colour codes for crepe rubber, based on the method of manufacture, was issued in the form of a Booklet entitled "A New Presentation Method for Sri Lanka Latex Crepe". The Booklet was printed with technical details and uses of crepe rubber prepared as specified by the colour codes. Several copies of the booklet were sent to overseas buyers of crepe rubber, through the Shipping Firms

for their comments. Some of the comments that we have so far received indicate that most of the buyers have not understood our "message". This shows the necessity for personal contact and promotional work in marketing.

At the moment more attention is being focussed on presenting crepe in block form. Further studies on presenting crepe rubber with a colour code should be undertaken, starting with a survey in consuming countries. (*R. Tharmalingam* and *M. C. S. Perera*).

Bleaching of Crepe: Work was undertaken to find out suitable substitutes for RPA 3 to obtain bleached, light coloured pale-crepe. RPA 3 will not be available in the market in the future due to manufacturing hazards. Promising results were obtained in preliminary trials with thiobeta-naphthol and further work is being carried out using this material. (*M. R. N. Fernando, M. Nadarajah* and *K. A. R. M. Perera*).

Factory Development Scheme: The response to this scheme has been poor during the year 1978, showing a very slow progress in factory development. This was highlighted in the Seminar organised by the JEDB at the Talduwa Club on 12th December, 1978. We anticipate that a large number of factories will require extensive machinery repairs and replacements in the coming years, and the two State Corporations handling estates should immediately start on a systematic programme of factory development.

Block Rubber - Feasibility Reports: Technical and Economic Feasibility Reports were submitted to six interested parties, based on low grade RSS as the raw material.

Block Rubber - Processing Scrap: Trials are in progress at the Durampitiya Block Rubber Factory to process scrap into TSR. The problems of low P_o and PRI were overcome by air drying the laces from crumbs obtained after precleaning in the hammermill, blending in crepers and hammermilling again. The final drying was done in a deep bed drier in lace form. But the dirt and volatile matter are still rather high, and studies are in progress to overcome these problems. (*R. Tharmalingam, and K. P. N. de Silva*).

SPECIFICATIONS

Technical specifications: During this year 7948 samples from Mawanella, 1959 samples from Paiyagala, 7186 samples from C. W. Mackie & Co., Ltd. and 355 other samples have been tested. In addition to this, 1399 rubber samples from Research Departments, 28 latex samples and 5 water samples have also been tested during this year.

Testing charge for a sample of block rubber was increased from Rs. 10/- to Rs. 25/- with effect from October this year in order to cover increased cost of chemicals. (*L. M. K. Tillekeratne*).

Inspectorate visits: In June this year a separate inspectorate was formed under Dr. W. S. E. Fernando and Mr. R. Tharmalingam to carry out the inspection of block rubber factories. A visit was made by the Specifications Officer on the 15th September, 1978 to appraise and evaluate the laboratory at the Mawanella Block Rubber Factory and the work done at the laboratory for the last 4 years, as requested by the Chairman, SRMC, and a report was written. (*L. M. K. Tillekeratne*).

Blocking of RSS: In December, the Specifications Officer carried out an experiment at C. W. Mackie & Co., Ltd. on the possibilities of blocking RSS, to meet SLR Specifications and the results were submitted to the Technical Committee on raw rubber.

The results of these tests enabled the Committee to accept this grade of block rubber also as a new grade of SLR rubbers and C. W. Mackie & Co. was allowed to export a few trial shipments of this grade. (*L. M. K. Tillekeratne*).

Specifications for blocked latex crepe: M. Nadarajah, S. W. Karunaratne and L. M. K. Tillekeratne participated in the Sri Lanka Drafting Committee for TSR standards, organised by the Ceylon Standards Bureau and recommended four grades for blocking latex crepe namely: SLR EQ, SLR L, SLR WF and SLR 5F.

BIOCHEMISTRY

Palmyrah seed distillate as a coagulant for latex: TLC analysis of the distillate has shown acetic acid to be the major acid component in the distillate. Satisfactory and complete coagulation of NR latex could be achieved by using this distillate as the sole coagulant for latex. Our tests have shown that this distillate has no deleterious effects on the technological properties of the rubber. Economic feasibility of using the distillate for the above mentioned use has to be worked out. A paper on this subject was presented at the 34th SLAAS Sessions, December 1978. (*A. Coomarasamy, P. A. J. Yapa, S. Kasinathan and R. Surendrakumar*).

Enzyme deproteinization of Hevea latex: Studies on enzyme deproteinization of NR latex were continued with particular attention to dynamic properties. Various papain treated rubbers were sent to Dunlops India Ltd. for testing for dynamic properties and the results are summarized in Table 1. Of the different treatments of field latex tested, the plain papain treatment resulted in the best heat build up properties, followed by papain/alkali/oxalic acid treatment. The addition of hydroxylamine hydrochloride to latex, with a view to producing the CV version of DPNR seems to adversely affect the heat build up properties. This was thought to be due to a retardation of microbial action by hydroxylamine hydrochloride which has been reported to have bactericidal properties.

The investigations on the sludge removal method (Annual Review 1977) were revived and satisfactory results were obtained. Rubbers with percentage weights of N and Ash of 0.10 each and PRI, 71 were obtained from field latex. These values are well within the proposed (revised) specifications for DPNR by the RRIM. This rubber is now being tested for dynamic properties at Dunlops Laboratories in India. The sludge removal method, adopted by us, was designed to produce favourable conditions for maturation of latex, which was subsequently coagulated with papain.

A large scale trial was carried out on the use of papain as a part coagulant in sheet manufacture (Annual Review 1977). Raw rubber properties were found to be satisfactory with mould resistent characteristics. Samples have been sent to Dunlops Laboratories, India, for tests of dynamic properties.

The vulcanizate properties of skim rubber produced by the new method developed by RRISL (Annual Review 1977) were studied along with the other papain treated rubbers. The results are summarized in Table 1. Further refinements in the process seem necessary to improve further the vulcanisate properties. (*P. A. J. Yapa, M. Nadarajah, W. A. Lionel, M. D. C. Seneviratne in collaboration with K. S. Loganathan of Dunlops India Ltd.*).

Studies on non-rubber constituents: The investigations on non rubber constituents in *Hevea* latex were continued with special reference to thiols. Further studies were carried out on clonal variation (see also Annual Review 1977). Stimulation

TABLE I. COMPOUND AND VULCANISATE PROPERTIES OF PAPAIN TREATED RUBBERS

		Acid coagulated control	Papain Coagulation	Papain/alkali/ oxalic treatment	Papain/ NH_2OHHCL	Skim Rubber
MONSANTO RHEOMETER @ 200°C MODEL TM 100 ARC 5°						
Minimum Torque	(Lbs)	11.0	10.0	15.0	10.0	12.0
Maximum Torque	(Lbs)	70.0	69.0	69.0	74.0	79.0
Scorch Time	(Mins)	1.95	2.00	1.95	2.00	1.95
T 90	(Mins)	3.35	3.45	3.40	3.40	3.30
RT (98% of max torque)	(Mins)	4.20	4.35	4.25	4.20	4.20
VULCANISATE PROPERTIES - CURE 35' min @ 141°C						
Tensile Strength	(MN/m 2)	25.8	27.3	26.0	25.1	25.7
300% modules		17.0	15.6	16.5	16.9	16.2
Elongation @ Break	(%)	460	490	450	445	455
Rebound Resilience	(%)	59.5	62.5	65.4	59.5	56.7
Hardness	IRHD	72	72	69	72	74
Tear Strength N/stp	At 21°C	275	260	275	270	255
Goodrich Flexometer ASTM D 623 - Temp. rise°C	At 100°C	201 24.3	176 18.5	173 20.8	174 29.5	159 26.3

of trees with Ethrel resulted in a marked drop in thiol level in the F-serum. However, it appears, in general, that thiol levels may not serve as a satisfactory indicator with a practical value that can be utilized in the detection of the yield potential of various clones. (*P. A. J. Yapa, and S. Kasinathan*).

The protein content in the dry rubber of popular clones was investigated. Five clones suitable for enzyme deproteinisation by using papain were selected. Seasonal variations in protein content of these clones are being studied. Some of the raw rubber properties such as ash content, Plasticity and Plasticity Retention Index are also being studied. (*P. A. J. Yapa, W. A. Lional & M. D. C. Seneviratne*).

Culture of yeasts in factory serum: This study was initiated during the first quarter of the year, in collaboration with the Chemistry Department of Vidyodaya Campus. Thirty one yeast strains, most of them unidentified, were grown on normal sheet serum. Of these, ten strains were selected for further trials. The degree of fermentation was also recorded with these strains. Attempts were also made to supplement the initial sugar concentration of 0.3 - 0.5% by the addition of waste carbohydrate substrates such as pineapple juice. A considerable improvement in the growth rate was observed when carbohydrate substrates were added. Amino acid composition of these strains is also being studied. (*P. A. J. Yapa in collaboration with Dr. A. W. Liyanage of Vidyodaya Campus*).

Heritability of raw rubber properties : An investigation was initiated late in the year to study the heretability of raw rubber properties. Samples collected at Kuruwita Substation are now being tested. (*P. A. J. Yapa, D. M. Fernando, B. M. S. G. Peiris & M. D. C. Seneviratne*).

Studies on Brown Bast: Studies on antihormonal substances were continued. (Annual Review 1977). Two field trials were carried out with little or no success. Ag^{++} ions were found to have a stimulatory effect on latex production. Further trials with new substances will be carried out next year. (*P. A. J. Yapa, D. M. Fernando & K. W. Rupathunga*).

Effect of mould growth on raw rubber properties: An investigation was initiated to study the effect of mould growth on raw rubber properties of sheet rubber. The RSS samples collected from various centres throughout the island were tested for raw rubber properties. Mould growth seems to have, according to preliminary results, a significant effect on properties such as volatile matter, dirt content Plasticity and Plasticity Retention Index. Further studies are being carried out. (*P. A. J. Yapa, M. D. C. Seneviratne in collaboration with A. de S. Liyanage*).

REVIEW OF THE STATISTICS SECTION

by

W. N. WICKREMASINGHE

SUMMARY

Mr. W. N. Wickremasinghe, was recruited as Assistant Statistician, and started work on the 1st of November. Two research projects were continued. The section was mainly involved in routine statistical analysis for the Research Departments and also recording of Meteorological observations.

DETAILED REVIEW

General

The main duty of the section consisted of the analysis of the experimental data provided by Research Departments, recording the daily meteorological data and supplying summaries when required. Apart from the routine work, the two research projects viz. "The effect of weather on yield of *Hevea*" and "General leaf area estimation" were continued. The latter was just a modification of the previous research project "Leaf area estimation of *Hevea*" carried out by Mr. J. Gunasekera, former Assistant Statistician, and Dr. U. P. de S. Waidyanatha, Botanist. Manioc and Jak leaves along with *Hevea* leaves had been used in 'The general leaf area estimation'. These projects had been carried out uninterrupted up to June, when Mr. J. Gunasekera resigned.

Staff

The post of Assistant Statistician was vacant from June to November. Mr. L. T. Pieris, Technical Assistant, was handling most of the analytical work while Mr. R. A. P. Abayapala, Technical Assistant, handled the Meteorological work with the help of the Assistant Statistician and Consultant Biometrician. The total cadre of the section was five with two minor staff members. Mr. V. Abeywardena, Consultant Biometrician, continued to render valuable service to the Institute.

Visits

Visits were made to the Data Processing Units of the State Engineering Corporation and Peradeniya Campus to make use of their computers regarding lengthy calculations and graphical work. Regular visits to estates and sub-stations were made as part of the routine work.

Meteorology

Readings of the weather factors were taken daily at the Dartonfield meteorological station. These were recorded every day along with the other data obtained from the sub-stations maintained by this section. Weather records were sent regularly to the Meteorological Department and also Land and Water Use Division, of the Department of Agriculture, Peradeniya. A summary of the annual weather data at Dartonfield is given in the following Table.

METEOROLOGICAL OBSERVATIONS

DARTONFIELD-AGALAWATTA

(Summary for 1978)

Longitude:- 80° 09'E

Latitude:- 6° 32'N

Height above mean sea level:- 65.5 Meters.

Month	Rainfall			Evaporation			Shade Temperature (c°)						Ground Temperature (C°)										Mean Atmospheric Pressure (Hg. mms)		Total hours of sun shine	Mean Speed of wind	
					Temp. of water					Mean Temperature		Average at 8.30 a. m.					Average at 3.30 p.m.					Mean Grass Minimum Temperature					
	Monthly Total (mm)	Greatest daily fall and date	No. of Rainy days	Monthly Mean Evaporation (mm)	Mean at 8.30 a. m.	Mean at 3.30 p. m.	Mean daily Maximum	Highest Maximum and date	Mean Daily Minimum	Lowest Minimum and Date	8.30 a.m.	3.30 p.m.	122 cm.	30 cm.	20 cm.	10 cm.	5 cm.	122 cm.	30 cm.	20 cm.	10 cm.	5 cm.		8.30 a.m.	3.30 P. m.		Monthly Mean (KMPH)	Max. Daily Mean & Date (KMPH)
January	146.4	25.0 (4)	15	2.70	24.7	34.1	32.8	34.9 (30)	21.0	18.9 (20)	25.3	30.0	27.9	27.2	27.2	26.6	26.3	27.9	28.9	29.0	30.4	31.7	20.6	759.54	756.79	167.5	1.67	2.35 (24)
February	153.9	45.0 (23)	12	3.68	24.9	34.5	33.4	35.0 (17)	21.4	19.5 (7)	26.7	31.3	28.4	28.5	28.4	27.5	27.4	28.4	31.0	31.5	34.1	36.7	21.0	759.68	756.86	190.9	2.02	2.87 (13)
March	382.1	59.6 (4)	23	3.07	25.2	34.7	33.1	34.8 (5)	21.8	20.0 (9,19)	26.3	30.0	29.0	28.5	28.4	27.6	27.6	29.1	31.0	31.4	34.3	35.4	21.7	758.53	756.17	184.0	1.77	4.76 (15)
April	161.2	44.3 (28)	16	—	26.0	34.1	33.0	34.5 (9)	22.9	20.5 (29)	27.7	30.3	29.4	29.0	29.2	28.1	28.1	29.5	31.1	31.5	33.4	34.7	22.1	758.20	755.90	165.8	2.00	2.70 (29)
May	735.4	85.5 (10)	30	—	26.0	32.0	30.7	33.5 (7)	23.6	21.5 (14)	26.8	28.5	28.1	27.4	27.3	27.2	27.3	28.1	28.8	29.0	30.1	31.1	23.2	756.76	754.89	82.6	1.82	3.36 (23)
June	275.4	32.2 (15)	26	3.61	25.9	32.2	30.5	32.0 (23)	23.0	21.0 (10.30)	26.8	29.0	28.3	28.0	27.9	27.5	27.3	28.3	29.3	29.6	30.7	32.0	22.6	756.82	755.33	126.6	2.38	4.06 (15)
July	182.9	31.8 (6)	23	2.36	25.4	31.9	29.7	31.0 (12)	23.0	21.4 (3)	26.1	28.1	28.4	27.6	27.5	27.2	26.8	28.4	28.8	29.0	29.8	30.8	22.3	756.69	755.14	88.0	2.59	4.83 (30)
August	176.3	56.7 (26)	26	2.41	25.3	31.8	29.4	31.1 (29)	22.6	21.2 (30)	26.0	27.9	28.1	27.4	27.4	27.0	26.7	28.1	28.5	28.8	29.6	30.6	22.7	758.06	756.38	125.1	2.73	5.92 (14)
September	293.9	81.7 (30)	20	3.90	25.2	33.7	30.5	31.9 (17)	22.0	20.5 (2)	26.3	22.7	28.4	27.8	27.7	27.4	27.0	28.4	29.4	29.6	30.5	31.8	22.2	758.24	756.43	165.9	2.77	4.08 (22)
October	351.9	47.0 (14)	21	3.01	25.7	33.5	31.2	32.8 (27)	21.8	20.5 (24)	26.8	28.3	28.2	27.5	27.5	27.2	27.4	28.2	30.1	30.3	32.1	33.0	22.4	758.61	756.38	164.1	1.88	4.00 (1)
November	499.7	108.1 (2)	21	3.68	25.3	33.3	31.8	34.5 (20)	21.1	18.9 (15)	27.0	28.7	27.8	26.5	26.7	26.4	26.9	27.7	29.4	29.5	31.6	32.5	21.6	759.23	756.95	190.5	2.01	6.44 (23)
December	312.6	83.9 (29)	15	3.15	25.0	34.4	32.4	34.7 (6)	21.6	19.0 (2)	26.3	29.8	27.9	27.0	27.1	26.5	26.7	27.9	29.3	29.7	31.6	33.3	21.7	759.18	756.53	172.6	1.59	2.89 (25)
TOTAL	3671.7		248																							1823.6		
Mean	306.0		21	3.16	25.4	33.4	31.5		22.2		25.6	29.2	28.3	27.7	27.7	27.2	27.1	28.3	29.6	29.9	31.5	32.8	22.0	758.30	756.15	152.0	2.10	

REVIEW OF THE ADVISORY SERVICES DEPARTMENT AND, THE ECONOMIC RESEARCH UNIT

by

A. B. DISSANAYAKE

GENERAL

The annual review comprises of three main sections, which describe (A) Advisory Services to Smallholders, (B) Advice to Estates and (C) Economic Research.

STAFF

The Head, Advisory Services Department and Economic Research Unit, Mr. A. B. Dissanayake, the Deputy, Mr. R. P. M. de Zoysa and one Regional Advisory Officer, Mr. A. Dahanayake, were on duty throughout the year. Mr. A. J. L. de Silva, Divisional Rubber Extension Officer, Homagama and Mr. A. S. Widanapathirana were appointed Regional Advisory Officers for Galle and Ratnapura respectively. Mr. J. D. S. Wickremaratne, Regional Advisory Officer, Ratnapaura, retired in March after 33 years service. I take this opportunity to place on record the services rendered by Mr. Wickremaratne during his 33 years at the Institute which was of value to the Rubber Research Institute as well as the industry. In order to provide a better service to the Rubber Smallholder a new Division called Agalawatta was carved out and Matugama Division was renamed Dodangoda. Mr. U. S. Wijepala, Mr. W. A. S. Wijesekera and Mr. M. V. P. S. Perera were promoted as Divisional Rubber Extension Officers. Mr. D. U. Wijesinghe, Rubber Extension Officer, Udugama, was discontinued from service.

With effect from January the routine transfers took place and all Rubber Extension Officers who had served for 4 years in a station were transferred. Trainee Rubber Extension Officers recruited in September 1977 were put in charge of ranges during the year.

Mr. G. R. Chandrasiri, Agricultural Economist, resigned from service during the second quarter, on appointment as Director, Agricultural Development Authority, Mr. H. B. D. M. Gunasekera, Assistant Agricultural Economist, proceeded to the Australian National University, Canberra, for Post Graduate Studies.

OTHER ADMINISTRATIVE MATTERS

Correspondence

Inward	... 9707
Outward	... 11017

With Rubber Controller

Inward	... 5002 (applications for new planting, unregistered rubber lands and new planting permits)
Outward	... 1642 (preliminary reports, final inspection reports and special reports)
	... 2377 From Rubber Extension Officers to smallholders

A. ADVISORY SERVICES TO SMALLHOLDERS

New Planting

The following visits were carried out :

First visits	...	2024
Subsequent visits	...	2439
Preliminary reports	...	2073
Final inspection and special reports	...	3053

Lining	*No. of Permits*	*Acreage*
This year's permit areas:		
Soil conservation	... 194	277
Planting holes	... 192	287
Last year's permit areas:		
Soil conservation	... 441	706
Planting holes	... 479	708

Replanting

Visits

Permits issued	... 3764	4390
Visits to this year's permit areas	... 5785	
Visits to previous year's permit areas	... 9790	
Special reports	... 443	

Lining	*No. of Permits*	*Acreage*
This year's permit areas:		
Soil conservation	... 1485	1972
Planting holes	1592	2142
Last year's permit areas:		
Soil conservation	... 557	845
Planting holes	... 592	830
Marking of trees for tapping	... 244	4757

Special inspections for Rubber Controller's Department

Visits for preliminary reports	...	2073
Visits for final inspection reports and special reports (new planting)	...	3053
Visits for special inspection reports (replanting)		2176
Visits to Commodity Purchase Depots	...	147
Visits to planting material checks at the Commodity Purchase Depots		51
Plants inspected	....	868
Plant nursery reports	...	128

Smallholders' Rubber Conferences

During the year under review 37 smallholder conferences in the form of group discussions were held at range level. At the request of the Additional Secretary Ministry of Plantation Industries, smallholder seminars at district level were held at Elpitiya, Dodangoda and Mawanella.

Meetings and Conferences

1. All staff officers attended the staff meetings presided by the Director.

2. All Divisional Rubber Extension Officers and Regional Advisory Officers attended a Conference convened by the Head, Advisory Services Department.

3. The Head, Advisory Services Department and Economic Research Unit, the Deputy, Agricultural Economist and his assistant attended a seminar on Group Farming organised by the FAO/ESCAP in collaboration with the A.R.T.I., where a case study of a successful venture - the Pore Group Processing Centre - was presented.

4. All Regional Advisory Officers and Divisional Rubber Extension Officers attended a Conference regarding the Group Processing Centres programme presided over by the Secretary, Ministry of Plantation Industries.

5. The Head, and a Regional Advisory Officer attended the joint seminar convened by the Planters Association and the SLAAS held in Galle. The Head of the Department delivered an illustrated talk on "Accounting Systems for Plantations".

6. The Head, attended a number of meetings convened to organise the A.N.R.P.C., seminar on Development of smallholders due to be held in Sri Lanka in late 1979.

7. The Head, was appointed to the "Steering Committee" in connection with the "World Bank Project" and the preparation of the "Master Plan" for the Rubber Industry.

Field Day

A successful 'Field Day' for all officers of the Department was conducted on 25th September 1978 at Elston Estate, Puwakpitiya. The officers were shown areas intercropped with coffee, cocoa and bananas. At the Elston Factory the officers were shown the manufacture of prevulcanized sole crepe, coloured sole crepe and cyclised rubber. Talks were given on this day by Mr. L. B. Chandrasekera, Head Botany Department and Dr. A. Coomarasamy, Rubber Chemist.

Visitors

Mr. C. W. Brookson and a team of World Bank officials visited the Department. A farm budget survey of rubber holdings in Kalutara and Ratnapura Districts was carried out to provide information for the World Bank team. Sir Roger Swynnerton of the Commonwealth Development Corporation and his team of experts visited various rubber growing areas with our officers in preparation for the drawing up of a "Master Plan" for the NR industry.

Improvement of Smallholders' sheet rubber

Progress on the construction of group processing centres is as follows :

Group processing centres in operation	...	97
Group processing centres (work completed)	...	2
Group processing centres (under construction)	...	4
Group processing centres (surveys approved)	...	5
Group processing centres (surveys going on)	...	3

One day seminars for group processing centre officials were held at each of the eleven divisions. These seminars were attended by at least three group processing centre officials consisting of President, Secretary and another.

All matters connected with the day to day management, maintenance, accounts, other problems and also the economics of processing were fully discussed. The Assistant Commissioner, Commodity Purchase Department and the Assistant Rubber Controller too attended these seminars. The Director, Rubber Research Institute, addressed these seminars wherever it was possible. A total of 194 group processing centre officials and 87 Extension Officers attended these seminars.

During the year under review Rs. 3,500/- were released to each group processing centre, as cash advances to smallholder members who supply latex to the centres.

On the 27th December 1978 the group processing centre at Pitigala was ceremoniously opened by the Deputy Minister of Trade and Shipping.

Recoveries on Group Processing Centre loans amounted to Rs. 40,601/05 while another Rs. 5,820/- were recovered on sales of coagulating pans. During the year Rs. 3,30,080/- was allocated for use as cash advances to group processing centres.

Other Visits

A total of 3703 visits to group processing centres and 568 visits to ordinary and demonstration smoke houses were made during the year under review.

Training classes

A total of 16 classes for 529 smallholders were held and 212 successfully completed the course.

Fertilizer demonstration plots

The fertilizer demonstration plots, commenced in 1972, were stopped as fertilizer issues are not made by the Fertilizer Corporation.

Demonstrations

The following demonstrations were carried out by the field staff for the year:

Sheet making	...	321
Tapping	...	323
Disease control	...	251
Miscellaneous	...	432

Sale at subsidised price

A total of 249½ sq. ft. of monel metal mesh were sold at subsidised rates

B. ADVICE TO ESTATES

Visits

A total of 314 visits were made to small and medium sized estates by the officers of the Department during the year.

Other visits

As from July 1978 advice on RSS manufacture in estates was provided by this Department. 7 smoke house plans of varying capacities were provided on request to private and state owned estates. 18 visits were made to estate smoke houses to advise on weighing latex, improvement in the quality of RSS and storage. In addition to the above, 4 separate visits were made to inspect and advise on reconstruction of smoke houses.

C. ECONOMIC RESEARCH

Survey on the Economics of production of rubber

The survey started with the idea of finding out the present economics of production of rubber has to be repeated as the exchange rate of the rupee changed after the 1977 budget.

Replanting and Economics of Resource Use

The data collected on the two above units will be analysed as soon as a 'Systems Analyst' is recruited to the Katubedda Campus.

Farm Record Keeping Survey

The long term Farm Record Keeping Survey done on a grant from the National Science 'Council' had to be postponed to 1979 due to the resignation of the Agricultural Economist. It is being started using an Assistant Advisory Officer.

A survey of Farm Budgets of smallholders and small estate owners of Kalutara and Ratnapura Districts was completed during the fourth quarter and the data and information obtained were sent to the World Bank Team.

Training Classes

A study of the reasons for the poor attendance at training classes was conducted.

Three final year under-graduates of the Faculty of Agriculture, University of Sri Lanka, completed the following projects under the guidance of the Head of the Department:

Evaluation of training classes on rubber for smallholders. A study of the factors affecting the success of a group processing centre - a case study of Dambara Group Processing Centre. The economics of the production of RSS latex crepe and block rubber.

Group Processing Centres

Data on monthly performances of Group Processing Centres are being collected. Some Group Processing Centres are reluctant to send their monthly reports, but an effort is being made to get all Group Processing Centres to send their reports in time. Once sufficient data are collected, the correlation between production and cost of manufacture will be studied.

The following surveys were also conducted.:

Girth measurements; survey of fertilizer demonstration plots, cost of maintenance and extraction of rubber in smallholdings; the improvement in quality of rubber effected by the organising of Group Processing Centres. This survey is being conducted with the help of Dr. L. M. K. Tillekeratne, Chief Specifications Officer.

REVIEW OF THE ESTATE DEPARTMENT

by

Gamini Siriwardena

The Institute's Group of Estates known as "Dartonfield Group" comprises of Dartonfield Division in Agalawatta, Nivitigalakele Division in Matugama and Gallawatta Division in Agalawatta. Gallawatta Division was earlier a division of Yatadola Group and was subsequently handed over to Dartonfield Group in 1978. Hedigalla. Division was handed over to the State Plantations Corporation in November 1978. An extent of 2.02 ha, adjoining Nivitigalakele Division was handed over to the Institute by the Land Reforms Commission direct. The estate now has an extent of 344.60 ha (851 acres) which includes .71 ha of jungle land. The planted area is 299.54 ha of which 216.36 were tapped during the year. The area of immature plantings and nurseries were 82.98 ha.

The weather pattern experienced during the year was favourable for tapping. The crop harvested was 186,075 kg representing an average yield of 860 kg per ha. The crop secured fell short of the estimate by 5875 kg.

No symptoms of *Oidium* leaf disease were noticeable, since wintering was early this year, but late winterers suffered some leaf fall.

Budwood of clones of RRIC series and PB 86 continued to be much in demand and issues were made accordingly.

Latex and scrap from Hedigalla, Horagoda and Mukalana was manufactured at Dartonfield Factory up to the time of take over of these estates in November 1978.

All agricultural operations were carried out in both mature and immature areas of the Group.

DETAILED REVIEW

Mr. M. M. A. N. Marrikkar, the Estate Superintendent was on duty up to 15th October 1978, when he resigned to join the State Plantations Corporation. Alternative arrangements were made to look after the estate till a new Estate Superintendent was appointed.

Weather (Estate Guage):

Comparative rainfall figures (cm) for 1978 & 1977 are given below:

	Dartonfield		*Nivitigalakele*		*Gallawatta*	
	1978	*1977*	*1978*	*1977*	*1978*	*1977*
January	14.6	2.92	13.24	.89	16.15	2.29
February	15.4	27.16	11.40	13.51	9.22	18.29
March	38.3	37.89	21.63	28.32	53.34	33.38
April	16.1	31.77	18.12	103.51	17.62	33.43
May	73.6	96.84	81.26	46.08	72.51	105.56
June	27.5	46.64	31.17	7.98	24.56	38.91
July	18.3	7.18	16.23	21.84	14.07	—
August	17.6	22.25	19.11	23.60	18.36	22.53
September	29.4	28.88	27.19	23.01	30.04	20.40
October	35.2	68.89	56.17	66.90	28.82	63.09
November	49.9	27.70	33.46	38.51	50.85	35.51
December	31.3	28.38	30.18	17.96	36.67	24.51
Total	367.2	426.50	359.16	392.11	372.21	397.90
Average (five) year period	2206.05 cm		2186.17 cm		2168.25 cm	
Total number of wet days	232		218		202	

MANUFACTURE:

A summary of the manufacture records during the year 1978 is as follows:-

Latex Grades		*Total Kg.*	*Percentage*
Latex Crepe	No. 1	163,092	95.00%
,, ,,	No. 2	1,343	1.25%
,, ,,	No. 3	6,885	3.75%
		171,320	100.00%

Scrap Grades

No. 1	—	—
No. 2	14,775	—
No. 3	—	—
	14,755	

NURSERIES : BUDWOOD MULTIPLICATION NURSERIES : 2.22 ha at Dartonfield; 2.92 ha at Nivitigalakele; .50 ha at Gallawatta. These nurseries consists of RRIC clones. Routine weeding, manuring and other experimental operations were carried out in all nurseries, except .50 ha on Gallawatta division which has been left over.

GENERAL:

A sum of Rs. 78,827/75 was paid in 1978 for the Estate Labourers/Workers as Profit Bonus for 1977, approved by the Rubber Research Board, Plantations Division.

The break up is as follows:-

Dartonfield Division	Rs. 30,736.00
Nivitigalakele Division	Rs. 19,862.40
Gallawatta ,,	Rs. 28.229.35
	Rs. 78,827.75