The RUBBER RESEARCH INSTITUTE *of* CEYLON

ANNUAL REVIEW FOR 1962

MARCH 1963

RUBBER RESEARCH INSTITUTE OF CEYLON

BOARD OF MANAGEMENT

(as at 31st December 1962)

Ex-Officio Members

The Director of Agriculture—Mr. A. V. Richards, M.Sc. (Calif.), B.Sc. (Lond.), Dip. Agric. (Cantab.), A.I.C.T.A. (Trinidad).
The Acting Deputy Secretary to the Treasury—Mr. C. Balasingham, B.A. (Lond.), C.C.S.
The Rubber Controller—Mr. B. Mahadeva, M.A., C.C.S.
The Acting Director, Rubber Research Institute of Ceylon—Mr. C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye). (*Vice-Chairman*).

Members of Parliament nominated by the Hon'ble Minister of Agriculture, Land, Irrigation and Power :

Senator T. P. de Zoysa
Mr. D. P. R. Weerasekera, M.P.

Members nominated by the Planters' Association of Ceylon :

Mr. J. W. Craig
Mr. W. B. Jonklaas

Members nominated by the Low-Country Products Association of Ceylon :

Mr. T. C. A. de Soysa, B.A. (Cantab.), Dip. Agric. (Cantab.), (*Chairman*).
Mr. Nelson Abeygoonewardena, J.P.

Member nominated by the Hon'ble Minister of Agriculture, Land, Irrigation and Power to represent Smallholders :

Mr. W. P. H. Dias, J.P.

Administrative Committee :

Mr. T. C. A. de Soysa, B.A. (Cantab.), Dip. Agric. (Cantab.). (*Chairman*).
Mr. C. Balasingham, B.A. (Lond), C.C.S.
Mr. B. Mahadeva, M.A., C.C.S.
Mr. W. P. H. Dias, J.P.
Mr. D. P. R. Weerasekera, M.P.
Mr. J. W. Craig.
Mr. C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).

Estate and Experimental Committee :

Mr. T. C. A. de Soysa, B.A. (Cantab.), Dip. Agric. (Cantab.), (*Chairman*).
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Mr. C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).

Smallholdings Committee :

Mr. T. C. A. de Soysa, B.A. (Cantab.), Dip. Agric. (Cantab.), (*Chairman*).
Mr. W. P. H. Dias, J.P.
Mr. D. P. R. Weerasekera, M.P.
Mr. C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).

Smallholdings Department Selection Committee :

Mr. B. Mahadeva, M.A., C.C.S.
Mr. W. P. H. Dias, J.P.
Mr. C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).
Mr. A. B. Dissanayake, B.Sc. Ag. (Cey.), B. A. (Cey.).

RUBBER RESEARCH INSTITUTE OF CEYLON

STAFF AS AT 31st DECEMBER 1962

Director (Actg.)	...	C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).
Research Asst. (Statistics)	...	V. B. Solomon, B.Sc. (Madras), M.Sc. (Madras).
Botany Department		
Botanist	...	C. A. de Silva, B.Sc. Agric. (Lond.), C.D.A. (Wye).
Assistant Botanist	...	L. B. Chandrasekera, B.Sc. (Cey.), Dip. Ag. Sci. (Cantab.).
Research Assistant	...	R. Satchuthananthavale, B.Sc. (Madras), M.A. (Madras).
Senior Technical Assistant	...	W. G. V. Fernando.
Technical Assistant	...	C. Amaracone.
Plant Breeding Section		
Plant Breeder	...	R. T. Wijewantha, B.Sc. Hons. (Lond.), M.Sc. (Lond.).
Assistant Plant Breeder	...	D. M. Fernando, B.Sc. (Cey.), M.Sc. (Mc Gill).
Plant Pathology Department		
Plant Pathologist (Actg.)	...	O. S. Peries, B. Agr. Sci. (Melb.), Ph.D. (Bristol), M.I. Biol.
Research Assistants	...	Miss V. Sivapalan, B.A. (Madras), M.Sc. (Madras). D. L. S. Wimalajeewa, B.Sc. (Cey.).
Senior Technical Assistant	...	H. L. Munasinghe.
Technical Assistants	...	T. M. Fernando, S. K. Samaraweera, D. M. Danthanarayana Z. E. Irugalbandara.
Agricultural Engineer	...	J. H. Lloyd, B.Sc. Hons. (Wales).
Technical Assistants	...	E. G. Mendis, W. C. Dayaratne, T. Shanmuganathan.
Soils Department		
Soils Chemist	...	A. J. Jeevaratnam, B.Sc. Ag. (Cey.), B.Ag. Sc. (Adel.), M. Ag. Sc. (Adel.).
Assistant Soils Chemist	...	Camillus G. Silva, B.Sc. (Cey.), M.S. (Hawaii).
Research Assistant	...	R. S. John, B.Sc. Ag. (Cey.).
Senior Technical Assistant	...	T. Kanthasamy.
Technical Assistants	...	A. K. Gunadasa, E. R. Chelliah, D. J. M. Samarasinghe, H. A. Seemon and F. P. W. Silva.
Chemistry Department		
Rubber Chemist (Actg.)	...	M. Nadarajah, B.Sc. (Cey.), M.Sc. (Birm.), A.R.I.C.
Assistant Rubber Chemist	...	Vacant.
Research Assistant	...	S. W. Karunaratne, B.Sc. (Cey.), A.R.I.C.
Senior Technical Assistant	...	D. S. Muthukuda.
Technical Assistants	...	M. T. Veerabangsa, G. G. Gnanasegaram and O. M. R. Sirisena.
Estate Department		
Estate Superintendent	...	L. Wijeyegunawardena.
Assistant Estate Superintendent	...	M. R. T. Mendis.
Chief Field Assistant	...	H. M. Buultjens
Senior Field Assistant	...	D. C. Kannangara.
Office Assistant	...	T. S. J. Peiris.
Apothecary	...	J. W. S. Bulner.
Factory Assistant, Assistant Rubber Maker		
Field Assistants (10)		
Clerks (5)		
School Masters (2)		
Sub-Station, Kuruwita		
Visiting Superintendent	...	B. Cocking.
Senior Field Assistant	...	L. P. de Mel
Smallholdings Department		
Chief Advisory Officer Smallholdings	...	A. B. Dissanayake, B.Sc. Ag. (Cey.), B.A. (Cey.).
Assistant Advisory Officers	...	H. H. Peiris, K. Wilson de Silva and D. E. A. Abeywickrema
District Advisory Officers	...	D. R. Ranwala, P. S. G. Cooray, B. D. Pedrick, L. A. Wijesinghe, M. B. Dissanayake and J. D. S. Wickremaratne.
Office Assistant	...	R. A. Somadasa.
Rubber Instructors (57)		
Clerks (9)		
Mechanic		
Administration		
Chief Administrative Officer	...	C. D. de Fonseka, A.C.C.A., A.C.C.S.
Assistant Administrative Officer	...	B. C. Moldrich, B.A. (Cey.).
Librarian	...	Mrs. S. C. Goonetilleke, B.A. (Cey.), Dip. Ed. (Cey.).
Office Assistant	...	J. A. Attygalle.
Accounting Assistant	...	H. Kulasena, A.C.C.S.
Personal Assistant to the Director	...	Vacant.
Clerks (14), Book-keeper, Library Assistant, Storekeeper and Stores Assistant		
Works Section		
Works Inspector	...	P. C. J. F. Keerthisinghe.
Works Clerk		
Mechanical Foreman		
Electrical Foreman		
Building Foreman.		

Note.—The Laboratories and Headquarters Offices of the Institute are situated at Dartonfield Estate, Agalawatta, Telephone No. 26, Agalawatta, Telegraphic Address 'Rubrs', Agalawatta. There are two Experimental Stations, one at Nivitigalakele, Matugama, and the other at Hedigalla, Latpandura. The Office of the Smallholdings Department is at No. 267/3, Galle Road, Colombo 4. Telephone No. 84205, Colombo. The Sub-station is at Kuruwita, Ratnapura.

All enquiries and other communications should be addressed to the Director, Rubber Research Institute of Ceylon, Dartonfield, Agalawatta.

THE
RUBBER RESEARCH INSTITUTE OF CEYLON

ANNUAL REVIEW FOR 1962

CONTENTS

THE RUBBER RESEARCH INSTITUTE OF CEYLON ANNUAL REVIEW FOR 1962

ACTING DIRECTOR'S REVIEW

By

C. A. De Silva

1. GENERAL

The Golden Jubilee of the Institute (1910-1960) was celebrated at the Institute's headquarters on 21 February 1962 when a new wing to the Administration Block was officially opened and the photographs of four elected past Chairmen of the Rubber Research Board were unveiled by the Hon'ble Mr. C. P. de Silva, Minister of Agriculture, Land, Irrigation and Power. Other distinguished visitors who took part in the celebrations included :—

The Chairman, Planters' Association of Ceylon.
The Chairman, Low-Country Products Association.
The United Kingdom Principal Trade Commissioner, representing the British High Commissioner.
The Director, Tea Research Institute of Ceylon.
The Director, Coconut Research Institute of Ceylon.
The Chairman, Ceylon Planters' Society.
The Chairman and Members of the Rubber Research Board.

In connexion with this event, congratulatory messages were received from the following organizations and persons :—

International Rubber Research and Development Board, London.
Director, Rubber Research Institute of Malaya.
President, Institut Francais du Caoutchouc, Paris.
President, Institut des Recherches sur le Caoutchouc au Viet-Nam.
President, Institut des Recherches sur le Caoutchouc au Cambodge.
President, Institut des Recherches sur le Caoutchouc en Afrique.
Director-General, Institut des Recherches pour les Huiles et Oleagineux, Paris.
Mr. R. M. E. Michaux.

The Chairman, Rubber Research Board and the Director of the Institute attended the International Conference on Rubber (Natural and Synthetic) held at the Palais de l'Unesco, Paris from 14 to 18 May, 1962.

Both the Chairman and the Director presided over a Session of the Conference and in addition, the Director delivered the main address on production research entitled " Present Possibilities of *Hevea* culture ".

While in Paris the Director attended a meeting of Chief Executives and Directors of Research and Development of the International Rubber Research and Development Board held at the Institut Francais du Caoutchouc on 19 May and he visited the various departments of that Institute.

The Director attended in his capacity as Fellow of the Institution of the Rubber Industry and Chairman of the Ceylon Branch of the Institution of the Rubber Industry, meetings of the Fourth Rubber Technology Conference of the Institution of the Rubber Industry held in London from 22 to 25 May.

The Director also attended the Symposium on the " Future of Natural and Synthetic Rubbers " organized under the auspices of the International Rubber Study Group and held from 29 May to 1 June in the main Conference Room of the International Conference Suite, Department of State, Washington D.C. where he gave a supplementary address to that of Mr. H. A. Campbell, C.B.E. on " The Supply of Natural Rubber ", besides sitting on the panel of speakers on (a) The Supply of Natural Rubber and (b) Factors determining the acceptability of Natural Rubber.

Votes of condolence were passed by the Rubber Research Board at its meeting held on 24 August on the deaths of Mr. R. M. E. Michaux, former Chairman of the International Rubber Research and Development Board, and of Mr. J. A. Nelson, former Secretary of the London Advisory Committee for Rubber Research (Ceylon and Malaya).

Mr. J. H. Lloyd, B.Sc. Hons. (Wales), who was assigned to the Institute's service under the Colombo Plan to work on problems of *Phytophthora* control, submitted a preliminary report in 1962 on the efficiency of dusting and spraying machines, together with an evaluation in the laboratory of spray formulations and copper-based dusts, with particular regard to the rainfastness properties of deposits on *Hevea* leaves.

A large-scale clone trial of 25 selected clones (150-300 plants of each clone) and a small-scale clone trial of 30 clones (10 plants of each clone) were established at the Kuruwita Sub-station in the South-West monsoon planting period. During the same period a large-scale clone trial of 20 clones and a small-scale trial of 17 clones were established at the Nivitigalakele Station.

A report submitted by Mr. W. J. A. van Langenberg, who was appointed by the Rubber Research Board.

> " to examine and report on the present salaries and conditions of service and other grievances of employees of the Institute " and
>
> " to report on any administrative, financial and other changes which are considered to be necessary in the organisation of the Institute to enable the Institute to carry out its functions more efficiently "

was accepted by the Rubber Research Board and the recommendations embodied therein will be given effect to from 1 January, 1963.

At Dartonfield contracts were awarded during the year for the construction of a new Botany Laboratory and an additional store room for the Plant Pathology Department and at Kuruwita Sub-station, two Junior Staff Bungalows were built and two old sets of six-room lines were converted into store-rooms.

2. STAFF

The Director, Dr. E. D. C. Baptiste, was on duty until he left the services of this Institute on 13 December, at the end of his contract. During the period 20 April to 20 June he attended three Rubber Conferences in France, U.K. and U.S.A. and Mr. C. A. de Silva, Deputy Director and Botanist, acted as Director.

The Botanist, Mr. C. A. de Silva, was appointed Deputy Director of the Institute with effect from 30 March and Acting Director on the departure of Dr. Baptiste. He was on duty throughout the year.

The Rubber Chemist, Dr. K. F. Heinisch, resigned his post and left the Island on 14 September. Mr. M. Nadarajah, Assistant Rubber Chemist was appointed Acting Rubber Chemist with effect from 12 October.

The Acting Plant Pathologist, Dr. O. S. Peries ; the Agricultural Engineer Mr. J. H. Lloyd ; the Soils Chemist, Mr. A. J. Jeevaratnam ; the Chief Advisory Officer Smallholdings, Mr. A. B. Dissanayake ; the Chief Administrative Officer, Mr. C. D. de Fonseka and the Estate Superintendent, Mr. L. Wijeyagunawardena, were on duty during the year.

The Plant Breeder, Mr. R. T. Wijewantha, continued his post-graduate studies in Plant Breeding and Plant Genetics at the University of California under the International Co-operation Administration of the United States of America. His scholarship period was extended to June, 1963

Mr. B. Cocking, Visiting Superintendent, R.R.I.C. Kuruwita Sub-station, continued to overlook the Sub-station during the year.

The Acting Rubber Chemist, Mr. M. Nadarajah, the Assistant Botanist, Mr. L. B. Chandrasekera and the Assistant Plant Breeder, Mr. D. M. Fernando, were on duty throughout the year.

The following Intermediate staff officers were also on duty throughout the year :

Mr. R. Satchuthananthavale, Research Assistant, Botany Department.
Mr. S. W. Karunaratne, Research Assistant, Rubber Chemistry Department.
Miss V. Sivapalan, Research Assistant, Plant Pathology Department.
Mrs. S. C. Goonetilleke, Librarian.
Mr. P. C. J. F. Keerthisingha, Works Inspector.
Mr. H. H. Peiris, Senior Asst. Advisory Officer Smallholdings Department.
Mr. K. Wilson de Silva, Asst. Advisory Officer (N) Smallholdings Department.
Mr. D. E. A. Abeywickrema, Asst. Advisory Officer (S) Smallholdings Department.

The following Intermediate Staff appointments were made during the year :

Mr. B. C. Moldrich, B.A. Hons. (Cey.), as Assistant Administrative Officer with effect from 1 February.
Mr. R. S. John, B.Sc. Ag. (Cey.), as Research Assistant, Soils Chemistry Department, with effect from 24 March.
Mr. M. R. T. Mendis, as Assistant Estate Superintendent, with effect from 2 April.
Mr. V. B. Solomon, M.Sc. (Madras), as Research Assistant (Statistics), with effect from 2 May.
Mr. D. L. S. Wimalajeewa, B.Sc. Hons. (Cey.), as Research Assistant, Plant Pathology Department, with effect from 1 September.
Mr. Camillus Silva, B.Sc. (Cey.), M.S. (Hawaii), as Research Officer, Soils Department, with effect from 1 December.

Assistant Staff.—The Staff position in the Administrative Department was as follows :—

Head Office

Correspondence Section	*Accounts Section*	*Works Section*
One Office Assistant	One Accounting Assistant	One Clerk
Six Clerk-Typists	One Pay Clerk	One Transport Stores Assistant
One Record Clerk	One Book-keeper	One Electrical Foreman
One Translator-cum-Typist	Three Accounts Clerks	One Mechanical Foreman
One Junior Clerk	One Storekeeper	One Building Foreman
	One Stores Assistant	
	One Junior Clerk	

Library

One Library Assistant

A number of changes in Assistant and Minor Staff in the Technical, Estate and Smallholdings Departments occurred, as shown in the respective departmental reviews.

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

Senior Staff Grade I	9
Senior Staff Grade II	3
Intermediate Staff	14
Assistant Staff	143
Minor Staff	72
Total	241

3. MEETINGS

The Director and the Acting Director attended the following meetings :

Rubber Research Board	9	27/2, 30/3, 28/6, 10/7, 24/8, 17/9, 8/10, 29/10, 12/12.	Director
Administrative Committee, RRB	5	24/1, 13/3, 9/4, 27/7, 27/9.	Director
Estate & Experimental Committee, RRB	2	16/4, 9/10.	Director
Selection Committee, RRB	4	30/1, 3/4, 21/8, 8/10.	Director
Smallholdings Selection Committee, RRB	2	12/4, 25/5.	Acting Director
Committee of Inquiry, RRB	2	18/4, 24/10.	Director
Rubber Replanting Advisory Board	5	6/2, 3/4, 7/8, 11/10, 11/12	Director
	1	5/6.	Acting Director
Planters' Association of Ceylon	6	20/2, 30/3, 19/6, 24/8, 16/10, 11/12.	Director

District Planters' Associations :

Kalutara	3	14/3, 3/8, 14/11.	Director
Kelani Valley	2	13/2, 24/7.	Director
Low-Country Products Association	1	28/3.	Director
Ceylon Chamber of Commerce	1	28/3.	Director
Ceylon Estate Employers' Federation	1	29/6.	Director
Central Board of Agriculture	1	22/9.	Director
Ceylon Branch of the Institution of Rubber Industry	3	18/4, 28/8, 27/11.	Director
Ceylon Association for the Advancement of Science	2	21/11, 23/11.	Director
Technical Education Commission	1	1/2.	Director
TRI Appointment Committee	3	29/3, 12/7, 7/11.	Director
RRI Staff meeting	5	27/1, 22/8, 26/10, 9/11, 29/11.	Director
RRIC Staff Club meeting	1	5/10.	Director
International Rubber Research & Development Board	1	19/5 (at I.F.C. Paris)	Director

4. VISITS

Estates.—The Director paid 17 visits to estates during the year. He also paid 10 visits to R.R.I.C. stations and 5 visits to R.R.I.C. Kuruwita Sub-station.

Institutes.—The Tea Research Institute of Ceylon and the Ceylon Institute for Scientific and Industrial Research were visited.

Smallholdings.—The Director, accompanied by the Chairman of the Rubber Research Board, the Acting Rubber Chemist and the Acting Plant Pathologist, attended the Annual Field Day of the Smallholdings Department of the Institute held at the School Hall of Ananda Sastralaya, Matugama on 10th November.

Visits in Europe.—While in Europe the Director visited the following Institutions :

Natural Rubber Bureau, London.
International Rubber Study Group, London.
Institution of the Rubber Industry, London.
International Rubber Research and Development Board, London.
Natural Rubber Producers Research Association, Welwyn Garden City.
Rothamsted Experimental Station, Harpenden, Herts.
Chesterford Park Research Station, Essex.
Institut Francais du Caoutchouc, Paris.

5. VISITORS

The visitors to the Institute besides those who took part in the Golden Jubilee celebrations included the following :—

Mr. R. M. E. Michaux, President, Socfin Co., Paris.
Prof. J. A. Bennet-Clark, F.R.S., King's College, London.
Mr. F. C. Bawden, F.R.S., Director, Rothamsted Experimental Station, Harpenden, Herts.
Sir Alexander Morley, K.C.M.G., C.B.E., High Commissioner for the U.K. in Ceylon.
Mr. Harry'Odell, Second Secretary of American Embassy, Colombo.
Mr. C. A. Meakin, Director, Grand Central (Rubber) Co., London.
Mr. William F. Hall, Agricultural Economist, U.S. Department of Agriculture.
Mr. G. G. Gibson, Food & Agricultural Officer, U.S. Aid, Colombo.
Mr. M. J. Bell, Guthrie & Co., Ltd., Singapore.
Mr. C. A. C. Bowen, Director, Dalkeith Group.
Mr. C. G. Akhurst, C.B.E., United Kingdom (formerly Deputy Director, R.R.I. of Malaya).
Mr. J. E. Morris, Chemist, Rubber Research Institute of Malaya.
Mr. C. A. K. Salgado, Technologist, Rubber Research Institute of Malaya.
Mr. Engracio Basio, Chief Librarian, University of Phillipines.
Dr. G. Heim, Ciba Ltd., Switzerland.
Mr. R. H. Hirst, I.C.I. (Malaya) Ltd., Kuala Lumpur, Malaya.
Dr. C. C. Webster, Director, Rubber Research Institute of Malaya.
Dr. D. J. Watson, Head of Botany Department, Rothamsted Experimental Station, Harpenden, Herts, England.
Dr. B. G. Audley, Natural Rubber Producers Research Association, Welwyn Garden City, Herts, England.
Ing. E. C. Paardekooper, Botanist, Rubber Research Institute of Malaya.
Miss Lynden Moore, Agricultural Economics Research Institute, University of Oxford.
Mr. N. M. Garrard, Commonwealth Liaison Officer at the National Institute of Agricultural Engineering, Silsoe, Beds, England.
Mr. B. J. Mainstone, Dunlop Research Centre, Batang, Malaka, Negri Sembilan, Malaya.
Dato Gunn Lay Teik, O.B.E., M.A. (Cantab), a Member of the Malayan Rubber Fund Board.
Mr. K. Ratnasingam, Sagga Estate, Malaya.
Mr. G. A. Misner, Indofit Chemicals Ltd., Bombay.
Miss Frances E. Willis, American Ambassador in Ceylon.
Mr. & Mrs. Henry J. Willis, California.
Mr. Jiro Ishikowa, Leader of the 4th Japanese Youth Goodwill Mission to Ceylon in 1962.
Mr. G. van Contard, Agronomist, International Potash Institute, Berne.
Mr. Edward J. Bals, Micron Sprayers Ltd., Birmingham.
Mr. William B. Gay, Messrs. Rohm and Haas Co., Pennsylvania.

6. PUBLICATIONS

The following reports and articles were prepared by the Director :

(1) For information of the Rubber Research Board :

Director's Review for 1961.
Director's Report for the First Half Year 1962.
Research Programmes for 1963.

(2) Contribution to 1961 Annual Reports of the Planters' Association of Ceylon and of the Low-Country Products Association :

" Progress Report of the Rubber Research Institute for 1961 ".

(3) Contribution to the 1961 Annual Report of the Kalutara District Planters' Association :

"Rubber"

(4) Contribution to the Ceylon National Memorandum for the 16th meeting of the International Rubber Study Group :

"Review of the Activities of the Rubber Research Institute of Ceylon during 1960 and 1961".

(5) Contribution to the Ceylon Year Book 1962 :

"Activities of the Rubber Research Institute of Ceylon in 1961".

(6) For information of the Minister of Agriculture, Land, Irrigation and Power :

"Note on Technically Classified Rubber".

(7) Contribution to the International Rubber Conference (Natural and Synthetic Rubbers), Paris :

"Present Possibilities of *Hevea* Culture".

(8) Contribution to the Times of Ceylon Agriculture and Industries Supplement, September 1962 :

"Present Position and Prospects of Natural Rubber".

(9) For information of the Ceylon Association for the Advancement of Science (Section D) :

"Reports of Research carried out by the Research Departments of the RRIC"

(10) For contribution to the FAO Directory of Agricultural Research Institutes and Experiment Stations in Asia and the Far East :

"Agricultural Research Survey" by Acting Director.

(11) For publication in RRIC Quarterly Journal :

"Properties and Competitive Prospects of Natural and Synthetic Rubbers".

The following roneoed leaflets were issued :

(*a*) *Oidium* Questionnaire 1962 dated 15-1-1962.

(*b*) *Phytophthora* Control Questionnaire dated 13-2-1962.

(*c*) *Gloeosporium* Questionnaire dated 17-9-1962.

(*d*) Report of the Agricultural Engineering Unit for the First Half Year 1962.

The following publications were issued :

(*a*) Annual Review of the Rubber Research Institute of Ceylon for 1961.

(*b*) 1st and 2nd Combined Quarterly Journals, Vol. 38, March/June 1962. 3rd and 4th Combined Quarterly Journals, Vol. 38, Sept/Dec. 1962.

(*c*) Advisory Circular No. 70 — *Oidium* Leaf Disease.
Advisory Circular No. 72 — Planting and After Care of Budded Stumps and Stumped Buddings.

(*d*) Smallholdings Folder No. 8 — Soil Conservation.

A special publication entitled "Golden Jubilee Souvenir" was issued to commemorate the Golden Jubilee Celebrations of the Institute. Messages for this publication were received from :—

The Hon'ble Mr. C. P. de Silva, Minister of Agriculture, Land, Irrigation and Power.
Mr. T. C. A. de Soysa, Chairman, Rubber Research Board.
Dr. E. D. C. Baptiste, Director, R.R.I. of Ceylon.
Mr. A. V. Richards, Director of Agriculture.
Mr. B. Mahadeva, Rubber Controller.
Mr. W. P. H. Dias, J.P., Smallholders' Representative on the R.R.B.
Mr. V. G. W. Ratnayake, Chairman, Planters' Association of Ceylon.
Mr. F. Amarasuriya, Chairman, Low-Country Products Association.

7. CORRESPONDENCE

		Inward	*Outward*
Director	General ...	2726*	1644†
	Technical ...	105	208†
Administrative Department	...	4897	4415
Botany Department	...	378	312
Plant Pathology Department	...	856	630‡
Soils Department	...	521	374
Chemistry Department	...	545	446
Smallholdings Department	General ...	7781	12971
	With Rubber Controller ...	1191§	6193 ‖
Estate Department	...	766	1300
		19766	28493

* Includes 1587 applications for various posts advertised.
† Includes correspondence handled by the Acting Director.
‡ Includes correspondence handled by the Agricultural Engineer.
§ Includes New Planting Applications, etc.
‖ Includes Preliminary Reports, Final Inspection Reports and Special Reports, etc.

8. NOTES ON DEPARTMENTAL REVIEWS

Botany.—The advisory work as in former years has been mainly concentrated on the choice of new high-yielding clones for use in replanting programmes on commercial estates and on methods of obtaining increased yields with the use of yield stimulants, rainguards, and intensive tapping systems.

The more promising clones RRIC 5, 7, 36, 37, 41, 45, 51, 52, 74, 86, 87, 88 and Nab 15 have been recommended for commercial planting. Clones RRIC 7, 41, 45, 52 and 86 have been declared 'free' clones for multiplication and sale from registered budwood nurseries.

In the 1953 large-scale clone trial, Hedigalla, with 800 to 900 trees of each clone, the more promising clones are RRIC 5 and 7, which yielded 32·6 and 34·4 grams per tree per tapping respectively in 1962 compared with a yield of 30·2 grams per tree per tapping of clone RRIM 501.

In the 1954 large-scale clone trial, Hedigalla, with approximately 500 to 600 trees of each clone in tapping, clones RRIC 36 and 37 have yielded 33·0 and 28·8 grams per tree per tapping respectively in 1962 compared with a yield of 28·2 grams per tree per tapping of clone RRIM 501.

In the 1955 large-scale clone trial, Hedigalla, with 500 trees in tapping from April 1962, Clone RRIC 41 has yielded 30.3 grams per tree per tapping. Clone RRIC 45 budded in the field in 1955 has yielded 8·9 lb per tree in 1962, with 477 trees in tapping.

In the 1949 clone trial, Hedigalla, clone RRIC 52 has yielded 15·6 lb per tree in 1962. Clone PB 86 has given an equivalent yield of 15·6 lb per tree per year in this clone trial.

Yield stimulation experiments No. 3 and 4 were continued in 1962. Increased yields of 44 to 55% over the control were obtained in old budded rubber while 19 to 37% increased yields were obtained from old seedling rubber.

A large-scale yield stimulation experiment, initiated in November 1962 in a 40-acre polyclone block of 30-year-old budded rubber, gave increased yields of 46 to 70% in various treatments with stimulants in the first two months of experimental tapping. This experiment will be continued in 1963.

The Plant Breeding Section of the Botany Department carried out 60,571 hand-pollinations in 1962, which gave 1791 fruits, a 2·9% success under difficult conditions of fruit preservation from *Phytophthora* and *Gloeosporium* infection.

Clone RRIC 7, 10, 36, 45, 51, 52, 54, 62, 70 and Wagga 6278 and the foreign clones Ch 26, PB 86, PB 28/59 and Tjir 1, together with selected disease-resistant clones imported from Latin America, were used as female parents with a view to obtaining high-yielding, disease-resistant clones.

Radiation studies in collaboration with the Radioisotope Centre in Colombo yielded favourable critical values for gamma radiation of germinating *Hevea* seeds.

Methods for inducing early flowering were used extensively for hand-pollination work.

Routine attention was given to the crown-budded area on Moneragalla Group and a new experimental area at Kumarawatta Group.

Plant Pathology.—The incidence of *Oidium* leaf disease was light in all rubber districts. Heavy leaf fall was, however, experienced in late wintering areas. The foliage of most clones in 1962 was about the best seen for many years.

The results of two field experiments confirmed that spraying with sulphur-based fungicides can be as effective as sulphur dusting against *Oidium* infection.

The incidence of secondary Leaf-Fall caused by *Phytophthora palmivora* and Black Stripe (Bark Rot), caused by the same fungus was very light during the year under review.

Field experiments dealing with the control of *Phytophthora* Leaf-Fall was carried out by the Agricultural Engineer on the physical and biological efficiency of the spraying and dusting methods adopted in this country. A separate report has been submitted by him on his findings.

A preliminary selection of seven fungicides suitable for the control of Bark Rot has been made, based on the results of detailed laboratory and small-scale field experiments. The further testing of the selected fungicides under field conditions was carried out in the latter half of 1962.

The application of a selected fungicide for the control of Bark Rot has shown that the treatment at the time of latex collection is significantly better than the treatment before the commencement of tapping.

An assessment of the incidence of *Gloeosporium* and the economic importance of *Gloeosporium* leaf disease in Ceylon has been made.

The results of a number of field experiments on the control of *Fomes lignosus* have indicated that the use of organo-mercuric compounds for the control of White Root disease in Ceylon under field conditions may not be justified and the position will have to be reviewed in the light of results obtained from further experiments carried out by the Pathology Department.

Three long-term experiments have been initiated at Dartonfield to compare the effectiveness of the different methods of identifying and treating *Fomes* infected plants.

A simple method of inoculating *Hevea* roots with the fungus *Fomes lignosus* was perfected during the year.

The Agricultural Engineer in his report has provisionally drawn our attention to the serious doubts he has on the biological efficiency of the intensified use of copper fungicides in Ceylon for the control of *Phytophthora* Leaf-Fall. His report on the ineffectiveness of the dusting and spraying machines to deposit the copper fungicides efficiently on the leaves and on the better ' rainfastness ' qualities of selected copper sprays compared with colloidal dusts is based on factual data obtained in the field and laboratory.

The findings of the Agricultural Engineer indicate that the economic importance attributed to *Phytophthora* Leaf-Fall is not justified and that a considerable saving can be effected by less intensive dusting and spraying in the future.

Laboratory work under the guidance of the Plant Pathologist has been concentrated on the biological studies and the host-parasite relationships of the two leaf disease fungi, *Oidium* and *Phytophthora* with special emphasis on the methods of perennation of these fungi.

Studies on the methods by which *Phytophthora* tides over periods unsuitable for its growth, on bark, pods, fallen twigs and branches of *Hevea* have given results, which could lead to a more economic use of fungicides in the future.

Recent studies have indicated that mummified pods act as a source of primary inoculum of the fungus for the new season.

Soils.—Based on early results from experiments and as a precautionary measure against heavy losses of trees due to wind damage, certain tentative changes have been introduced in the fertilizer recommendations for both immature and mature rubber.

1. A reduction in the amount of NPK or NPK+Mg from 3 to 4 lb of the mixture per plant to 2 lb per plant during the first tapping cycle and to 1½ lb per plant subsequently.

2. A reduction in the level of nitrogen manuring for clones and areas (both immature and mature) definitely known to be susceptible to wind damage. It has been recommended that this could be effected by reducing the annual application of NPK mixture by half and supplying only the phosphate content of the other half in a separate application in order to avoid the introduction of new mixtures.

The recommendation to apply dolomite as a source of magnesium has not been withdrawn from the Institute's recommendations since the results from experiments do not support the claim made that dolomite has a depressing effect on the growth of rubber plants and because it is a cheap and effective source of magnesium which is available locally.

The technique of diagnosing nutrient requirements on the results of leaf or leaf and latex analysis, and the response obtained to fertilizer applications based on such diagnosis under field conditions has failed to give the striking and sudden response that was reported to have been obtained in Indochina. Investigations on this technique are being continued and a separate report will be submitted on this work during the course of 1963.

Reports on field experiments in progress are grouped and reported according to age of planting material in this year's review, which is a deviation from previous procedure.

Early observations maintained on experimental areas indicate that height measurement may not be a satisfactory criterion for evaluating growth response during the early stages of growth.

The type of fertilizer added, and the method of application of fertilizer to the planting-hole could not be expected to have a long term effect on the growth of plants as subsequent treatments have been found to overshadow earlier effects. Nevertheless it may be stated that application of a balanced fertilizer mixture like R 4 : 6 : 2+Mg or Animal Meal (7% N, 10% P_2O_5, 5% K_2O) will be more beneficial than application of phosphate as rock phosphate in the planting-hole.

Of two levels each of N, P and K tested on the growth of plants in the Moneragala District doubling the present level of nitrogen application was found to result in improved growth. The main drawback, however, seems to be one of inadequate moisture.

Experiments carried out on different sources of nitrogenous fertilizers indicate that there is no significant difference between Urea and Sulphate of Ammonia as sources of nitrogen for immature *Hevea.*

Three brands of pelleted concentrated complete fertilizers under trial have not shown any advantage over inorganic fertilizer mixtures on the growth of young *Hevea* up to the second year of growth.

Mulching with loppings of *Pueraria* showed a significant beneficial effect on growth over no mulching. Mulching with Guatemala loppings however, did not show this beneficial effect in one of the experimental areas.

The response of mature *Hevea* in its fourth year of tapping has not yet shown any significant differences in yield due to fertilizer treatments, although different clones tested in the same experiment have responded differently to a significant degree from the time of commencement of tapping. The clones tested responded to fertilizer treatments in a similar manner.

Since there is evidence that cover crop policies and cultivation practices could very often influence growth to a greater extent than even manuring, the importance of these practices are now emphasized in advisory work.

Specific recommendations for eradication of weeds by the application of safe and effective herbicides can now be made on the results of investigations that have been carried out.

With the appointment of a second graduate officer with post-graduate qualifications to the Soils Department in December 1962, it is hoped that the programme of soil survey of the rubber growing areas, which was initiated in 1957, and not continued due to lack of trained personnel, will get under way in 1963.

Meteorological data for a full year have been recorded at Dartonfield in 1962 at the station set up and maintained by the Soils Department. The data are published at the end of the review of the Soils Department.

Chemistry.—The systematic study of the latex and rubber has been continued for the second year. Monthly samples of latex of 20 selected clones are tested for dry rubber content, total solids, percentage of yellow fraction and viscosity. The total solids are tested for ash, copper, iron, manganese, magnesium, phosphorus calcium and iron. The crepe made from the latex of each clone has been tested for colour, plasticity, tensile strength, elongation at break and strain.

Crepe rubber manufactured on 3 estates have been sampled weekly and tested for copper and dirt content.

Investigations of the copper and manganese content of low grade rubbers mainly Brown Crepes manufactured from scrap rubber, have shown that these low grade rubbers often greatly exceed the specified maximum of 8 p.p.m. for copper and 10 p.p.m. for manganese, as laid down by the Rubber Manufacturers' Association of New York (RMA). The following factory practice for treatment of scraps is recommended as a normal procedure throughout the year to ensure that the copper content of the scraps is kept within the RMA specification.

All panel scraps, earth scraps and also cup scraps are soaked for at least one day in five to ten times the volume of fresh sheet or crepe serum to which 0·1% detergent may be added to remove dirt. Care should be taken to ensure that the scraps are properly submerged in the soaking solution. It has been suggested to the RMA that the levels selected for manganese should be based on the quality and form of manganese which will be harmful to rubber products and should take into account that low grade rubbers may absorb manganese from the bark of the trees. The figure of 25 p.p.m. has been suggested as the upper limit for manganese content of low grade rubbers.

The extent of copper contamination of panel scraps as a result of spraying with copper formulations for the control of *Phytophthora* Leaf-Fall is very high at the first tapping following the spray application due to direct contamination, but it assumes reasonable limits on subsequent tapping days, being somewhat higher for the spray formulations than for the copper dusts.

Complaints of dirt in Ceylon Thick Pale Crepe have been made by overseas buyers and estates were advised to keep their factories clean and not to use dirty, rusty water for the dilution of latex. Estates are also advised to use ultramarine blue instead of Swedish Red powder to facilitate the supervision of the application to the bark of the water-miscible panel fungicides for the control of Bark Rot.

Experiments for a direct determination of the colour of latex and for the improvement of the colour of finished scrap crepes are in progress. Investigations on the oil-extension of Natural Rubber at the latex stage are also in progress.

Investigation into the causes of discolouration of latex is being continued. A method has been devised to extract phenolic substances from the latex and chromatographic studies of the phenolic extracts are in progress.

Advice and demonstrations have been given to the Superintendent of an estate interested in the manufacture of Superior Processing Crepe. Experiments on the treatment of effluents from rubber factories to remove offensive smells have been continued.

Several estates have been visited and advice given on crepe manufacture, sheet manufacture, scrap manufacture, weighing of latex, precoagulation of latex, extensions to the factory and centralised rubber manufacture.

Smallholdings.—Mr. J. E. Morris of the R.R.I.M. and Dr. K. F. Heinisch of the R.R.I.C. visited the replantings of the smallholders and inspected sheet rubber manufacture in Colombo District with the Chief Advisory Officer Smallholdings.

The publicity unit continued its useful work throughout the year. 5 sets of colour slides on various aspects of rubber planting were shown. The unit also participated in a school science exhibition and in publicity meetings at Farm Schools for the benefit of the students.

Smallholdings Leaflet No. 9 was published both in Sinhala and English. A detailed leaflet on tapping is now ready for publication.

A series of lectures were given by the Divisional Advisory Officers to students of various Farm Schools and Agricultural Farms.

The Annual Field Day of the Department was held at the Ananda Sastralaya, Matugama. The Chairman, the Director, the Acting Plant Pathologist and the Acting Rubber Chemist of the R.R.I.C. attended the Field Day.

A total of 33,013 visits inclusive of 24,193 visits in 1961 were paid to areas which were being replanted and replanted smallholdings. 8,820 visits were made to replanting areas on 1962 permits. 1,599 subsidy holdings for replanting on 1962 permits totalling approximately 2,331 acres were lined by the Rubber Instructors and Assistants for soil conservation work. 2,091 holdings for replanting on 1962 permits totalling 2,969 acres were lined for planting holes. In addition 1,513 holdings and permit areas, which were outstanding from 1961 permits, were lined by officers for soil conservation works and holing.

1,900 preliminary reports on the suitability of holdings for new planting of rubber were submitted to Rubber Controller. 3,929 visits were made by the Field Staff to new planting and new planted areas on permits for 1962 to give advice on lining. Rs. 5,779/99 were paid as soil conservation grants to 106 peasant-class permit holders.

2,997 Final Inspection Reports were sent to the Rubber Controller to enable him to register these lands as rubber holdings.

The State Aided Sulphur Dusting Scheme initiated by this Department organised 95 Co-operative dusting groups during the year 1962. A total of 9,597 acres (2,927 holdings), were successfully dusted. Arrangements have been completed for the dusting of 10,221 acres in 3,202 holdings from January to March 1963.

Rubber Instructors conducted 2,630 demonstrations on sheet making, tapping, disease control and on miscellaneous subjects connected with rubber planting during the year under review.

A survey of tapping undergirth trees was carried out in 168 villages covering an acreage of approximately 3,770 acres. The survey revealed that out of 2,253 holdings that were inspected 608 holdings were not maintained properly and 305 holdings had cuts opened at incorrect heights and angles.

A survey to ascertain the economics of a replanted holding was continued throughout the year.

Estate.—The Institute's Experimental stations at Dartonfield, Nivitigalakele and Hedigalla have a total acreage of approximately 1,491 acres. 1,002 acres are under rubber with 760 acres in tapping in 1963. The average yield for the year was 604.7 lb per acre. Fifty-seven acres at Hedigalla make up the nursery of the Government Rubber Replanting Subsidy Scheme.

The Estate Superintendent is responsible for the distribution of budwood of local and foreign clones from the Institute's nurseries to commercial estates. A limited quantity of the authenticated budwood of the relevant clones is distributed for purposes of multiplication. He also supervises the Subsidy Scheme's nurseries at Hedigalla.

The incidence of *Oidium* was generally mild. A few locations with late wintering material registered a fairly heavy leaf-fall and called for several rounds of 'spot' dusting with sulphur.

Bark Rot among the better known clones was negligible, but there were indications of an increase in the incidence of *Gloeosporium* in the immature rubber.

Phytophthora Leaf-Fall was very mild during the susceptible season and was brought under control without difficulty with copper fungicides.

The rainfall for the year 1962 at Dartonfield, Nivitigalakele and Hedigalla was 163·4, 143·0 and 182·9 inches respectively.

The 18¾ acres due for replanting in 1963 was felled, cleared and fenced by the end of 1962.

The Visiting Agent paid two visits to the Institute's estates during the year under review.

Kuruwita Sub-station.—A total acreage of 122½ acres was replanted in 1961 and 1962. Approximately 83¾ acres were planted in 1961 with new 10-tree clones established from selected seedling progeny of the 1956, 1957, 1959 and 1960 hand-pollination programmes together with a selection of foreign "exchange" clones. Clone PB 86 was used as a control at suitable intervals in the planting rows.

A selection of FX and IAN clones, which are resistant to South American Leaf Blight (*Dothidella ulei*), was also planted in the 1961 replanting primarily for testing these clones for tolerance or resistance to diseases caused by *Oidium heveae* and *Phytophthora palmivora* and for any yielding qualities under local conditions of growth.

A further 38¾ acres were replanted in 1962 with 23 selected high-yielding local and foreign clones with 150 to 300 tree plots of each clone. The *Dothidella*-resistant clones IAN 45-717 and IAN 6497 were also included in this large-scale clone trial. Both these clones have been established from seedling crosses with clone PB 86 as a parent and show moderate yielding qualities.

The report for 1962 has been submitted by the Visiting Superintendent, Mr. B. Cocking. Mr. W. B. Jonklaas visited the Sub-station in March and September 1962.

Mr. L. P. de Mel, Senior Field Assistant was on duty during the year under review.

The estimated crop of 50,000 has been exceeded by approximately 4500 lb mainly due to the use of yield stimulants in November and December for increased yields from old budded rubber in a block of 48¾ acres.

The 1961 experimental replanting of 83¾ acres as well as the 1962 replanting of approximately 38¾ acres are progressing very satisfactorily with a vigorous development of young budded rubber and a luxuriant growth of the ground cover of *Pueraria*. A fair incidence of *Fomes* has been recorded in these replanted areas and the necessary attention is being given for an effective eradication of the root disease.

A total area of 22½ acres have been uprooted and prepared for replanting in 1963. The major proportion of this acreage will be used by the Soils Chemist for a manurial experiment with new local high-yielding clones recommended for Commercial planting.

REVIEW OF THE BOTANY DEPARTMENT

By

C. A. De Silva

SUMMARY

Field Experiments and Laboratory Work.—Field experiments carried out in connection with breeding and selection work and test-tapping of new clones extend over a total acreage of 1100 acres in the 4 experimental stations of the Institute.

The Staff of the Botany Department and Plant Breeding Section is responsible for the supervision of these experiments and the recording of the yield and growth data. The Estate Department attends to the commercial yield records.

Test tapping is carried out in small-scale clone trials with 3 or 5-trees of each clone. Selected high-yielding clones from these trials have been planted in large-scale clone trials with 800 to 1000 trees of each clone according to the available land for clone trials in subsequent years.

A number of clones in these large-scale clone trials were brought into test tapping from 1960 to 1962.

With an increased research staff it has been possible to make a close study in the field of the external vegetative characters of the more promising clones for making suitable selections of the best yielding clones with good secondary characters for planting on a limited scale in a variety of growing conditions on commercial estates in the rubber planting districts.

Laboratory work was again restricted in 1962. The new Botany Block which is in the course of construction will be completed in 1963 and a more permanent long-term research programme on anatomical and physiological problems will be initiated in 1963/64.

A separate report is submitted by the Assistant Plant Breeder on the work of the Plant Breeding Section. An area of 300 planting points within a large-scale clone trial at the Kuruwita Sub-station was planted in 1962 with 10-tree clones established from selected seedling crosses of the 1957, 1958, 1959 and 1960 hand-pollination programmes. In a large-scale clone trial at Nivitigalakele Station a single 150-tree plot was planted with 10-tree clones established from H.P. seedlings of the same hand-pollination programmes. This new budded material can be expected to combine high-yielding qualities with vigorous growth characteristics and disease resistance.

Advisory Work.—The advisory work as in former years was confined to replanting programmes and tapping problems connected with methods of obtaining increased yields from low-yielding old seedling and budded rubber with the use of yield stimulants, rainguards, and intensive tappings system.

Serious wind damage in clones LCB 1320 and PB 86 called for advisory visits to estates, where heavy damage was experienced in 1962. Clone RRIC 52 has been recommended for commercial planting in exposed areas. This clone is appreciably

tolerant to diseases caused by *Oidium* and *Phytophthora* and is also resistant to wind damage in the form of trunk snap. It is a late-maturing clone for high yields which compare very favourably, in about the 6th year of tapping, with those of high-yielding clones.

Tapping Experiments.—Yield stimulation experiment No. 3 was continued for the third year in 1962. Increased yields of 44 to 55 per cent compared with control areas, were obtained from applications of the RRIC Mixture No. 1 and Dilatex, from budded rubber planted in 1935 with a yield of about 600 lb dry rubber per acre per year.

A large-scale yield stimulation experiment No. 4 was initiated at the Kuruwita Sub-station in January 1962 in 40 acres of old seedling rubber tapped on the double-four and double-three systems. Dilatex failed to give good results on this thin-barked rubber, which had to be very lightly scraped. Stimulex with a thinner consistency than Dilatex gave a 19% increased yield. A stimulant with a liquid consistency gave a 37% increased yield with applications on the lightly scraped bark presumably due to better penetration.

A large-scale yield stimulation experiment No. 5 was started in November 1962 in a 40-acre block of budded rubber at the Kuruwita Sub-station. RRIC Mixture No. 1, Dilatex, and Stimulex gave increased yields of 46 to 70% in the first 2 months of experimental tapping, which will be continued in 1963.

Performance of Clonal Seedlings and Local Clones.—The hand-pollinated legitimate seedlings from crosses of clones PB 86, Mil 3/2, Wag 6278, RRIC 8, Hil 28 and Tjir 1 continue to give yields which compare favourably with those obtained from high-yielding clones. This type of clonal seedlings are, however, not available for commercial planting, but mixed seed collections have been approved on commercial estates, where two or more of the clone parents used in hand-pollination programmes are planted in adjacent blocks, which are sufficiently isolated from other rubber areas for use as seed gardens. Test-tapping in these clonal seedling areas will be discontinued from 1963.

The more promising RRIC clones with good secondary characters, Nos. 5, 7, 36, 37, 41, 45, 51, 52, 74, 87, 88, 89 and Nab 15 have been recommended for commercial planting in 1962 on a limited scale.

In the 1953 large-scale clone trial approximately 800 to 900 trees of each clone in commercial tapping have been test-tapped. Clones RRIC 5 and 7 have yielded 32·6 and 34·4 grams per tree per tapping respectively compared with clone RRIM 501 yielding 30·2 grams per tree per tapping in the same clone trial.

Clones RRIC 36 and 37, in the 1954 large-scale clone trial with approximately 500 to 600 trees of each clone in test-tapping, have given yields of 33·0 and 28·8 grams per tree per tapping respectively in 1962. Clone RRIM 501 in the same clone trial yielded 28·2 grams per tree per tapping.

Clone RRIC 41 with approximately 500 trees in test-tapping from April 1962 in the 1955 large-scale clone trial has given 30·3 grams per tree per tapping. This early yield is very promising.

Clone RRIC 45, budded in the field in 1955 in a clone trial at Nivitigalakele Station, with 477 trees in test-tapping, has yielded 8·9 lb per tree per year in the first year of tapping. The clone is a vigorous grower and this early yield is reassuring.

Clone RRIC 51, with the original 5 budded trees planted in 1941 still in test-tapping, has yielded 29·4 lb per tree per year in the 14th year of tapping. It has been planted in a large-scale clone trial at the Kuruwita Sub-station in 1962. The clone has good external vegetative characters and has been used for breeding work.

Clone RRIC 52 at 13 years of age in the 1949 large-scale clone trial at Hedigalla has yielded 15·6 lb per tree per year compared with an equivalent yield of 15·6 lb per tree per year of clone PB 86 in the same clone trial. The clone has a luxuriant, spreading foliage canopy, which is unsuited to close planting in the rows. A spacing of 15′×18′ is recommended for clone RRIC 52 to develop its full potentialities as the most vigorous growing clone we have at the present time.

In the small-scale clone trials of the original budgrafts planted in 3-tree and 5-tree clones in 1941, 1943, 1944, 1946 and 1947 at Nivitigalakele and Hedigalla Stations the selected clones test-tapped in 1962 continue to give promising yields. Clones RRIC 36 and 37 show a fall in yields with the rest of the clones in the 1943 clearing, Hedigalla as a whole. These two clones have, however, given very promising early yields in large-scale clone trials as indicated earlier in this summary.

The newer RRIC clones Nos. 50, 55, 59, 60, 64, 75, 96, 97 and 98 have also given promising yields and await trial on a larger scale.

Foreign Clones.—Clone PR 107 has now been tapped for 15 years. 19 trees in the 1940 clone trial at Nivitigalakele have given 15·1 lb per tree per year compared with a similar yield of 15·1 lb per tree per year of clone RRIM 501. Clone RRIM 513 with 19 trees in tapping in the same clone trial has yielded 10·0 lb per tree per year. Clone RRIM 513 in the 1949 clone trial with 120 trees in test tapping has yielded 13·4 lb per tree per year compared with clone PB 86 yielding 15·6 lb per tree per year with 107 trees in tapping.

293 trees in tapping of clone PR 107 has yielded 13·9 lb per tree per year in the 1946 clone trial at Nivitigalakele in the 10th year of tapping compared with a yield of 13·3 lb per tree per year of clone Tjir 1.

Clone IRCI 7 in the 1954 clone trial at Nivitigalakele has yielded 9·2 lb per tree per year in the third year of tapping compared with a yield of 11·9 lb per tree per year of clone RRIM 501. Clone PB 28/59 in the same clone trial has given the outstanding yield of 14·2 lb per tree per year.

Height of Opening Initial Tapping Cuts in Budded Rubber.—Tapping at heights of 42″ and 50″ from the union was initiated in 1954 on 18 foreign and local clones. No significant differences were found in yield or growth figures in 1962 after approximately two years of test-tapping. The average yields were 23·2 grams and 24·3 grams per tree per tapping at the heights of 42″ and 50″ respectively. Tappers find it difficult to tap up to normal standard of good tapping during the first 3 to 4 months at 50″ height with the Michie-Golledge knife. Incidentally the 10 trees of clone PB 28/59 in this experiment gave an outstanding yield of approximately 50 grams per tree per tapping in the second year of tapping; 3 cases of Brown Bast have been reported.

Growth Measurements in Immature Areas.—Girth measurements of foreign and local clones in all immature and mature areas were taken in 1962. The more important growth figures especially in the immature areas have been summarized in this report.

The growth generally has been very satisfactory in the replanted areas at Dartonfield, Nivitigalakele and Kuruwita Sub-stations. The poorest growth is to be found in some of the newly planted areas at Hedigalla on mountainous land. The ' virgin ' jungle land at Hedigalla is not up to the standard of fertility of the better types of rubber land which are used for replanting, presumably due to the many years of cultivation and manuring of replanted land.

1962 Replanting Programme

1962 Large-Scale Clone Trial, 38¾ Acres, Kuruwita Sub-station.—25 local and foreign high-yielding clones as well as moderate-yielding clones resistant to *Dothidella ulei* and to *Oidium heveae* (on early indications at the testing station on Kepitigalla Estate) were planted in 150-tree or 300-tree plots during the South-West planting period of 1962 as given below :

Clones AVROS 529 and 2037, Harbel 1, IAN 45-717 and 6497, IRCI 7 and 9, PB 86 (Control), PR 228, PR 251, PR 259, RRIC 7, 14, 36, 37, 41, 45, 51, 52, RRIM 607, 623, 628, 701, 707 and WR 101.

A small-scale clone trial made up of 10-tree clones established from selected H.P. seedlings from the 1957, 1958, 1959 and 1960 pollination programmes and established clones were also included in a single 300-tree plot within the large-scale clone trial. The material was as follows :—Clone Nos. 566, 759, 784, 815, 828, 864, 1009, 1018, 1103, 1108, 1141, 1317, 1458, 2002, 2005, 2028, 2031, 2124, FX 3925, IAN 45-713, IAN 6754, PB 28/59 RRIC 90, 91, 92, 93, 94, 95, 96, 97.

Boundary areas were planted with 70 trees of clone RRIM 628.

1962 Large-Scale Clone Trial, 16¾ Acres, Nivitigalakele Station.—17 local and foreign clones were planted in the South-West planting season of 1962 in 150-tree plots as follows :—

Clones IAN 45-717, PB 86, RRIC 5, 39, 51, 86, 90, 91, 92, 93, 94, 95, 96, 97 and RRIM 623, 628, 701.

A small-scale clone trial was planted in 10-tree clones in a single 150-tree plot within the large-scale clone trial as follows :—

Clone Nos. 82, 566, 759, 815, 1009, 1103, 1317, 1458 and the established clones Harbel 1, IAN 6497, PB 28/59, RRIC 7, 36, 45 and 52, RRIM 607 and 707.

DETAILED REVIEW

1. GENERAL

1.1. Staff.—Mr. C. A. de Silva, Botanist, was on duty during the year under review. He acted for the Director from 20th April to 20th June 1962 while the Director was away from Ceylon attending Conferences in Paris and in Washington.

The Botanist was appointed Deputy Director in addition to his own duties as from 30th March 1962 and he acted for the Director again from the 14th December 1962 following the resignation of the Director at the end of his term of contract.

The Plant Breeder, Mr. R. T. Wijewantha, continued his post-graduate studies in Plant Breeding & Plant Genetics at the University of California.

Mr. D. M. Fernando, Assistant Plant Breeder, was on duty during the year. A separate report is submitted by him on the work of the Plant Breeding Section of the Botany Department.

Mr. L. B. Chandrasekera, Assistant Botanist and Mr. R. Satchuthananthavale, Research Assistant, were on duty throughout the year.

Mr. W. G. V. Fernando, Senior Technical Assistant and Mr. C. Amaracone, Technical Assistant were also on duty during the year.

1.2. Advisory Work.—The advisory work as in former years has been confined to recommending suitable planting material for use in replanting programmes.

Methods of obtaining increased yields by yield stimulation, the use of rainguards, and intensive systems of tapping were the subjects of numerous inquiries in an all-out attempt to increase the average yields per acre on estates with a considerable acreage of old budded and seedling rubber where the yields had fallen below an economic level.

Serious wind damage in clones LCB 1320 and PB 86 in 1962 has called for advice on methods of minimizing such damage in the future.

A two-week's training course was organized in June 1962 at Dartonfield, for the District Advisory Officers and the Rubber Instructors of the Smallholdings Department, on the various aspects of tapping *Hevea* Rubber. The Botanist together with Heads of Departments and the Assistant Chemist attended to practical classes in the morning sessions and gave talks in the afternoon sessions.

The writer carried out an inspection of the Mitrigalla Government Forest Reserves via Nittambuwa and submitted a report to the G.A., Colombo, on the feasibility of using this jungle for land-allocations to plant rubber.

The writer was a member of two Committees of Enquiry, one acting on behalf of the Government Rubber Replanting Subsidy Scheme and the other on behalf of the Rubber Research Board, in connection with the Smallholdings Department at the Bulathsinghala Police Station and at Pelmadulla respectively. Two reports were submitted by the writer on behalf of the committees concerned.

Correspondence :

Inward	...	**878**
Outward	...	**812**

1.3. Visits

To Estates	...	**10**
To Experimental Stations	...	**27**
To Colombo	...	**6**

1.4. Meetings.—The Botanist attended the following meetings of the Planters' Associations to address the members on replanting rubber and allied subjects and to take part in general discussions on planting topics.

(1) The Southern Province Planters' Association, Galle.

(2) The Kalutara Planters' Association, Tebuwana.

1.5. Publications.—The following articles were prepared for publication in the Institute's Quarterly Journal for 1962.

(*a*) History and Description of Promising RRIC Clones. II—Clones RRIC 7, 41 and 45. *Rubb. Res. Inst. Ceylon Quart. J.* (1962) **38**, 1-10.

(*b*) History and Description of Promising RRIC Clones. III—Clones RRIC 86, 88 and 89. *Ibid*, (1962) **38**, 47-56.

(*c*) " Question Corner " — The basis on which new local and foreign clones are recommended for commercial planting in this country.

(*d*) " Planting Topics " — Pruning and Pollarding of Rubber Trees.

The Annual Report of the Botany Department for 1961 was prepared for publication.

2. YIELD STIMULATION EXPERIMENTS

Yield stimulation experiment No. 3 was continued in 1962. The 'RRIC' Mixture and Dilatex were used on budded rubber planted in 1935 and capable of yielding up to 600 lb dry rubber per acre at the commencement of the applications of stimulants. The stimulants were applied with independent controls in two sections of the 1935 clearing. The results from 1960 to 1962 are presented below.

Yield Stimulation Experiment No. 3, 1935 Clearing, Nivitigalakele
Tapped S/2, d/2, 100%
Yield in lb dry rubber

Treatments	RRIC Mixture I	Control	Dilatex	Control
Yield 1960 ...	1,324	1,054	1,722	1,232
As per cent of control ...	126	100	140	100
Yield 1961 ...	1,159	760	1,438	990
As per cent of control ...	152	100	145	100
Yield 1962 ...	1,114	767	13,88	896
As per cent of control ...	145	100	155	100

A large-scale yield stimulation experiment No. 4 was initiated in January 1962 in two fields of 40 acres of old seedling rubber tapped on the double-four and double-three systems of tapping at the Kuruwita Sub-station. Stimulex, Dilatex and Ready-Rub, a 2, 4, 5-T preparation, were applied on lightly scraped bark. The field tapped on the double-four system was uprooted in August 1962 for replanting in 1963. The results for 1962 were as follows for a section of the field tapped on the double-three tapping system.

Yield Stimulation Experiment No. 4
Tapped 2S/2, d/3, 133%
Yield in grams per tree per tapping

Treatments	Ready Rub	Dilatex	Stimulex	Control
Yield 1962 ...	42·9	32·4	37·2	31·2
As per cent of control ...	137	104	119	100

Ready Rub which is normally recommended for application without scraping was applied on lightly scraped bark together with the other stimulants. Ready Rub responded better than the other stimulants and Dilatex, which is of a thicker consistency than Stimulex, gave poor results with the light scraping.

A large-scale yield stimulation experiment No. 5 was initiated in November 1962 in a 40-acre polyclone area at the Kuruwita Sub-station consisting of clones Tjir 1 and 16, BD 5, BD 10 and AVROS 49. This clearing is over 30 years of age with an average stand of about 80 trees per acre. The stimulants, Dilatex and Stimulex were applied on scraped bark of $1\frac{1}{2}$ inches width below the tapping cut. The RRIC Mixture 2, with a liquid consistency was applied on bark of $1\frac{1}{2}$" width groomed with a wire brush and on bark without pre-treatment before application. The results for the first two months of experimental tapping are given below :—

Yield Stimulation Experiment No. 5, 40 Acres, Kuruwita
Tapped 2S/2, d/4, 100%
Yield in grams per tree per tapping

Treatments	Stimulex	Dilatex	RRIC Mixture I	RRIC* Mixture II	RRIC** Mixture II	Control
Yield November 1962	78·5	63·6	86·8	74·1	75·6	59·3
Yield December 1962	95·9	96·1	98·9	80·9	77·5	50·1
Mean	87·2	79·9	92·9	77·5	76·6	54·7
As per cent of control	160	146	170	142	130	100

*Applications on groomed bark.

**Applications without grooming or scraping.

Increased yields have been obtained from all the stimulants and the RRIC Mixture No. 1 has done particularly well in giving an increased yield of 70% over the control.

The increased yields in the first two months after application have brought the rubber crop substantially above the estimated figure for 1962 at the Kuruwita Sub-station.

This class of rubber yielding about 600 to 800 lb per acre per year with good bark reserves responds well to stimulation with applications made once in a 12-month period of tapping.

3. TAPPING EXPERIMENTS

3.1. Tapping Experiment, 1938 Replanted Area, Dartonfield.—A tapping experiment was started in November 1961 in a 3-acre block of clone PB 86 planted in 1938. The experiment consists of 4 blocks of 80 trees each, which were first tapped for preliminary yields on the S/2, d/2, 100% system before the 4 tapping systems were introduced. The results for the year 1962 were as follows :

Tapping Experiment, 1938 Replanted Area, Dartonfield
Yield in lb dry rubber

Treatments	S/2, d/2, 100%	2S/2, d/4, 100%	2S/2, d/3, 133%*	2S/2, d/3, 133%**
Preliminary yields on S/2, d/2, 100%	189	166	161	182
Experimental yields 1962	828·7	794·7	945·4	1232·9
Adjusted yields 1962	814·2	803·2	958·9	1225·4
As per cent of control	100	98·6	117·8	150·5
Relative tapping costs	100	84·5	94·3	147·6

*Two normal half-spiral cuts tapped downwards.

**One high cut at 100 inches from ground level tapped with a ladder downwards with a normal half-spiral cut tapped downwards on the opposite panel.

The tapping costs are based on a task of 250 trees per tapper per day for a single-cut tapping system and 150 trees per tapper per day on a double-cut system. The double-cut system with one high cut tapped with a ladder reduces the tapping task per day to 75 trees in this experiment, taking into consideration the hilly land on which this experiment is located.

The double-cut systems in this experiment were introduced in the 18th year of tapping. There was some difficulty in introducing the second cut for the double-cut system, as the systematic change-over system had not been followed in these early replantings in the past.

The expected standard of increased yields from the double-four system 2S/2, d/4, 100% of 5 to 10% over the control system S/2, d/2, 100% has not materialized in the first year of test tapping, even so the 98·6% crop compared with the control has been obtained at a reduced cost of 15·5%. This tapping experiment will be continued in 1963.

In general it has been found that a higher yield is obtained from a double-cut system compared with a single-cut system of the same tapping intensity. Tapping on the double-four system after the third year of tapping on high-yielding clones is not recommended at the present time. The introduction of a double-cut tapping system should be postponed until the trees are tapped for about 8 to 9 years on S/2, d/2, 100%. With the correct application of the change-over system of tapping increased yields have been obtained on the double-four system at a reduced cost of tapping compared with the control half-spiral alternate-day system.

3.2. Test-Tapping of Clones and Clonal Seedlings.—The test-tapping of clones and legitimate clonal seedlings was continued as in previous years and the results are presented in Tables I and II.

The test-tapping of the H.P. seedlings given in Table I will be discontinued from 1963. The information up to 1962 indicates that clones RRIC 8, Mil 3/2, Wag 6278, Hil 28, Tjir 1 and 16 and PB 86 used as parents in the early pollination programmes from 1941 to 1947 have given seedling progeny capable of yielding up to the standard of budded rubber.

In more recent years high-yielding budded rubber has been used more extensively for replantings than clonal seedlings. The limited acreage planted with clonal seedlings have been confined to a choice of Tjir 1 seed from approved collection areas on commercial estates and Prang Besar Isolated Garden seed from Malaya.

The type of clonal seedlings represented in Table I have been produced from hand-pollinations and will not be available on a commercial scale. The yield results, however, indicate the useful clone parents that could be planted out in isolated seed gardens. This knowledge has been of practical value in approving collection areas for mixed seed on commercial estates, which have these clone parents in polyclone blocks with the necessary isolation for use as seed gardens.

In the yield results of RRIC clones presented in Table II considerable fluctuations are noticeable from year to year with 3 to 5 trees of each clone included in the test-tapping rounds carried out twice per month on normal tapping days. The change-over of the tapping cut from one tapping panel to the opposite one can cause such fluctuations especially if one of the two panels on each tree has been treated for bark disease in the past.

Most of the better yielding clones in Table II with good secondary characters have been planted since 1954 in large-scale clone trials and 400-800 trees of each selected clone have been test-tapped in 1961/62. The early yield results of the clones in these large-scale clone trials are given in Tables XIIA and B, XIII and XIV in this review.

Clones RRIC 36, 37, 41 and 45 have been recommended for commercial planting on a limited scale in 1962.

3.2.1. Test-Tapping of Clones RRIC 88 and 89.—These clones were established from two selected high-yielding Prang Besar clonal seedlings and planted in the 1946 clone trial at Nivitigalakele Station for a study of hard and soft rubbers by the Chemist. Early observations on the high-yielding qualities of these clones by the Botanist led to the inclusion of these clones for test-tapping from 1953 by the Botany Department. In recent years both clones have shown an appreciable tolerance to *Phytophthora* diseases, especially Leaf-Fall, which is very marked in some clones in the 1946 clearing.

TABLE I

Test Tapping Results of Hand-Pollinated Clonal Seedlings
Tapped S/2, d/2, 100%

RRIC Station	Origin of material	Year of planting	Parentage of seedling family	No. of trees tapped	Yield in lb d.r. per tree per year		No. of trees affected		
				1962	1961	1962	Canker and Bark Rot	Brown Bast	Wind damage
Nivitigalakele	1939 H.P. seedlings	1941	RRIC 8 × Mil 3/2	34–33	19·0	20·5	9	16	4
			RRIC 8 × Wag 6278	33–31	19·2	20·8	8	14	5
			Control Wag 6278 (budded)		17·1	16·5	3	4	1
Nivitigalakele	1940 H.P. seedlings	1942	RRIC 8 × Hil 28	115–109	14·5	16·2	11	31	9
			RRIC 8 × Tjir 1	75–58	18·1	17·0	4	26	27
			Control Wag 6278 (budded)		18·2	18·3	4	9	21
Hedigalla	1941 H.P. seedlings	1943	PB 86 × PR 107	15	28·8	25·0	1	6	1
			PB 86 × Tjir 1	14	21·2	16·5	—	11	—
			RRIC 8 × Tjir 16	10	20·2	18·8	—	4	—
			Control Wag 6278 (budded)	21	21·1	20·3	—	3	—
Hedigalla	1943 H.P. seedlings	1946	PB 86 crosses	79	20·5	17·4	—	2	—
			Control Tjir 1 (budded)	27	17·5	15·4	—	1	—
Hedigalla	1944 H.P. seedlings	1946	PB 86 crosses	124	19·8	22·4	—	13	1
Hedigalla	1945 Clonal seedlings	1947	PB 86 crosses	603–534	17·5	15·3	26	29	3
			Tjir 1 crosses	241–221	13·6	21·0	13	2	—
			*Tjir 1 selfs	309–281	9·4	8·1	—	12	—

*Seed from an isolated seed garden of clone Tjir 1

TABLE II

Test Tapping Results of Clones Established from Hand-Pollinated Seedlings

RRIC Station	Origin of material	Year of planting	Clone	No. of trees tapped in 1962	Yield in lb d.r. per tree per year		No. of trees affected			Mean girth in inches at 60" 1962	Bark thickness in mm.	
					1961	1962	Canker and Bark Rot	Brown Bast	Wind damage		Virgin bark	Renewed bark
Nivitigala-kele	1939 H.P. Seedlings	1941	RRIC 9	3	26·1	31·9	—	1	—	49·1	12·3	10·8
			,, 51	5	24·1	29·4	1	2	—	50·3	12·4	9·6
			,, 24	5	24·8	19·6	2	—	—	48·4	11·0	8·6
			,, 14	5–2	14·2	14·3	1	1	1	40·4	11·7	10·0
			Control Wag 6278		11·1							
Nivitigala-kele	1940 H.P. Seedlings	1944	RRIC 41	2	28·3	41·0	—	2	—	41·6	12·5	11·0
			,, 45	1	45·4	47·1	1	—	2	49·1	12·0	10·0
			,, 39	1	34·1	46·3	1	—	1	47·8	14·0	13·0
			,, 60	3	32·0	34·0	—	2	—	46·9	12·7	10·0
			,, 40	3–1	38·3	31·7	1	—	1	53·3	12·5	9·0
			,, 59	3	39·8	39·6	—	—	—	46·9	13·7	10·6
			Control Wag 6278		18·7	19·3						
Hedigalla	1941 H.P. Seedlings	1943	RRIC 50	4	44·0	40·1	—	—	—	42·5	12·3	—
			,, 75	2	52·2	32·3	—	—	—	41·8	11·2	—
			,, 33	4	39·9	30·9	—	1	—	—	—	—
			,, 36	4	44·4	30·9	—	—	—	43·0	12·3	—
			,, 35	5	42·9	30·6	—	—	—	43·3	11·4	—
			,, 76	4	32·7	28·4	1	—	—	39·6	13·2	—
			,, 79	5	32·4	26·9	—	—	—	44·7	11·3	—
			,, 74	5	35·8	26·8	1	—	—	39·3	12·0	—
			,, 37	4	50·8	26·0	—	—	—	37·0	10·5	—
			,, 46	3	30·9	21·6	—	—	—	37·3	10·6	—
			,, 47	4	31·1	21·0	—	1	—	40·2	10·8	—
			Control Wag 6278	5	22·0	21·7	—	—	1	—	—	—
Hedigalla	1943 H.P. Seedlings	1946	RRIC 98	4	33·1	40·4	—	—	1	38·1	11·6	—
			,, 55	3	29·4	35·6	—	—	2	31·0	11·1	—
			,, 96	5	30·6	32·4	—	—	—	42·1	11·5	—
			,, 97	4	23·3	26·3	—	—	1	44·5	10·4	—
			,, 77	4	29·4	25·7	1	—	—	36·7	11·9	—
			RR 241	5	23·2	25·0	—	—	—	33·0	9·7	—
			RRIC 61	4	26·1	23·6	—	1	—	34·9	9·3	—
			Control Tjir 1	4	18·2	20·9	—	—	1	—	—	—
Hedigalla	1944 H.P. Seedlings	1947	RRIC 64	5	25·7	34·7	—	—	—	34·3	9·7	—
			,, 65	4	23·0	26·1	—	1	—	33·7	9·7	—
			,, 78	4	19·8	24·2	—	1	—	29·7	10·0	—
			,, 66	5	19·9	22·2	—	—	1	31·1	8·3	—

*Up to June only.

Test-tapping results for 1962 are presented below :—

Large-Scale Clone Trial, 1946 Replanted Area, Nivitigalakele
Tapped on S/2, d/3, 67% from 1953
Tapped S/2, d/2, 100% from 1956
Yield in lb dry rubber per tree per year

Clone	RRIC 88	RRIC 89
Yield 1962 ...	23·1	22·4
Yield 1961 ...	25·2	21·7
No. of trees tapped 1962 ...	23–22	22–21
Brown Bast cases ...	1	2
Wind damage cases ...	1	—
Girth in inches 1962 ...	37·3	35·3
Thickness of virgin bark (mm.) ...	11·8	10·1
,, ,, renewed bark (mm.) ...	10·5	8·7

The two clones continue to be promising in the 10th year of tapping. A 3-acre block of each clone has been planted in the 1961 large-scale clone trial at Dartonfield. Clone RRIC 88 shows a slight bending habit in the first year of growth but straightens out in the second year. Both clones have been recommended for commercial planting from 1962 on an experimental scale.

3.2.2. Test-Tapping in 1952 Clearing, Hedigalla, 25 Acres, Five-Tree Clone Trial.—625 five-tree clones established from a selection of the 1945 H.P. seedlings were planted in this clone trial. From 12 of the most vigorous growing and better yielding clones, 6 clones with good external vegetative characters were finally selected for planting in a large-scale clone trial at the Nivitigalakele station in 1962 in 150-tree plots of each clone. The early yields of the 6 selected clones, registered as RRIC clones, are presented below :

Large-Scale Clone Trial, 1952 Clearing, Hedigalla
Tapped S/2, d/2, 100% from July 1960
Yield in lb per tree per year

Clone	No. of trees tapped 1962	Yield		Girth in inches 1962	Bark thickness in mm.	
		1961	1962		Virgin	Renewed
RRIC 90	5	22·9	25·3	28·4	7·8	5·8
,, 91	5	20·5	21·1	33·7	8·6	7·4
,, 92	5	16·7	15·5	29·9	7·2	5·4
,, 93	5	15·8	18·2	25·7	7·7	5·7
,, 94	5	15·6	17·7	24·2	7·5	5·2
,, 95	5	14·5	15·6	32·3	9·0	6·3

Five of the 6 clones have given improved yields in 1962. Clones RRIC 90 and 91 are particularly promising.

3.3. Test-Tapping of Foreign and Local Clones established from Imported Clonal Seedlings.—Test-tapping was continued in 1962 and the results are presented in Tables III to XIV.

TABLE III

Large-Scale Clone Trial, 1952 Replanted Area, Dartonfield.

Tapped S/2, d/3, 67% from April 1958
Tapped S/2, d/2, 100% from 1960.

Yield in grams per tree per tapping

Clone	Yield		Girth in inches 1962
	1961	1962	
RRIM 501	44·0	45·5	26·1
Nab 15	41·8	37·4	29·3
Nab 12	30·0	33·9	28·0
PB 86	28·1	28·0	26·6
Nab 20	27·6	32·6	27·8
Mean	34·3	35·5	27·6

Clone Nab 15 is recommended for commercial planting on a moderate scale normally a 10-acre block on large estates. The clone has given better yields than clone PB 86 since the commencement of tapping in the 1952 trial.

3.3.1. Nab Clones.—The test-tapping of the original budgrafts of clones Nab 12 and 15 established from selected high-yielding Tjikadoe seedlings was continued in 1962. The results are presented in Table IV.

TABLE IV

1939 Clearing, Nivitigalakele
Tapped S/2, d/2, 100% from 1945
Yield in lb per tree per year

Clone	No. of trees tapped 1962	Yield		No. of trees affected			Mean girth in inches 1962	Bark thickness in mm.	
		1961	1962	Canker and Bark Rot	Brown Bast	Wind damage		Virgin	Renewed
Nab 12	16	18·4	17·1	2	5	3	37·0	9·8	7·5
Nab 15	18–15	14·8	14·6	4	5	—	35·8	11·4	8·9
PB 86	19–17	22·0	20·7	—	4	2	37·5	10·7	8·3

Clone PB 86, the control clone, has been free of *Phytophthora* diseases in this particular location and has given a better yield than the Nab clones.

Two of the foreign clones planted in 1940 in a large-scale clone trial at Nivitigalakele, which are recommended for commercial planting have been test-tapped from 1947. The results for 1962 are given in Table V.

TABLE V

1940 Clearing, Nivitigalakele
Tapped S/2, d/2, 100% from 1947
Yield in lb per tree per year

Clone	No. of trees tapped 1962	Yield		No. of trees affected			Mean girth in inches 1962	Bark thickness in mm.	
		1961	1962	Canker and Bark Rot	Brown Bast	Wind damage		Virgin	Renewed
PR 107 ...	19	13·9	15·1	12	4	2	34·0	11·3	7·6
RRIM 513	19	9·5	10·0	2	6	—	27·6	9·1	6·7
RRIM 501	10	13·1	15·1	2	6	11	28·4	10·6	8·0
Control									
Wag 6278	19–17	16·1	18·1	5	1	6	33·0	12·5	9·5
Tjir 1 ...	14	15·4	13·6	1	8	6	32·2	10·5	7·6

Clone RRIM 513 has been recommended for commercial planting in place of clone RRIM 501 which has been taken off the list of recommended clones. The thickness of renewed bark of clone RRIM 513 is below average.

The test-tapping of foreign clones planted in the 1954 clearing, Nivitigalakele, was continued in 1962. The results are presented in Table VI.

TABLE VI

Large-Scale Clone Trial, 1954 Clearing, 10 Acres, Nivitigalakele,
Tapped S/2, d/2, 100% from March 1960.
Yield in lb d.r. per tree per year.

Clone	IRCI 10	IRCI 7	PB T-207	PB 6/5	PB 24/3	PB 28/59	PB 24/51	RRIM 501
Yield 1961	8·8	10·2	7·0	8·9	8·6	14·2	7·6	9·7
Yield 1962	10·5	9·2	9·5	10·2	9·9	15·3	8·3	11·9
No. of trees tapped, 1962	105–89	164–151	133–94	147–141	144–137	158–149	156–148	168–154
Canker and Bark Rot cases	—	1	1	1	1	1	—	1
Brown Bast cases	34	3	4	5	5	7	5	5
Wind damage cases	57	16	64	8	9	13	7	18
Mean girth in inches 1962	22·2	24·9	24·1	23·1	24·1	24·1	24·5	23·3
Virgin bark thickness in mm. 1962	6·0	6·5	7·7	6·7	7·3	7·7	6·5	7·3

The yield of clone PB 28/59 continues to be outstanding in this clearing. It has been planted in a 3-acre block at Dartonfield in 1961 and has been recommended for commercial planting on a limited scale. The incidence of Brown Bast will be carefully noted as it may be an undesirable secondary character of the clone.

Clone IRCI 10 with an improved yield in 1962 also shows an unduly high incidence of Brown Bast cases. This clone is known to be very susceptible to wind damage in its country of origin.

The test-tapping of the 3 original budgrafts of clone RRIC 52 was continued in the 1944 clearing in 1962. The results are presented in Table VII. The 3 trees have an average girth of 53.8 inches and average thickness of the virgin bark is 12·7 mm. One tree was uprooted in a storm and the largest tree of this 5-tree clone was burnt out by lightning.

TABLE VII

Small-Scale Clone Trial, 1944 Clearing, Hedigalla
Tapped S/2, d/2, 100% from May 1951
Yield in lb d.r. per tree per year

Clone	No. of trees tapped 1962	Yield				Canker and Bark Rot cases	Wind damage cases	Girth in inches	Virgin bark in mm.
		1959	1960	1961	1962				
PB 5/122	4	23·8	35·5	29·8	22·8	—	—	42·5	10·3
RRIC 52	3	25·1	31·2	35·6	33·0	—	1*	53·8	12·7
Control Wagga 6278	5	20·1	26·7	25·9	21·7	—	—	—	—

* Uprooted in a rain storm.

3.3.2. RRIC clones Nos. 2 to 7.—These clones were early selections from 190 three-tree clones established from Prang Besar Seedlings in 1937 which were planted out in a large scale clone trial in 1945. These clones were finally selected for further test-tapping. The results are presented in Table VIII.

TABLE VIII

1945 Clearing, Hedigalla
Tapped S/2, d/3, 67% from 1953 to 1955
Tapped S/2, d/2, 100% from 1956
Yield in lb d.r. per tree per year.

Clone	RRIC 4	RRIC 5	RRIC 7	Control Tjir 1
Yield 1960 ...	17·5	18·8	21·0	17·6
,, 1961 ...	14·2	18·9	18·4	16·6
,, 1962 ...	18·0	22·7	28·7	19·5
No. of trees tapped 1962 ...	43	63	72	73
Brown Bast cases ...	6	10	1	—
Wind damage cases ...	3	2	1	—

The yield of clone RRIC 7 is promising and clone RRIC 5 has also given an improved yield in 1962. The latex of clone RRIC 7 is prone to enzymatic discolouration but can be converted to good quality crepe or sheet with the correct use of bleaching agents. A short article will be published in the Institute's Quarterly Journal in 1963 by the Rubber Chemist on the general procedure for dealing with this discolouration.

3.4. Test-Tapping in 1950/51 Clearing, Hedigalla.—Test-tapping was continued in these 2 clone trials with 25-tree plots replicated three to four-fold. The results are presented in Tables IX A and B. Clone Ch 26 is susceptible to wind damage and this undesirable secondary character is under observation before the clone is considered for commercial planting. The yield of the clone is outstanding compared with that of clone PB 86.

TABLE IX A

Trial No. 1 Chemara Clones
Tapped S/2, d/3, 67% from March 1957
Tapped S/2, d/2, 100% from 1960
Yield in lb d.r. per tree per year.

Clone	Ch 26	Ch 3	Ch 31	PB 86 Control
Yield 1961 ...	24·7	16·6	9·6	14·3
„ 1962 ...	27·0	19·4	13·1	18·1
Brown Bast cases ...	2	1	2	2

TABLE IX B

Trial No. 2 Small-Scale Clone Trial
Tapped S/2, d/3, 67% from 1958
Tapped S/2, d/2, 100% from 1960
Yield in lb per tree per year

Clone	RR 134	RR 108	PB 86	RR 116	141/41N	154/41N
Yield 1961	14·2	15·2	13·3	10·5	10·1	9·8
„ 1962	19·4	15·9	16·3	10·8	10·8	11·0
Brown Bast cases	2	1	—	—	—	—

Clones RR 134 and RR 108 will be considered for further testing as registered RRIC clones.

3.5. Test-Tapping: Large-Scale Clone Trial, Planted 6′×45′, 1949 Clearing, 35 Acres, Hedigalla.—The test-tapping of the major proportion of the 31 clones originally planted in this clone trial has been discontinued for a number of years based on growth, yield, and secondary characters. A selection of the more promising clones was test-tapped in 1962. The results are presented in Table X.

TABLE X

Clone Trial, 35 Acres, Planted 6′×45′, 1949 Clearing Hedigalla
Tapped S/2, d/3, 67% from July 1956
Tapped S/2, d/2, 100% from 1959
Yield in lb d.r. per tree per year

Clone	No. of trees tapped 1962	Yield		Brown Bast cases	Wind damage cases 1962	
		1961	1962		Branch and stem damage	Up-rooted
RRIC 86	87–81	16·7	21·0	2	8	—
Nab 20	88–69	16·7	20·2	6	19	6
RRIM 501	92–85	16·3	17·7	6	6	7
RR 29	118–110	15·8	16·9	—	3	—
PB 86	107–105	15·7	15·6	4	2	2
RRIC 52	108	13·9	15·6	—	1	—
RRIC 87	125–123	12·7	13·6	5	2	—
RRIM 513	120–114	12·6	13·4	8	8	2
Dar 38	108–106	11·1	11·6	3	7	—

The 1949 clearing is exposed to strong monsoon storms and big losses of trees have been reported in previous reports. These storms continue to cause damage every year and the number of trees tapped at the present time are the remaining trees from the original 150 trees of each clone planted out in six 25-tree plots of each clone.

Clone RRIC 52 is of particular interest in this trial. It is the most vigorous growing clone we have at the present time. The clone is definitely late maturing for high yields which can be compared favourably with other high-yielding clones recommended for commercial planting. Because of its spreading branches a spacing of 15′×18′ is recommended. It is more specifically recommended in place of clone LCB 1320, for its tolerance to diseases caused by *Oidium* and *Phytophthora*. It also has an added advantage in that it is resistant to wind damage unlike clone LCB 1320.

3.6. Test-Tapping of Large-Scale Clone Trial, 1953 Clearing, 60 Acres, Hedigalla.—The clones in this trial are planted in 200-tree and 240-tree plots replicated five-fold and four-fold respectively. Two tapping tasks A and B were taken into tapping when the girth was 18″ and 20″ respectively while tasks C and D were tapped when the girth of the trees was 22″ about 12 months after the commencement of tapping on tasks A and B. The yield results for 1962 are presented in Table XI.

TABLE XI

Large-Scale Clone Trial, 1953 Clearing, Hedigalla
Tapped S/2, d/2, 100% from April 1960 (Tasks A & B) and from March 1961 (Tasks C & D)
Yield in grams per tree per tapping

Clone	Task	Yield				No. of trees affected			
		Task 1961	Mean	Task 1962	Mean	Bark Rot	Brown Bast	Wind damage: Branch damage	Wind damage: Up-rooted
RRIC 1	A	16·2)		21·3)		1	4	—	—
	B	18·6)	18·8	18·4)	19·2	2	2	—	1
	C	20·5)		16·4)		2	—	—	—
	D	19·8)		20·7)		6	4	—	—
RRIC 2	A	18·7		20·5		1	3	—	—
	B	21·1		22·2		1	5	—	1
	C	24·8		27·6		5	2	1	1
	D	29·3	23·5	24·4	23·7	6	3	2	—
RRIC 3	A	15·8		22·4		—	4	—	—
	B	23·6		26·0		2	1	—	—
	C	23·2		27·0		8	5	3	1
	D	25·5	22·0	22·7	24·5	5	1	—	—
RRIC 4	A	27·5		25·4		1	6	—	7
	B	22·8		28·2		—	—	—	—
	C	18·8		23·2		5	2	1	—
	D	25·0	23·5	27·6	26·1	12	4	2	1
RRIC 5	A	25·2		29·6		—	—	—	—
	B	22·2		36·3		—	10	—	—
	C	27·1		31·3		7	4	1	2
	D	36·1	27·6	33·1	32·6	4	1	—	—
RRIC 6	A	26·8		34·6		2	2	—	—
	B	28·6		30·5		1	2	—	2
	C	20·1		33·6		6	—	—	—
	D	31·9	29·1	32·5	32·8	5	—	—	—
RRIC 7	A	26·2		34·7		—	—	—	—
	B	22·4		32·1		—	—	—	1
	C	34·3		35·8		2	1	—	—
	D	37·6	30·1	34·8	34·4	5	—	—	—
Mean	A	22·3		26·9		—	—	—	—
	B	22·8		27·7		—	—	—	—
	C	25·4		27·8		—	—	—	—
	D	29·3	24·9	28·0	27·6	—	—	—	—
RRIM 501	A	22·7		24·1		—	1	—	—
	B	29·1		28·0		—	2	38	10
	C	25·1		27·4		5	2	2	—
	D	30·8	26·9	41·4	30·2	2	7	—	—
LCB 1320	A	32·0		32·1		—	—	10	11
	B	27·1		36·0		—	9	2	2
	C	32·2		34·6		—	—	10	5
	D	26·5	29·5	34·3	34·2	—	—	5	6
RRIM 513	A	21·6		31·7		1	5	—	—
	B	23·7		25·3		2	1	4	4
	C	27·9		35·3		—	—	2	2
	D	26·3	24·9	25·7	29·5	—	—	—	—
Tjir 1	A	15·3		32·1		—	4	1	—
	B	17·3		30·3		—	2	—	—
	C	26·9		25·4		—	1	1	2
	D	23·3	20·7	21·8	27·4	—	5	8	1
Lun N	A	17·3		30·7		—	2	—	—
	B	18·4		28·0		—	2	—	2
	C	22·4		28·5		—	5	—	—
	D	13·5	17·9	23·2	27·6	—	6	—	2

TABLE XI—*Contd.*

Clone	Task	Yield				No. of trees affected			
		Task 1961	Mean	Task 1962	Mean	Bark Rot	Brown Bast	Wind damage	
								Branch damage	Up-rooted
Wag 6278	A	21·8		26·2		—	4	—	4
	B	20·6		22·3		2	—	1	3
	C	15·6		27·7		—	—	—	—
	D	22·6	20·2	30·9	26·8	—	—	1	3
Mil 3/2	A	13·6		21·6		7	13	—	2
	B	19·5		32·7		6	4	—	—
	C	19·1		27·5		18	1	—	—
	D	17·9	17·5	20·7	25·6	10	3	—	—
Mean	A	20·6		28·4		—	—	—	—
	B	22·2		28·9		—	—	—	—
	C	24·2		29·5		—	—	—	—
	D	23·0	22·5	28·3	28·8	—	—	—	—

3.7. Test-Tapping of Tappable Clones in the 1954 Large-Scale Clone Trial, 148 Acres, Hedigalla.—The trees of clones which had reached tappable girth in 1961 and 1962 were test-tapped in 1961 and 1962. The clones in this trial were planted in large monoclonal blocks of 800 to 1000 trees per clone on difficult terrain at the Hedigalla station with poor growing conditions generally due to heavy rainfall and monsoon storms. The results for 1962 are presented in Table XII A.

TABLE XII A

1954 Large-Scale Clone Trial, Hedigalla
First tapped in July 1961 on S/2, d/2, 100%
Yield in grams per tree per tapping

Clone	No. of trees tapped	Yield		Girth in inches 1962	Bark Rot cases	Brown Bast cases	Wind damage	
		1961	1962				Branch and stem	Up-rooted
RRIC 35	596–746	30·8	33·5	22·9	—	—	—	—
,, 36	484–660	29·8	33·0	23·4	6	6	—	2
RRIM 501	531–661	19·4	28·2	22·3	14	—	—	—
RRIC 22	518–710	17·5	25·1	23·7	2	—	—	1
,, 18	530–637	15·3	24·1	24·1	33	—	—	—
,, 16	448–673	16·7	16·8	23·8	4	—	—	—
,, 26	444–554	17·9	14·6	23·3	—	—	1	—
RRIC *34	456–480	—	33·6	22·0	10	—	—	—
,, *28	394–440	—	32·0	23·1	12	11	21	7
,, *37	378–487	—	28·8	21·7	8	32	—	2
AVROS *255	734–880	—	21·3	22·0	3	—	—	—
RRIC *31	551–757	—	21·0	22·6	8	—	—	—
,, *25	446–521	—	16·7	21·9	1	—	—	—
,, *29	380–493	—	16·7	21·3	7	1	6	1
,, *19	444–578	—	16·0	22·2	10	—	—	—
,, *21	469–529	—	14·4	22·1	20	—	—	—
,, *24	592–643	—	10·7	23·2	15	1	—	1

*First tapped in April 1962.

There are indications of the susceptibility of clone RRIC 37 to Brown Bast disease, while a number of clones have been affected with *Phytophthora* Bark Rot in the wet climatic conditions of Hedigalla, with a rainfall of approximately 180 inches per year. Clone RRIC 36 and 37 with the better external growth characters have been tentatively recommended for commercial planting on an experimental scale. Clone RRIC 28 is definitely susceptible to wind damage and is not recommended for commercial planting, while clone RRIC 34 and 35 have undesirable secondary characters which may be a deterrent to a final selection on yields alone. Careful attention will be given to the control of Bark Rot with recommended fungicides in 1963. Clones yielding over 30 grams per tree per tapping in the first year of production must be considered as very promising.

3.8. Tapping Experiment, 1954 Replanted Area, Dartonfield.—Two plots of 5 trees each of 18 clones are tapped at heights of 42″ and 50″ respectively from the union to observe the adaptability of the Michie-Golledge tapping knife to a height of 50″ compared with the recommended height of 42″ which provides for a tapping cycle of 12 years if tapping is continued down to the union according to the more recent recommendations on tapping. The results for 1962 are presented in Table XII B.

TABLE XII B

1954 Replanted Area, Dartonfield
Tapped S/2, d/2, 100% at heights of 42″ and 50″ from the union
Yield in grams per tree per tapping, 1962

Clone	Tapping height 42″			Tapping height 50″		
	Virgin bark thickness in mm.	Girth in inches at 5 feet	Yield in grams	Virgin bark thickness in mm.	Girth in inches at 5 feet	Yield in grams
RRIC 8	6·2	23·1	16·6	7·1	23·6	18·3
,, 16	7·0	25·7	19·8	6·5	26·6	16·3
,, 54	7·5	25·2	30·8	7·3	26·5	29·3
,, 17	8·0	24·6	20·2	7·8	24·8	23·0
,, 36	7·6	24·6	37·2	7·6	25·3	41·1
,, 18	6·6	24·3	20·2	7·3	24·7	20·7
,, 32	6·6	18·9	18·8	6·8	19·6	21·9
,, 57	6·0	22·0	22·3	6·6	22·6	25·8
,, 80	6·1	22·5	27·8	6·6	21·8	33·8
,, 20	6·5	22·4	21·6	6·5	23·4	23·1
,, 23	5·9	21·8	16·2	6·4	22·4	17·4
,, 21	6·2	26·2	17·0	6·1	23·5	12·7
,, 22	6·7	22·8	22·4	6·5	22·9	24·6
,, 25	6·0	20·9	12·8	6·0	21·3	14·6
,, 31	6·6	25·2	26·7	6·8	26·3	28·6
,, 24	7·1	26·3	16·9	7·0	27·8	15·0
,, 27	6·6	20·1	18·9	6·0	21·3	20·2
,, 28	7·0	24·0	30·4	7·0	25·0	27·5
,, 33	5·6	20·7	22·4	5·9	21·5	22·8
,, 34	8·2	20·5	28·9	8·5	21·5	23·9
,, 35	7·1	21·5	27·6	7·5	22·4	33·2
,, 37	3·6	20·9	21·6	6·4	22·3	29·4
,, 26	6·3	21·8	21·4	6·5	23·1	21·9
PBT 207	7·4	22·6	12·7	9·4	26·9	20·5
PB 28/59	7·8	21·9	48·2	8·3	22·7	52·4
PB 24/51	6·9	19·8	16·3	6·4	20·5	14·5
PB 24/3	6·8	21·8	31·0	6·5	21·7	25·1
Mean	6·8	22·7	23·2	6·8	23·4	24·3

3.9. Large-Scale Clone Trial, 1955 Clearing, 78 Acres, Hedigalla.—The clone trial includes 12 RRIC clones in large monoclonal blocks of 750 trees of each clone together with 5-tree clones established from H.P. seedlings. A selection of clones was test-tapped from June 1962 at the earliest opportunity when the trees reached a tappable girth of 20 inches and over. The results are presented in Table XIII.

TABLE XIII

Large-Scale Clone Trial, 1955 Clearing, Hedigalla
Tapped from April to December 1962
Yield in grams per tree per tapping

Clone	No. of trees tapped 1962	Yield in grams	Girth in inches 1962	Brown Bast cases	Bark Rot cases	Wind damage	
						Branch and stem	Up-rooted
RRIC 46	479–444	31·1	18·6	—	47	—	2
,, 41	495–463	30·3	19·8	—	5	4	15
,, 13	507–484	30·3	19·4	—	—	—	7
,, 40	550–515	28·5	20·2	—	5	—	38
,, 43	493–470	25·4	18·7	—	4	8	12
,, 49	501–494	23·1	20·3	—	—	—	8
,, 11	475–457	21·6	20·6	—	—	—	18
,, 14	570–553	21·3	20·8	—	3	—	10
,, 47	470–464	20·3	18·7	—	—	—	5
,, 9	565–546	19·5	20·7	—	1	—	25
,, 50	246–233	17·7	18·1	—	—	—	7
,, 12	570–527	15·2	21·9	7	4	—	27
Mean	—	23·6	19·8	—	—	—	—

In the first half-year of tapping the yield of clone RRIC 41, which has been recommended for planting on a moderate scale on commercial estates is reassuring. A considerable number of clones have been uprooted due to the particular location of these clones on Hedigalla Division which is generally exposed to heavy monsoon storms. The clones are not inherently susceptible to wind damage.

3.10. Large-Scale Clone Trial, 1953 Clearing, 10 Acres, Nivitigalakele.—Clones RRIC 44 and 45 were budded in the field in 1955 on two-year-old stocks planted in 1953. There are approximately 700 trees each of the two clones in this clearing. A limited boundary area was planted with budded stumps of clone PB 86 in 1953. The trees of clone PB 86 are, therefore, two years older than the trees of clone RRIC 44 and 45, which were budded in the field in 1955.

The mature trees of clone RRIC 44 and 45 were brought into tapping in January 1962, for an early confirmation of the high-yielding characteristics of clone RRIC 45. The yields of the three clones in the 1953 clearing are given in Table XIV.

TABLE XIV

Large-Scale Clone Trial, 1953 Clearing, 10 Acres, Nivitigalakele
Tapped S/2 d/2, 100% from January 1962
Yield in lb d.r. per tree per year

Clone	RRIC 45	RRIC 44	PB 86
No. of trees tapped 1962	466–477	363–365	45–46
Yield 1962	8·9	10·8	13·6*
Brown Bast cases	5	—	—
Bark Rot and Canker cases	1	—	—
Wind damage cases	12	3	1
Mean girth in inches 1962	22·9	21·8	23·8
Thickness of virgin bark in mm.	6·4	6·4	6·3
Yield from estate records	7·0	8·1	—

*Yield of clone PB 86 from trees two years older than clones RRIC 44 and 45 planted in a boundary area.

The yield of clone RRIC 45 in the first year of tapping is reassuring. The yield of clone RRIC 44 is outstanding. This clone was established from a seedling cross of clones RRIC 8 and Hil 28 and has inherited the broadly fluted tapping panel of clone Hil 28, which makes it unpopular for commercial planting. The trees have, however, been tapped without any difficulty with the Michie-Golledge tapping knife.

4. GROWTH MEASUREMENTS IN IMMATURE AREAS

Girth measurements are taken at a height of 3 feet from the union on budded trees. The criterion of tappability is 20″ at this height. About 60 to 70% of the trees attain tappable girth in the 7th year of age under favourable conditions of growth.

The girth measurements on tapped trees were taken at a height of 5 feet from the union from 1962 instead of at 4 feet as in former years.

In large-scale clone trials of 4 to 5 acres of each clone every 5th or 10th tree was marked permanently for growth measurements.

4.1. Large-Scale Clone Trial, 1953 Clearing, 10 Acres, Nivitigalakele.—Trees which had reached tappable girth in 1962 were tapped for early information on clone RRIC 45. Approximately 700 trees each of clones RRIC 45 were budded in the field in 1955 on mixed clonal seedlings planted in 1953. The yield results are presented under 3·10.

4.2. Large-Scale Clone Trial, 1953 Clearing, 60 Acres, Hedigalla.—This clearing was brought into tapping in 1961 and the yield results appear under 3·6.

4.3. Large-Scale Clone Trial, 1954 Clearing, 148 Acres, Hedigalla.—The clones in this clearing were tapped from 1961 and the yield results are presented under 3·7. The girth measurements of the immature clones were taken in December 1962, and the trees of clones which have reached tappable girth will be test-tapped in 1963.

4.4. Large-Scale Clone Trial, 1955 Clearing, 78 Acres, Hedigalla.— The mature trees of clones in this clearing were tapped in December 1962 and the yield results are presented under 3·9.

4.5. Large-Scale Clone Trial, 1956 Clearing, 60 Acres, Hedigalla.— Local and foreign clones are planted in 300-tree monoclonal blocks in two sections of the clearing. Mean of clones marked with an asterisk refers to clones planted 4 months later than the other clones listed for girth measurements in the Table given below :—

Average Girth Measurements in Inches

Clone	Girth		Increase 1961/62	Clone	Girth		Increase 1961/62
	1961	1962			1961	1962	
RRIM 618	17·4	19·7	2·3	PR 258	12·3	14·4	2·1
IRCI 9	16·6	18·8	2·2	RRIC 59	13·3	14·8	1·5
RRIM 603	16·8	18·8	2·0	Mean	14·8	17·1	2·3
RRIM 612	16·0	18·8	2·8	RRIC 39	13·7	16·1	2·4
IRCI 5	16·5	18·5	2·0	AVROS 1447	12·4	15·9	3·5
RRIM 605	15·6	18·0	2·4	RRIC 42	13·2	15·8	2·6
PB 86	15·0	18·0	3·0	AVROS 1851	12·6	15·4	2·8
RRIM 617	14·3	17·6	3·3	RRIC 48	12·1	14·8	2·7
AVROS 1191	14·6	17·3	2·7	TR 1406	11·8	13·9	2·1
PR 228	14·2	17·1	2·9	IRCI 3	11·3	13·5	2·2
RRIC 55	15·0	17·1	2·1	AVROS 1328	10·6	13·2	2·6
PR 252	14·3	16·6	2·3	IRCI 1	10·9	12·7	1·8
PR 247	13·5	16·1	2·6	IRCI 6	19·3	11·0	1·7
PR 257	13·2	15·9	2·7	PR 256	18·8	10·7	1·9
RRIC 54	14·1	15·9	1·8	Mean*	11·5	13·9	2·4
PR 253	13·1	14·9	1·8				

*Mean of clones planted 4 months later than the other clones in Table.

4.6. Large-Scale Clone Trial, 1956 Replanted Area, Dartonfield.— Clones GT 1, WR 101, AVROS 385 and AVROS 427 were planted in 300-tree monoclone blocks in the Replanted Area, Dartonfield. 48 points on the boundaries were planted with clone RRIC 52.

A summary of the girth measurements taken in June 1962 is given below.

Large-Scale Clone Trial, 1956 Replanted Area, Dartonfield
Average Girth in Inches

Clone	No. of trees 1962	Girth		Increase 1961/62
		1961	1962	
GT 1	294	17·0	19·4	2·4
AVROS 385	292	16·7	19·1	2·4
WR 101	271	16·9	19·0	2·1
AVROS 427	286	13·8	16·3	2·5
RRIC 52	48	21·0	23·3	2·3

The 1956 replanted area is hilly with rocky outcrops. Clone AVROS 427 is the poorest grower, while a limited number of trees of clone RRIC 52 shows the best growth.

Clone RRIC 52 was tapped in 1962 at 6 years of age and gave approximately 3·7 lb dry rubber per tree per year.

4.7. 1957 Clone Trial, 17½ Acres, Hedigalla.—This clone trial was planted in the North-East planting season of 1957. The planting material was made up of 171 ten-tree clones established from selected H.P. seedlings of the 1945, 1954 and 1955 pollination programmes ; 24 ten-tree clones, established from seedling crosses of clone LCB 870 which showed *Oidium*-resistant characteristics in the 1952 trial of clonal seedlings at Dartonfield. Ten-tree plots of clone PB 86 were planted at intervals as control plots in the main trial of 10-tree clones.

Two RRIC clones 51 and 64 were planted in 250-tree blocks of each clone together with a control block of 200 trees of clone PB 86, making up a total of 491 holes of clone PB 86.

Clone CH 26 was planted in a boundary area with 132 planting points.

The girth measurements taken in 1961 and 1962 of the trees in the 1957 clone trial are given below. The rate of growth in the 17½ acre clearing has been the poorest at the Hedigalla station. The Soils Chemist has given special attention to the manuring of this area. The rate of growth has shown an improvement in 1961/62.

1957 Clone Trial, Hedigalla

	1961	1962	Increase 1961/62
No. of trees ...	2850	2900	
Girth in inches ...	7·6	10·4	2·8

The virgin jungle at the Hedigalla Division does not compare favourably with replanted rubber land which has been cultivated and manured over many years. The unfavourable soil conditions in our new planted experimental clearings, together with a heavy rainfall of up to 180 inches per year and monsoon storms along the valley of the 1000-acre block of the Hedigalla Estate, present very difficult conditions for the favourable growth of rubber for the best results from new clones on trial.

4.8. Clone Trials on Commercial Estates

4.8.1. 1957 Replanted Area, Small-Scale Clone Trial, Estate A, Kalutara District.—This clone trial was planted in May-June 1957 in 300-tree monoclonal blocks for tapping as a task in later years. A summary of the girth measurements taken in 1962 are given below :—

Average Girth in Inches (10-acre block)

Clone	TR 1406	AVROS 529	IRCI 2	IRCI 3	RRIM 607	PB 86 Control	Mean
Girth 1962	17·5	15·6	16·8	15·5	16·2	14·4	16·0
Girth 1961	13·5	12·0	12·5	11·5	11·3	11·0	12·0
Increase 1961/62	4·0	3·6	4·3	4·0	4·4	3·4	4·0

4.8.2. 1957 Replanted Area, Clone Trial, Estate B, Kalutara District.— This clone trial was planted in May-June 1957 in 300-tree monoclonal blocks of each clone. A summary of the girth measurements taken in 1962 are presented below :—

Average Girth in Inches (10-acre block)

Clone	TR 1548	RRIM 612	AVROS 2037	AVROS 1734	PR 254	PB 86 Control	Mean
Girth 1962	19·3	19·2	18·4	18·3	17·5	16·3	18·1
Girth 1961	15·5	15·5	15·0	15·0	14·3	13·3	14·8
Increase 1961/62	3·8	3·7	3·0	3·3	3·2	3·0	3·3

Average Girth in Inches (20-acre block)

Clone	RRIC 75	RRIM 603	RRIM 602	RRIC 76	RRIM 623	RRIM 622	RRIC 60	TR 1542	RRIC 61	WR 101	PR 248	PB 86 control	Mean
Girth 1962	19·0	16·8	17·6	17·4	17·3	17·0	16·7	16·5	16·5	17·1	15·8	15·3	16·9
Girth 1961	15·5	14·0	14·8	14·0	14·3	14·0	14·0	13·8	13·8	13·8	12·5	12·4	13·9
Increase 1961/62	3·4	2·8	2·8	3·4	3·0	3·0	2·7	2·7	2·7	3·3	3·3	2·9	3·0

4.8.3. 1958 Replanted Area, Clone Trial, Estate B, Kalutara District.— This clone trial was planted in August-September 1958. Eighteen foreign and local clones were planted in 300-tree blocks of each clone. A summary of the girth measurements taken in August 1962 are given below :—

Average Girth in Inches (31-acre block)

Clone	RRIC 52	RRIC 54	RRIC 41	IRCI 2	RRIC 22	RRIC 28	GT 1	RRIC 45	AVROS 385
Girth 1962	16·2	14·7	14·8	13·9	14·2	13·8	13·8	14·2	13·5
Girth 1961	9·3	10·3	11·0	10·0	10·0	8·3	10·0	10·3	9·3
Increase 1961/62	6·9	4·4	3·8	3·9	4·2	5·5	3·8	3·9	4·2

Clone	RRIM 605	RRIC 37	IRCI 6	RRIC 39	AVROS 427	RRIC 36	RRIM 607	RRIC 55	PB 86 Control	Mean
Girth 1962	13·6	14·0	13·1	14·9	12·6	13·5	14·6	12·1	12·3	13·9
Girth 1961	9·8	10·0	9·0	8·0	9·3	8·8	10·0	8·3	8·3	9·4
Increase	4·2	4·0	4·1	6·9	3·3	4·7	4·6	3·8	4·0	4·5

4.8.4. 1961 Large-Scale Clone Trial, 30 Acres, Dartonfield.—This clone trial was planted in 1961 in areas replanted previously in 1934, 1936, 1938 and 1939 at Dartonfield. Two tapping tasks of clones RRIC 88 and 89, PB 28/59 and PB 86 were planted in the South-West monsoon season, while clones RRIC 7, 52 and RRIM 513 were planted in the North-East monsoon season. First series of girth measurements will be due in 1963.

5. CROWN-BUDDING INVESTIGATIONS

5.1. Large-Scale Clone Trial, 1952 Clearing, 35 Acres, Dartonfield: Effect of Crown-Budding on the Growth of Budded Centre Sections.—This 35-acre area has been depleted of about 40-50 per cent of its original stand of trees in large blocks for building blocks and electric mains. The comparisons have been reduced to ten-tree plots with and without crown-buddings with clone LCB 870.

Clone LCB 870 is an extremely low-yielding clone, which is appreciably resistant to *Oidium*. Crown budding with this clone was tried out as a means of controlling *Oidium*, especially in the low-country districts.

The results for 1962 are presented below :—

Crown-Budding Experiment
1952 Replanted Area, Dartonfield
Yield in grams d.r. per tree per tapping

Clone	Trees not crown-budded	Trees crown-budded
PB 86	28·0	20·4
RRIM 501	45·5	27·1
Nab 12	33·9	20·9
Nab 15	37·4	25·2
Nab 20	32·6	19·5
Mean	35·5	22·6

The average girth of the trees not crown-budded and that of the crown-budded was 27·6 and 25·1 inches respectively. The crown-budded trees lost approximately an year's growth after the trees were budded 2 years after planting at a height of 8 feet from ground level. The crown-budded plots were tapped one year after trees which were not crown-budded.

The depressing effect of poor-yielding crown on high-yielding centre sections was confirmed in the large-scale crown-budding experiment at Hedigalla, which was discontinued in 1961.

6. LABORATORY AND FIELD INVESTIGATIONS

The main programme of work on laboratory investigations has not been carried out as the new Botany Block still awaits completion. With the limited facilities for laboratory work in the old block, anatomical and physiological studies were restricted to problems of more immediate importance connected with field experiments.

The new Botany Block will be definitely completed in 1963.

REVIEW OF THE PLANT BREEDING SECTION

By

D. M. Fernando

SUMMARY

The use of *Dothidella*-resistant material in the breeding programme was greatly intensified this year. Hand-pollinations were carried out on an increased scale over last year. Flower storage was also greatly improved this year.

Radiation studies commenced in collaboration with the Radioisotope Centre yielded favourable critical values for gamma radiation of germinating *Hevea* seeds.

Selections were made for a small-scale clone trial at Kuruwita and another at Nivitigalakele.

Flower inducement methods were used to obtain the majority of the flowers used in hand-pollinations.

A screening of the 1960 planting of the *Oidium*-Testing Station on Kepitigalla Group was carried out and the results were used in selecting material for further breeding and clone trials.

Routine attention was given to the crown-budded area on Moneragalla Group and the new experimental area at Kumarawatte Group.

The progress of the budgrafts at the *Phytophthora*-Testing Station at Peenkande Group was noted and a successful early screening was obtained.

DETAILED REVIEW

1. GENERAL

1.1. Staff The Plant Breeder, Mr. R. T. Wijewantha, continued his Post Graduate studies at the University of California.

The Assistant Plant Breeder, Mr. D. M. Fernando, was on duty throughout the year.

Mr. C. Amaracone, Technical Assistant (Botany Department), continued to assist in the clerical duties of the Section.

Mr. D. S. Gamage, Field Assistant, was on duty throughout the year.

Mr. W. D. Armon, Field Attendant, carried out field operations at Hedigalla with the assistance of Mr. H. B. H. de Silva (Field Assistant, Botany Department).

1.2. Buildings The plans for a store-room at Nivitigalakele await a tender.

2. HAND-POLLINATION PROGRAMME

Hand pollinations were carried out at Nivitigalakele and Hedigalla on an increased scale over last year's programme. It was also possible, as a result of successful and well-timed flower inducement, to obtain a sufficient number of sets of some clone combinations to emphasize lines of *Dothidella* resistance. A few trees of the early *Dothidella*-resistant introductions crown budded at Hedigalla in 1954 commenced flowering and these trees were extensively used as female parents. The programme was designed to obtain material for immediate combination of yield, favourable secondary characters and disease resistance and also for the production of progeny suitable for later double crossing in order to counteract the physiological specialization of *Dothidella ulei*.

Clones used as female parents at each station were :

Hedigalla :—Ch 26, F 351, FB 3300, FX 25, FX 360, FX 652, LCB 1320, PB 86, RRIC 7, RRIC 36, RRIC 52.

Nivitigalakele :—F 4542, FB 3300, FX 25, FX 349, FX 516, FX 617, FX 1042, FX 3482, FX4098, IAN 45-710, IAN 45-717, IAN 45-873, IAN 2664, IAN 2667, IAN 2668, IAN 2750, IAN 2833, IAN 2878, IAN 3434, IAN 3763, IAN 3787, IAN 3793, PB 28/59, RRIC 10, RRIC 45, RRIC 51, RRIC 52, RRIC 54, RRIC 62, RRIC 70, Tjir 1, Wag 6278.

A few of the plants induced to flower and used as female parents were found to bear fruit abnormally susceptible to *Gloeosporium* and *Phytophthora* attack, probably owing to the weakened condition of the plant, thus necessitating more intensive disease-control measures on these plants.

Table I summarizes the data on the hand-pollination programme.

Flower transport and storage was improved this year using closely packed male flowers in Dewar flasks rather than using the inflorescences as in previous years.

A total of 60,571 artificial pollinations were carried out and a late census gave 1791 fruits or 2·9% success. Finally 2839 seedlings were obtained.

Ineffective control of *Oidium* on flowers of clone RRIC 7 at Hedigalla resulted in a total failure of this clone as female parent. Wind damage was again responsible for much fruit drop.

3. RADIATION STUDIES

Arrangements were made with the Radioisotope Centre to conduct radiation studies using gamma rays.

3.1. Low intensity.—Initially a Caesium 137 gamma-cell with an output of 100 millicuries was used for low intensity long duration studies for periods of up to 10 days. No obvious changes were noted on the growth of germinating seed.

3.2. High intensity.—Subsequently a Cobalt 60 gamma-cell with a dose-rate of 59·6 rads per minute was used on germinating seed. 3000 rads was obtained as a critical exposure leading to death in some cases and growth retardation in others. Observations on these seedlings are being continued. Another set of exposures were made on twinned seedlings ; a single twin serving as the unexposed control.

TABLE I

Hevea Hand-pollination Programme 1962

(SS) Denotes selected seedling of unknown parentage

Station	Cross	Parentage	No. of pollinations	No. of successes	% success	No. of seeds collected	No. of seeds germinated	% germination
Hedigalla	Ch 26 × F 1638	(BR 2 × BR 2) × H. brasiliensis	495	52	10·5	154	99	64·3
,,	CH 26 × FB 3300	,, × ,,	175	32	18·2	84	68	80·9
,,	CH 26 × FX 25	,, × F 351 × AVROS 49 (?)	719	121	16·8	360	167	46·4
,,	F 351 × LCB 1320	H. brasiliensis × (SS)	90	1	1·1	—	—	—
,,	F 351 × RRIC 7	,, × ,,	361	6	1·6	9	7	77·8
,,	F 351 × RRIC 36	,, × (PB 86 × PR 107)	1549	38	2·4	93	65	69·9
,,	FB 3300 × Ch 26	,, × (BR 2 × BR 2)	588	22	3·7	9	5	55·5
,,	FB 3300 × LCB 1320	,, × (SS)	352	16	4·5	9	5	55·5
,,	FB 3300 × RRIC 7	,, × (,,)	1155	54	4·6	15	11	73·3
,,	FB 3300 × RRIC 36	,, × (PB 86 × PR 107)	3168	158	4·9	63	55	87·3
,,	FX 25 × Ch 26	F 351 × AVROS 49 (?) × BR 2 × BR 2	2501	163	6·5	479	468	97·7
,,	FX 25 × PB 86	,, × (SS)	924	26	2·8	78	76	97·4
,,	FX 25 × RRIC 36	,, (PB 86 × PR 107)	95	7	7·3	21	20	95·2
,,	FX 25 × RRIC 52	,, × (SS)	100	6	6·0	17	15	88·2
Nivitigalakele	FX 349 × RRIC 51	(F 4542 × Tjir 1) × (RRIC 8 × Mil 3/2)	14	1	7·1	—	—	—
,,	FX 349 × RRIC 52	,, × (SS)	14	1	7·1	—	—	—
Hedigalla	FX 360 × RRIC 52	(F 4542 × AVROS 363) × (SS)	765	243	31·7	727	685	94·2
Nivitigalakele	FX 516 × PB 28/59	(F 4542 × AVROS 363) × (,,)	67	3	4·4	8	7	87·5
,,	FX 516 × RRIC 45	,, × (RRIC 8 × Tjir 1)	73	4	5·4	9	4	44·4
,,	FX 516 × RRIC 52	,, × (SS)	195	16	8·2	44	27	61·4
Hedigalla	FX 652 × RRIC 52	(F 4542 × Tjir 1) × (SS)	534	5	0·9	14	11	78·6
Nivitigalakele	FX 1042 × RRIC 51	(F 1425 × PB 186) × (RRIC 8 × Mil 3/2)	3	1	33·3	—	—	—
,,	FX 3482 × RRIC 51	(F 4542 × PB 86) × (RRIC 8 × Mil 3/2)	31	7	22·5	12	10	83·3
,,	FX 3482 × RRIC 52	,, × (SS)	19	7	36·8	9	3	33·3
,,	FX 3482 × RRIC 57	,, × (PB 86 × RRIC 8)	13	6	46·1	6	4	66·7
,,	IAN 45-710 × RRIC 52	(PB 86 × F 409) × (SS)	39	2	5·1	—	—	—
,,	IAN 45-717 × RRIC 51	(PB 86 × F 4542) × (RRIC 8 × Mil 3/2)	26	1	3·8	—	—	—
,,	IAN 45-717 × RRIC 52	,, × (SS)	16	1	6·2	—	—	—
,,	IAN 45-873 × RRIC 52	,, × (SS)	208	8	3·8	13	6	46·1

TABLE I—(*Contd.*)

Station	Cross	Parentage	No. of pollinations	No. of successes	% success	No. of seeds collected	No. of seeds germinated	% germination
Nivitigalakele	IAN 2664 × RRIC 51	(FX 4068 × PB 86) × (RRIC 8 × Mil 3/2)	9	1	11·1	—	—	—
,,	IAN 2664 × RRIC 52	,, × (SS)	53	3	5·6	—	—	—
,,	IAN 2667 × RRIC 26	,, × (RRIC 8 × Pil A 44)	203	5	2·4	—	—	—
,,	IAN 2667 × RRIC 57	,, × (PB 86 × RRIC 8)	44	1	2·2	—	—	—
,,	IAN 2667 × RRIC 70	,, × (PB 86 × RRIC 7)	95	2	2·1	—	—	—
,,	IAN 2667 × RRIC 73	,, × (PB 86 × RRIC 7)	91	3	3·2	—	—	—
,,	IAN 2668 × RRIC 25	,, × (RRIC 8 × Mil 3/2)	4	1	25·0	—	—	—
,,	IAN 2668 × RRIC 51	,, × (RRIC 8 × Mil 3/2)	27	3	11·1	9	1	11·1
,,	IAN 2668 × RRIC 52	,, × (SS)	203	26	12·8	24	1	4·2
,,	IAN 2668 × RRIC 57	,, × (PB 86 × RRIC 8)	22	2	9·1	6	1	16·7
,,	IAN 2750 × RRIC 10	(FX 4068 × Tjir 1) × (Mil 3/2 × Wag 6278)	35	1	2·8	—	—	—
,,	IAN 2750 × RRIC 26	,, × (RRIC 8 × Pil A 44)	130	4	3·0	—	—	—
,,	IAN 2750 × RRIC 27	,, × (Pil A 44 × Wag 6278)	178	2	1·1	—	—	—
,,	IAN 2750 × RRIC 51	,, × (RRIC 8 × Mil 3/2)	374	4	1·0	—	—	—
,,	IAN 2750 × RRIC 52	,, × (SS)	602	4	0·6	—	—	—
,,	IAN 2750 × RRIC 57	,, × (PB 86 × RRIC 8)	46	4	8·6	—	—	—
,,	IAN 2750 × RRIC 70	,, × (PB 86 × RRIC 7)	111	2	1·8	—	—	—
,,	IAN 2750 × RRIC 73	,, × (PB 86 × RRIC 7)	86	1	1·1	—	—	—
,,	IAN 2833 × RRIC 51	(FX 516 × PB 86) × (RRIC 8 × Mil 3/2)	24	1	4·1	—	—	—
,,	IAN 2878 × RRIC 52	(FX 516 × PB 86) × (SS)	60	5	8·3	15	9	61·7
,,	IAN 3434 × RRIC 26	(FX 4371 × PB 86) × (RRIC 8 × Mil 3/2)	97	2	2·0	6	3	50·0
,,	IAN 3434 × RRIC 52	,, × (SS)	1027	71	6·9	64	11	17·2
,,	IAN 3434 × RRIC 57	,, × (PB 86 × RRIC 8)	113	6	5·3	—	—	—
,,	IAN 3434 × RRIC 73	,, × (PB 86 × RRIC 7)	141	12	8·5	12	3	25·0
,,	IAN 3763 × RRIC 25	(FX 4371 × PB 86) × (RRIC 8 × Mil 3/2)	24	3	12·5	—	—	—
,,	IAN 3763 × RRIC 26	,, × (RRIC 8 × Pil A 44)	57	9	15·7	—	—	—
,,	IAN 3763 × RRIC 70	,, × (PB 86 × RRIC 7)	25	1	4·0	—	—	—
,,	IAN 3787 × RRIC 26	(FX 516 × Tjir 1) × RRIC 8 × Mil 3/2)	18	1	5·0	4	3	75·0
,,	IAN 3787 × RRIC 52	,, × (SS)	54	2	3·7	2	2	100·0
,,	IAN 3787 × RRIC 73	,, × (PB 86 × RRIC 7)	17	1	5·8	—	—	—
Hedigalla	LCB 1320 × FX 516	(SS) × (F 4542 × AVROS 363)	261	2	0·7	6	5	83·3
,,	LCB 1320 × RRIC 7	,, × (SS)	564	11	0·9	34	31	91·2

TABLE I—(*Contd.*)

Station	Cross	Parentage	No. of pollinations	No. of successes	% success	No. of seeds collected	No. of seeds germinated	% germination
Nivitigalakele	PB 28/59 × F 4542	(SS) × H. benthamiana	81	10	12·3	—	—	—
,,	PB 28/59 × FX 516	,, × (F 4542 × AVROS 363)	560	15	2·6	21	6	28·6
,,	PB 28/59 × FX 617	,, × (F 4542 × Tjir 1)	179	7	3·9	9	1	11·1
,,	PB 28/59 × IAN 45-873	,, × (PB 86 × FA 1717)	283	4	1·4	6	4	66·7
,,	PB 28/59 × IAN 3787	,, × (FX 516 × Tjir 1)	257	2	0·8	—	—	—
,,	PB 28/59 × RRIC 52	,, × (SS)	293	6	2·0	—	—	—
Hedigalla	PB 86 × F 1638	,, × H. brasiliensis	752	5	0·66	9	5	55·5
,,	PB 86 × FB 3300	,, × H. brasiliensis	175	6	3·4	15	11	73·3
,,	PB 86 × FX 25	,, × (F 351 × AVROS 49 (?)	3127	2	0·06	9	7	77·8
,,	PB 86 × IAN 2750	,, × (FX 516 × PB 86)	692	1	0·14	9	5	55·5
,,	PB 86 × IAN 3787	,, × (FX 516 × Tjir 1)	528	1	0·18	63	55	87·3
,,	PB 86 × RRIC 52	,, × (SS)	2327	25	1·0	74	53	71·6
,,	RRIC 36 × F 1638	(PB 86 × PR 107 × H. brasiliensis	27	2	7·4	6	6	100·0
,,	RRIC 36 × F 4542	,, × H. benthamiana	103	1	0·9	3	2	66·7
,,	RRIC 36 × FB 3300	,, × H. brasiliensis	482	10	2·0	30	30	100·0
,,	RRIC 36 × FX 516	,, × (F 4542 × AVROS 363)	206	2	0·9	6	5	83·3
Nivitigalakele	RRIC 45 × FX 349	(RRIC 8 × Tjir 1) × (F 4542 × Tjir 1)	86	1	1·1	—	—	—
,,	RRIC 45 × FX 516	,, × (F 4542 × AVROS 363)	31	2	6·4	—	—	—
,,	RRIC 45 × FX 617	,, × (F 4542 × Tjir 1)	25	1	4·0	—	—	—
,,	RRIC 45 × IAN 45-873	,, × (PB 86 × FA 1717)	105	6	5·7	3	3	100·0
,,	RRIC 51 × F 4542	(RRIC 8 × Mil 3/2 × H. benthamiana	17	2	11·7	3	3	100·0
,,	RRIC 51 × IAN 45-873	,, × (PB 86 × FA 1717)	10	1	10·0	—	—	—
,,	RRIC 51 × IAN 2667	,, × (FX 4068 × PB 86)	3	1	33·3	—	—	—
,,	RRIC 52 × F 4542	(SS) × H. benthamiana	453	3	0·6	—	—	—
,,	RRIC 52 × FX 25	,, × (F 351 × AVROS 49 (?)	153	5	3·2	12	12	100·0
Hedigalla	RRIC 52 × FX 25	,, × ,,	1135	49	4·3	106	86	81·1
Nivitigalakele	RRIC 52 × FX 349	,, × (F 4542 × Tjir 1)	192	2	1·0	3	3	100·0
Hedigalla	RRIC 52 × FX 360	,, × (F 4542 × AVROS 363)	2618	49	1·9	150	112	74·7
,,	RRIC 52 × FX 516	,, × (F 4542 × AVROS 363)	606	7	1·1	21	16	76·2
Nivitigalakele	RRIC 52 × FX 516	,, × ,,	3069	66	2·2	51	28	54·9
,,	RRIC 52 × FX 617	,, × (F 4542 × Tjir 1)	231	4	1·7	6	3	50·0
Hedigalla	RRIC 52 × FX 652	,, × ,,	2867	46	1·6	130	93	71·5
Nivitigalakele	RRIC 52 × FX 1042	,, × (F 1425 × PB 186)	30	2	6·6	6	5	83·3
,,	RRIC 52 × FX 2784	,, × (F 4542 × AVROS 363)	16	5	31·2	—	—	—

TABLE I—(*Contd.*)

Station	Cross	Parentage	No. of pollinations	No. of successes	% success	No. of seeds collected	No. of seeds germinated	% germination
Hedigalla	RRIC 52 × FX 2784	(SS) × (F 4542 × AVROS 363)	2738	96	3·5	278	240	86·3
Nivitigalakele	RRIC 52 × IAN 45-710	,, × PB 86 × F 409)	71	6	8·4	14	5	35·7
,,	RRIC 52 × IAN 45-873	,, × PB 86 × FA 1717)	218	2	0·9	7	1	14·3
Hedigalla	RRIC 52 × IAN 45-873	,, × (PB 86 × FA 1717)	276	3	1·0	9	9	100·0
Nivitigalakele	RRIC 52 × IAN 2664	,, × (FX 4068 × PB 86)	20	1	5·0	—	—	—
,,	RRIC 52 × IAN 2667	,, × (FX 4068 × PB 86)	12	2	16·6	3	2	66·7
,,	RRIC 52 × IAN 2750	,, × (FX 4068 × Tjir 1)	91	1	1·1	3	3	100·0
Hedigalla	RRIC 52 × IAN 2750	,, × ,,	1617	13	0·8	40	30	75·0
,,	RRIC 52 × IAN 3434	,, × (FX 4371 × PB 86)	660	7	1·0	15	11	73·3
,,	RRIC 52 × IAN 3787	,, × (FX 516 × Tjir 1)	688	16	2·3	36	28	77·8
Nivitigalakele	RRIC 52 × IAN 3787	,, × ,,	660	9	1·3	3	3	100·0
,,	RRIC 52 × IAN 3793	,, × (FX 516 × Tjir 1)	35	2	5·7	—	—	—
,,	RRIC 52 × PB 28/59	,, × (SS)	331	1	0·3	—	—	—
Hedigalla	RRIC 52 × PB 86	,, × ,,	355	29	8·1	67	53	79·1
Nivitigalakele	RRIC 52 × Tjir 1	,, × ,,	117	4	3·4	—	—	—
,,	RRIC 52 × Wag 6278	,, × ,,	405	3	0·7	—	—	—
,,	RRIC 54 × FX 516	(PB 86 × Wag 6278) × (F 4542 × AVROS 363)	88	7	7·9	12	2	16·7
,,	RRIC 54 × FX 617	,, × (F 4542 × Tjir 1)	34	5	14·7	6	3	50·0
,,	RRIC 62 × FX 516	(PB 86 × RRIC 8) × (F 4542 × AVROS 363)	214	4	1·9	11	9	81·8
,,	Tjir 1 × F 4542	(SS) × (SS)	449	3	0·6	—	—	—
,,	Tjir 1 × FX 516	,, × (F 4542 × AVROS 363)	1153	18	1·6	18	2	11·1
,,	Tjir 1 × FX 2784	,, × (F 4542 × AVROS 363)	182	2	1·1	6	1	16·7
,,	Tjir 1 × IAN 2750	,, × (FX 4068 × Tjir 1)	494	2	0·4	—	—	—
		Total ...	51713	1791	3·46			
		Unsuccessful Crosses, including early fruit drop ...	8858	—	—			
		Grand Total ...	60571	1791	2·9	3694	2839	76·8

4. ESTABLISHMENT OF CLONE TRIALS

4.1. Kuruwita Sub-station

4.1.1. Large-scale clone trial.—A large-scale clone trial consisting of the following clones was established at Kuruwita Sub-station during the South West monsoon period.

Clone	Parentage	No. of plants
AVROS 529	AVROS 279 × AVROS 281	150
AVROS 2037	AVROS 256 × AVROS 352	300
Harbel 1	Unknown	300
IAN 45-717	PB 86 × F 4542	300
IAN 6497	IAN 2818 (FX 516 × PB 86) × PB 86	150
IRCI 7	BD 10 × BD 5	150
IRCI 9	Tjir 1 × BD 5	150
PB 86	Unknown	300
PR 228	BR 2 × PR 107	150
PR 251	Pil A 44 × PR 107	150
PR 259	Tjir 1 × BR 2	150
RRIC 7	Unknown	150
RRIC 14	RRIC 8 × Wag 6278	300
RRIC 36	PB 86 × PR 107	300
RRIC 37	RRIC 8 × DBK 1	150
RRIC 41	RRIC 8 × Tjir 1	150
RRIC 45	RRIC 8 × Tjir 1	300
RRIC 51	RRIC 8 × Mil 3/2	300
RRIC 52	Unknown	300
RRIM 607	Tjir 1 × PB 49	300
RRIM 623	PB 49 × Pil B 84	300
RRIM 628	Tjir 1 × RRIM 527	150
RRIM 701	44/553 (Tjir 1 × Pil B 84) × RRIM 501	300
RRIM 707	RRIM 632 (Tjir 1 × PB 49) × RRIM 501	300
Waring 101	Unknown	150

4.1.2. Small-scale clone trial.—A small-scale clone trial, occupying a 300 tree block of the large-scale trial area and planted as thirty ten-tree clones, was also established at Kuruwita during the South West monsoon. The material planted was as follows :

Clone	Parentage
	1957 Progeny Selections
566	RRIC 52 × PB 86
759	RRIC 52 × Tjir 1
784	PB 5/139 × RRIC 52
815	,, × ,,
828	,, × ,,
864	,, × ,,
	1958 Progeny Selections
1009	T 170 × RRIC 52
1018	,, × ,,

Clone	Parentage
	1959 Progeny Selections
1103	RRIC 52 × RRIC 7
1108	,, × ,,
1141	LCB 1320 × RRIC 45
1317	RRIC 45 × LCB 1320
1458	LCB 1320 × RRIC 7
	1960 Progeny Selections
2002	LCB 1320 × GPM 1
2005	PR 107 × LCB 1320
2028	RRIC 52 × RRIC 7
2031	,, × ,,
2124	RRIC 52 × Wag 6278
	Established Clones
IAN 6754	PB 86 × IAN 2814 (FX 516 × PB 86)
FX 3925	F 4542 × AVROS 363
IAN 45-713	PB 86 × F 409
PB 28/59	Unknown
RRIC 90	PB 86 × RRIC 5
RRIC 91	,, × ,,
RRIC 92	PB 5/139 × RRIM 520
RRIC 93	PB 86 × RRIC 5
RRIC 94	PB 5/139 × RRIM 519
RRIC 95	PB 5/139 × RRIM 520
RRIC 96	PB 86 × Wag 6278
RRIC 97	PB 86 × Mil 3/2

A residual area was planted with seventy plants of clone **RRIM 628.**

4.2. Nivitigalakele.—A small-scale clone trial was also established at Nivitigalakele during the South West monsoon, consisting of the following clones :

Clone	Parentage
	1956 Progeny Selections
82	RRIC 41 × RRIC 10
	1957 Progeny Selections
566	RRIC 52 × PB 86
759	RRIC 52 × Tjir 1
815	PB 5/139 × RRIC 52
	1958 Progeny Selections
1009	T 170 × RRIC 52

Clone	Parentage
	1959 Progeny Selections
1103	RRIC 52 × RRIC 7
1317	RRIC 45 × LCB 1320
1458	LCB 1320 × RRIC 7
	Established Clones
Harbel 1	Unknown
IAN 6497	IAN 2818 (FX 516 × PB 86) × PB 86
PB 28/59	Unknown
RRIC 7	Unknown
RRIC 36	(PB 86 × PR 107)
RRIC 45	(RRIC 8 × Tjir 1)
RRIC 52	Unknown
RRIM 607	Tjir 1 × PB 49
RRIM 707	RRIM 632 (Tjir 1 × PB 49) × RRIM 501

The above material was projected on a background of the following 150-tree plot clones already established at Nivitigalakele during the same season : IAN 45-717, PB 86, RRIC 5, RRIC 39, RRIC 51, RRIC 86, RRIC 90, RRIC 91, RRIC 92, RRIC 93, RRIC 94, RRIC 95, RRIC 96, RRIC 97, RRIM 623, RRIM 628, RRIM 701.

A residual area of the large-scale clone trial at Nivitigalakele was planted with three plots of forty plants each of clones RRIC 36, RRIM 628 and RRIM 707.

5. FLOWER INDUCEMENT

5.1. Pollarded area, Nivitigalakele.—General care and maintenance of this area continues. A few budded trees came into flower in this area for the first time. These trees were used in the current programme and were as follows :

Tree No.	Clone	Parentage	Year of introduction
14	FX 637	F 4542 × Tjir 1	1958/1959
31	IAN 2668	FX 4068 (F 4542 × PB 86) × PB 86	,,
37	IAN 2954	FX 4073 (F 4542 × PB 86) × PB 86	,,
38	IAN 2664	FX 4068 (F 4542 × PB 86) × PB 86	1957
39	IAN 2667	,, × PB 86	1958/1959
49	FX 3810	F 4542 × AVROS 363	1957
69	IAN 3787	FX 516 (F 4542 × AVROS 363) × Tjir 1	1957
71	IAN 3787	,, × ,,	1957
75	IAN 3434	FX 4371 (F 4542 × PB 86) × PB 86	1957
89	IAN 2965	FX 4073 (F 4542 × PB 86) × PB 86	1958/1959

5.2. Flower Stimulation.—Some of the clones stimulated into flower by ring-barking flowered earlier than expected or for too short a time to be of much use but in the main a satisfactory number of successful crosses were made using flowers obtained by this method. The *Dothidella*-resistant material which came into flower this year was as follows:

F 1168, F 4542, FX 273, FX 516, FX 614, FX 617, FX 1042, FX 2784, FX 3482, IAN 45-717, IAN 2750, IAN 2877, IAN 2878, IAN 2879, IAN 3646, IAN 6645.

Local material successfully ringed in order to obtain flowers were clones, LCB 1320, RRIC 15, RRIC 21, RRIC 25, RRIC 26, RRIC 27, RRIC 54 RRIC 57, RRIC 62, RRIC 63, RRIC 67, RRIC 70, RRIC 72, RRIC 73.

Two plants of clones FX 3482 and IAN 2750 which were untreated but were adjoining ring-barked plants also flowered at the same time. Investigations are proceeding as to whether this could be caused by a diffusion of flowering hormones through naturally grafted roots.

Some plants which were ring-barked in 1960 and flowered in 1961, flowered again in 1962.

6. EXPERIMENTS ON COMMERCIAL ESTATES

6.1. Oidium Testing Station, Kepitigalla Group.—The 1960 planting was screened for *Oidium* resistance and the results are shown in Table II. It was further observed that, in regard to the 1959 planting, differences in the degree of *Oidium* resistance exhibited by different clones were not as sharp as when the plants were one year younger. Probably increased vigour and thicker foliage resulting in less wind movement between trees and consequently less spore dispersal diminished severity of attack ; in appearance therefore this older clearing seemed more uniformly healthy.

6.1.1. Dothidella-resistant clones.—It is of interest to note that the early **H. brasiliensis** selections F 406, F 409, F 1168, F 1619 and FB 3300 as well as the *H. benthamiana* selection F 4537 showed an appreciable degree of *Oidium* resistance. Of further interest is the confirmation of resistance of IAN 45-717 and the detection of resistance and vigour in IAN 6497. Although clone IAN 6497 possesses only 1/8 of the *benthamiana* heritage a very favourable degree of *Oidium* resistance was shown along with vigorous growth.

6.1.2. Transmission of Oidium resistance by RRIC 52.—A few clones of the progeny of RRIC 52 were shown to have a favourable degree of *Oidium* resistance out of the many crosses of this clone with PB 5/139 and Tjir 1. On the other hand RRIC 7, which has been shown to be an outstanding parent in earlier crosses, was found to give a very large proportion of *Oidium*-resistant progeny in combination with RRIC 52; it was also observed on Kepitigalla Estate, as well as in the Institute's nurseries at Nivitigalakele, that clone RRIC 7 transmits a high degree of vigour in association with most clones. The intensification of *Oidium*-resistance when RRIC 52 was combined with LCB 870 progeny was again evident.

TABLE II

Screening of Oidium Test Area at Kepitigalla Group
1960 Planting

Key : I. *Oidium* Resistance obvious
II. ,, ,, possible
III. ,, ,, doubtful
IV. ,, ,, absent

Clone	Origin and/or Parentage	*Oidium* resistance rating	Remarks
	Dothidella-resistant introductions in 1955		
F 351	*H. brasiliensis selection of Acre Origin*	III	Attacked by *Gloeosporium.*
F 406	,,	II	
F 409	,,	II	
F 1168	,,	II	
F 1619	,,	II	Vigorous.
F 1638	,,	III	
F 4506	*H. benthamiana selection of Rio Negro Origin*	IV	
F 4537	,,	II	Attacked by *Gloeosporium.*
FB 3300	*H. brasiliensis selection of Belem Origin*	II	
FX 25	F 351 × AVROS 49 (false)	IV	
FX 232	F 351 × PB 186	IV	
FX 273	,, × ,,	IV	
FX 360	F 4542 × AVROS 363	I	
FX 516	,, × ,,	II	
FX 636	,, × Tjir 1	III	
FX 645	,, × ,,	IV	
FX 652	,, × ,,	IV	
FX 664	,, × ,,	IV	
FX 714	F 315 × AVROS 183	III	
FX 2784	F 4542 × AVROS 363	II	Vigorous. Attacked by *Gloeosporium.*
FX 4037	F 4542 × PB 86	III	
FX 4421	F 4537 × PB 86	IV	
	Later Dothidella-resistant introductions		
IAN 45-717	PB 86 × F 4542	II	
IAN 2321	PB 86 × FX 3993 (F 4542 × AVROS 363)	IV	Attacked by *Gloeosporium.*
IAN 2322	,, ,,	IV	
IAN 2328	,, ,,	IV	
IAN 2667	FX 4068 (F 4542 × PB 86) × PB 86	IV	
	Dothidella-resistant clones of the Second Backcross to Eastern clones, introduced into Ceylon during 1959.		
IAN 6163	FX 43-443 (PB 86 × FX 2251 (F 4542 × AVROS 183) × Tjir 1	IV	
IAN 6165	FX 43 × 448 (PB 86 × FX 2251 (F 4542 × AVROS 183) × Tjir 1	II	
IAN 6166	,,	IV	
IAN 6167	,,	IV	
IAN 6497	IAN 2818 (FX 516 (F 4542 × AVROS 363) × PB 86) × PB 86	II	Vigorous.
IAN 6499	,,	III	Replicates inconsistent.
IAN 6500	,,	III	,,
IAN 6584	FX 43-651 (FX 213 (F 4542 × AVROS 183) × AVROS 183) × PB 86	III	Attacked by *Phytophthora.*

TABLE II—(*Contd.*)

Clone	Origin and/or Parentage	*Oidium* resistance rating	Remarks
	Later Dothidella-resistant introductions		
IAN 6585	,,	IV	Poor survival
IAN 6586	,,	III	Vigorous. Attacked by *Gloeosporium.*
IAN 6587	,,	III	Attacked by *Gloeosporium.*
IAN 6640	FX 43-655 (FX 213 (F 4542 × AVROS 183) × AVROS 183) × PB 86	IV	
IAN 6641	,,	IV	
IAN 6645	,,	IV	
IAN 6753	PB 86 × IAN 2814 (FX 516 (F 4542 × AVROS 363) × PB 86	III	Attacked by *Gloeosporium.*
IAN 6754	,,	III	
IAN 6755	,,	II	
IAN 6756	,,	IV	
IAN 6757	,,	IV	
IAN 6834	FX 43-443 (PB 86 × FX 2251 (F 4542 × AVROS 183) × AVROS 49 (false)	III	
	1957 Progeny		
433	RRIC 52 × PB 86	III	Vigorous
436	,, × ,,	III	
449	,, × ,,	III	
451	,, × ,,	II	
463	,, × ,,	IV	
499	,, × ,,	IV	
527	,, × ,,	IV	
558	,, × ,,	III	Vigorous
566	,, × ,,	II	Vigorous
568	,, × ,,	IV	
576	,, × ,,	IV	
614	,, × ,,	III	
619	,, × ,,	IV	
627	,, × ,,	IV	
644	,, × ,,	IV	
650	,, × ,,	IV	
729	RRIC 52 × Tjir 1	IV	
730	RRIC 52 × Tjir 1	IV	
735	RRIC 52 × Tjir 1	IV	
738	,, × ,,	IV	
753	,, × ,,	IV	
759	,, × ,,	II	Vigorous
767	,, × ,,	IV	
775	,, × ,,	IV	
781	,, × ,,	III	Attacked by *Gloeosporium.*
782	,, × ,,	IV	
783	PB 5/139 × RRIC 52	IV	
784	,, × ,,	II	Vigorous
787	,, × ,,	III	
789	,, × ,,	IV	
790	,, × ,,	III	
798	,, × ,,	III	
801	,, × ,,	III	Attacked by *Gloeosporium.*
805	,, × ,,	IV	
808	,, × ,,	III	
811	,, × ,,	II	Attacked by *Gloeosporium.*

TABLE II—(*Contd.*)

Clone	Origin and/or Parentage	*Oidium* resistance rating	Remarks
815	PB 5/139 × RRIC 52	II	Vigorous
821	,, × ,,	III	Vigorous
828	,, × ,,	II	Vigorous
830	,, × ,,	IV	
832	,, × ,,	IV	Vigorous
838	,, × ,,	IV	Vigorous
846	,, × ,,	IV	
848	,, × ,,	IV	
849	,, × ,,	III	Vigorous
850	,, × ,,	IV	
851	,, × ,,	III	
855	,, × ,,	IV	
858	,, × ,,	III	
860	,, × ,,	II	
864	,, × ,,	II	Vigorous
870	,, × ,,	IV	
876	,, × ,,	IV	Replicates inconsistent
877	,, × ,,	II	
882	,, × ,,	III	
884	,, × ,,	III	Vigorous
889	,, × ,,	III	Attacked by *Gloeosporium.*
894	,, × ,,	IV	
	1958 Progeny		
1002	T 307 × RRIC 52	I	Attacked by *Gloeosporium*
1003	,, × ,,	III	
1007	T 170 × ,,	III	
1008	,, × ,,	III	
1009	,, × ,,	II	
1012	,, × ,,	III	
1013	,, × ,,	III	
1014	,, × ,,	IV	
1016	,, × ,,	IV	
1018	,, × ,,	IV	
1021	,, × ,,	IV	
1022	,, × ,,	IV	
1023	,, × ,,	IV	
1035	T 180 × Tjir 1	III	
1036	,, × ,,	IV	
1040	,, × ,,	III	
1041	,, × ,,	III	
1043	,, × ,,	III	Vigorous
	1959 Progeny		
1101	RRIC 52 × RRIC 7	III	
1103	,, × ,,	II	Vigorous
1108	,, × ,,	II	Vigorous
1153	RRIC 86 × T 108	IV	
1184	Ch 26 × T 108	II	
1188	,, × ,,	III	
1194	,, × ,,	IV	
1197	,, × ,,	IV	
1198	,, × ,,	IV	
1199	,, × ,,	III	
1200	,, × ,,	III	Vigorous
1203	,, × ,,	II	Vigorous

TABLE II—(*Contd.*)

Clone	Origin and/or Parentage	*Oidium* resistance rating	Remarks
1231	LCB 870 × RRIC 7	IV	
1235	LCB 1320 × T 327	II	
1236	,, × ,,	III	
1241	,, × ,,	III	
1260	Ch 26 × RRIC 52	IV	
1267	Ch 26 × RRIC 52	III	Vigorous
1269	Ch 26 × RRIC 52	III	Vigorous
1308	T 306 × RRIC 52	II	
1309	,, × ,,	II	
1311	,, × ,,	IV	
1325	T 16 × ,,	II	
1448	LCB 1320 × T 108	III	
1450	LCB 1320 × T 108	IV	
1451	,, × ,,	IV	Vigorous
1452	,, × ,,	III	
1459	,, × ,,	II	Vigorous
	Established Clones		
LCB 870	Selected seedling origin	II	
TR 1548	,, ,, ,,	IV	
	Control		
Tjir 1		IV	

6.2. Hevea Breeding Stations at Moneragala

6.2.1. Moneragalla Group.—Distinctive labelling of stem and crown sections of crown-budded trees has been carried out in this area. The growth of these trees continues to be vigorous. In view of the supplemental station opened at Kumarawatte Group it was decided to omit the few clones not established in Moneragala last year.

6.2.2. Kumarawatte Group.—The growth in this area was satisfactory and a few vacancies were supplied with plants of clone LCB 1320.

The survival figures of the modern clones planted on a medium scale are of interest in view of the dry, hot climate and are as follows :

Clone	No. planted	No. surviving	% survival
PB 28/59	60	46	76·6
RRIC 7	30	25	83·3
RRIC 52	60	26	43·3
RRIC 88	60	56	93·3
RRIC 89	30	23	76·6

6.3. Phytophthora Testing Station, Peenkande Group.—The growth in this area was satisfactory. Prolonged unseasonal showers and overcast conditions during the latter part of the year supported a severe attack of *Phytophthora* in the test area : this attack led to leaf-fall with or without die-back of the affected shoots.

It is to be noted however that this attack of *Phytophthora* in the test area was not complicated by the presence of fruits as the plants were young.

6.3.1. Affected plants.—The following clones were attacked by *Phytophthora* and the clones marked with an asterisk (*) showed a light attack with only a few fallen leaves.

Group I.—H. P. Material

H.P. Year	*Parentage*	*Clone Nos.*
1956	BD 10 × PR 107	109
1957	RRIC 52 × Tjir 1	770*
	PB 5/139 × RRIC 52	788*, 885*, 892
1958	T 327 × RRIC 52	1003
	T 170 × RRIC 52	1007, 1023
1959	RRIC 52 × RRIC 7	1102, 1114
	LCB 1320 × RRIC 45	1136
	,, × T 327	1237, 1239*, 1240, 1242
	Ch 26 × RRIC 52	1280*
	RRIC 52 × RRIC 86	1289*

Group II.—1953 H. P. Established as 5-point buddings at Hedigalla

1953 — 3 clones with LCB 870 parentage—none attacked.

Group III.—Established Clones

Clones

Ch. 26*, PR 107, RRIC 51*, RRIC 52*.

Group IV—Dothidella-resistant material

Origin

Ford Clones: F 409, 4537.
FX 25, 349, 567, 614*, 637, 1042, 3482, 3810, 3925, 4037, 4065, 4098, 4421

IAN Clones: IAN 45-713, 45-717, 2322, 2328, 2361, 2363, 2489, 2664, 2667*, 2744, 2829*, 2867, 2878, 2879, 2887, 2890, 2891, 2892, 2897, 2900, 2903, 2904*, 2958, 2960, 3457, 3460*, 3646, 3702, 3711*, 3714*, 3763, 3787, 3793*, 6584*, 6586, 6641, 6645, 6753*, 6756*, 6757*.

Control: PB 86—14 plants were attacked.

REVIEW OF THE PLANT PATHOLOGY DEPARTMENT

By

O. S. Peries

SUMMARY

The Acting Plant Pathologist, the Research Assistant and all the Technical Assistants of the Department were on duty throughout the year.

The new Research Assistant, Mr. D. L. S. Wimalajeewa, B.Sc. Hons. (Ceylon), appointed to the Department took up duties on 1st September 1962, and a newly appointed Technical Assistant, Mr. Z. E. Irugalbandara, assumed duties on 2nd July 1962.

The incidence of *Oidium* leaf disease remained light in all the rubber growing districts of Ceylon during the refoliation season of 1962. Heavy leaf-fall caused by the disease occurred only in areas where wintering was very late and the weather conditions became more conducive to the spread of the disease. As a result of the light *Oidium* infection and the good control measures generally adopted, the foliage on most clones was better in 1962 than it has been in many years.

The results of two field experiments have confirmed that spraying with sulphur-based fungicides can be as effective as sulphur dusting for *Oidium* control.

The incidence of secondary leaf-fall caused by *Phytophthora palmivora* and of Black Stripe (Bark Rot) caused by the same fungus, was very light during the year under review, presumably because the weather conditions during the South-West monsoon season were not conducive to the propagation of the fungus.

The field experiments dealing with the control of *Phytophthora* leaf disease were carried out by the Agricultural Engineer in 1962, and his report is being submitted separately.

Detailed laboratory and small-scale field experiments were carried out for the preliminary selection of fungicides suitable for Bark Rot control. In these early studies the main objective was to establish the limits of toxicity of the various fungicides submitted to the Institute from time to time to the causal fungus, *Phytophthora palmivora*, on the one hand and to the host plant, *Hevea brasiliensis*, on the other. Fungicides which have a high fungicidal and low phytotoxic value can be expected to be useful for the control of tapping panel diseases. Based on the results of these experiments, seven fungicides were selected for testing under field conditions during the latter half of 1962.

A field experiment carried out to establish the optimum time for the application of a selected fungicide for the control of Bark Rot has shown that treatment at the time of latex collection is significantly better than treatment before the commencement of tapping. This result has been discussed with reference to the incidence of Bark Rot this year.

An assessment of the incidence and economic importance of the *Gloeosporium* leaf disease of *Hevea* in Ceylon has been carried out.

Field experiments on the control of *Fomes lignosus* (White Root disease) on *Hevea* have indicated that the continued use of Organo-mercurials for the control of the disease under field conditions in Ceylon, may have to be reviewed in the light of the results obtained in these experiments.

Three long-term field experiments have been started at Dartonfield to compare the efficacy of the different methods of identifying and treating *Fomes* infected plants.

A Hirst Spore Trap was installed at Dartonfield and worked continuously throughout the South-West monsoon season, with a view to studying the pattern of fungal spore dispersal in *Hevea* plantations.

Laboratory work carried out during the year included studies on the biology and host-parasite relationships of the leaf disease fungi *Oidium heveae* and *Phytophthora palmivora*, with special emphasis on the methods of perennation of these fungi.

A simple method of inoculating *Hevea* roots with the fungus *Fomes lignosus*, the causal agent of White Root disease, was perfected during the period under review. This has facilitated the studies on host-parasite relationships in connexion with this disease.

DETAILED REVIEW

1. GENERAL

1.1. Staff.—The Acting Plant Pathologist, Dr. O. S. Peries, the Research Assistant, Miss V. Sivapalan, the Senior Technical Assistant, Mr. H. L. Munasinghe, and the Technical Assistants Messrs. T. M. Fernando, S. K. Samaraweera and D. M. Dantanarayana were on duty throughout the year.

Mr. D. L. S. Wimalajeewa, Research Assistant, appointed 1st September 1962, and Mr. Z. E. Irugalbandara, Technical Assistant, appointed 2nd July 1962 were on duty throughout, from their respective dates of appointment.

1.2. Correspondence

		Inward	Outward
General	...	81	122
Technical	...	490	376

1.3. Visits

		Advisory	Experimental
Acting Plant Pathologist	...	20	25
Research Assistants	...	1	40
Senior Technical Assistant	...	21	7
Technical Assistants	...	12	127

1.4. Meetings

The Acting Plant Pathologist delivered the following lectures at the meetings detailed overleaf :—

(*a*) The factors affecting the incidence of White Root disease in *Hevea*. Kegalla District Planters' Association meeting, 11th April.

(*b*) The incidence of *Phytophthora* leaf and bark diseases in Ceylon. Kalutara District Planters' Association, 1st June.

(*c*) The fungal diseases of *Hevea*. Smallholdings Department Field Day, 10th November.

(*d*) The identification and control of *Gloeosporium* leaf disease of *Hevea*, Kurunegala District Planters' Association, 15th November.

(*e*) The identification and control of the fungal diseases of *Hevea*. Sabaragamuwa Planters' Association, 28th November.

(*f*) The problem of disease resistance in plants. University of Ceylon, Botany Society, 12th November.

The Acting Plant Pathologist also attended a second meeting of the Kalutara District Planters' Association (15th November) and a meeting of the Ceylon Estate Employers' Federation (28th June), convened to discuss the application of fungicides for the protection of the tapping panel.

1.5. Visitors

Dr. Allen Kerr, Senior Lecturer, University of Adelaide, South Australia, visited the Department on 8th November. This visit gave the Departmental staff a useful opportunity of discussing the problem of fungal relationships in the soil with an authority on the subject.

1.6. Publications

The following papers were prepared for publication by the Staff of the Plant Pathology Department during 1962.

(*a*) Annual Review of the Plant Pathology Department for 1961.

* (*b*) Studies on Strawberry Mildew, caused by *Sphaerotheca macularis* (Wallr. ex Fries) Jaczewski 1. Biology of the fungus. — *Ann. appl. Biol.* 50, 211-224 (1962).

* (*c*) Studies on Strawberry Mildew, caused by *Sphaerotheca macularis* (Wallr. ex. Fries) Jaczewski II. Host-parasite relationships on foliage of strawberry varieties. *Ann. appl. Biol.* 50, 225-233 (1962).

* (*d*) Studies on Strawberry Mildew. *Rep. agric. hort. Res. Sta. Bristol* 1961, 153—162.

(*e*) Diseases of *Hevea* caused by non-parasitic agents. *Rubb. Res. Inst. Ceylon Combined 1st and 2nd Quarterly Journals*, 38, Parts 1 & 2, 13-17 (1962).

(*f*) Contribution on *Phytophthora palmivora* to the "Question Corner". *Rubb. Res. Inst. Ceylon Combined 1st and 2nd Quarterly Journals*, 38, Parts 1 & 2, 25-26 (1962).

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*Based on research work carried out by the writer at the University of Bristol, during tenure of a Colombo Plan Scholarship from 1959-1961.

(*g*) Methods used by the Rubber Research Institute of Ceylon for testing water-miscible fungicides for the control of Bark Rot of *Hevea*. 1. *In Vitro* and phytotoxicity tests. *Rubb. Res. Inst. Ceylon Combined 3rd and 4th Quarterly Journals*, **38**, Parts 3 & 4, 57-61.

(*h*) Contribution on the biology of *Oidium heveae* to the "Planting Topics". *Rubb. Res. Inst. Ceylon Combined 3rd and 4th Quarterly Journals*, **38**, Parts 3 & 4, 83.

(*i*) Contribution on the identification and control of *Gloeosporium* leaf disease of *Hevea* to the "Question Corner". *Rubb. Res. Inst. Ceylon Combined 3rd and 4th Quarterly Journals*, **38**, Parts 3 & 4, 85.

(*j*) Advisory Circular No. 48 on *Oidium heveae* was completely revised and issued as Advisory Circular No. 70.

2. LABORATORY WORK

2.1. Diseased specimens.—Laboratory observations were made on the following diseases and pests found on specimens sent to the Institute, in connexion with advisory work during the year.

Identity of diseases, pests and other causes of damage		No. of cases
(*a*) *Fungi and Bacteria*		
Botryodiplodia theobromae	...	1
Hypocrella reineckiana	...	2
Fomes lignosus	...	1
Fomes noxius	...	1
Gloeosporium alborubrum	...	18
Helminthosporium heveae	...	4
Oidium heveae	...	12
Phytophthora palmivora	...	4
(*b*) *Pests and other causes*		
Caterpillars	...	5
Drought	...	2
Insect damage	...	3
Physiological yellowing of leaves	...	13
Wind damage	...	2

2.2. Biology of the fungal parasites of Hevea.—The Technical Assistants of the Department were initiated into the methods of carrying out investigations on the biology of fungal spore germination and growth.

2.2.1. Biology of Oidium heveae.—(S. K. Samaraweera). Observations were made on the effect of environment on the germination of *Hevea* mildew conidia during the *Oidium* season. These studies were of a preliminary nature and more detailed experiments will be carried out during the next refoliation season. The lack of adequate greenhouse facilities is a distinct drawback to the rapid progress of these studies; as the heavy inoculum of the fungus, necessary for this work, cannot be maintained outdoors during a major part of the year. A temporary greenhouse has therefore been erected with polythene sheeting in an attempt to extend these studies beyond the limits of the *Oidium* season.

Observations have also been made on the host range of *O. heveae* by transferring the conidia of the mildew on *Hevea* to the leaves of various species of weeds. None of these inoculations was successful, so that it appears at present that *O. heveae* has a more limited host range than has been claimed by other workers on this subject in the past.

2.2.2. Biology of Phytophthora palmivora.

2.2.2.1. Growth.—(T. M. Fernando). Studies on the growth rate and pH requirements of P. *palmivora* on different media have been completed. Of the media tested in these studies, it has been found that linear growth of the fungus and production of aerial mycelium are best on Oat and on Maize Meal Agar, whereas sporulation of the fungus is best on Lima Bean Agar. There are slight differences in the pH requirements for growth on different media, but optimum growth was generally obtained in the pH range 5 to 6.5 on all the media studied. Observations on the temperature requirements for growth of *P. palmivora* on culture media and on host tissue have been seriously hampered as a result of recurrent electricity failures in the transition period from D.C. to A.C. The results obtained so far indicate that the optimum temperature for growth on all media tested lies between 25 and 28°C.

Sporangia of *P. palmivora* germinate quite readily in distilled water at room temperature. Percentage germination of sporangia varies with the type of isolate, its age, the culture medium and temperature at which it is grown and the temperature at which germination takes place.

The zoospores are extremely sensitive to moisture and require free water for germination both on *Hevea* leaves and on agar coated glass slides. The optimum temperature for germination of zoospores lies between 20 and 25°C.

2.2.2.2. Sexuality in P. palmivora isolated from Hevea.—(Miss V. Sivapalan). Eighteen isolates of *P. palmivora*, sixteen from rubber and one each from cocoa and coconut*, have been studied with reference to their ability to produce oospores in paired cultures. The results of these investigations have shown that these isolates are divisible into two groups one of eight and the other of ten, there being one " master " isolate in each group which can pair with any isolate of the other group. The members of each group, however, do not produce sexual spores when paired with one another. The isolates from coconut and cocoa both fall into one group.

These results are extremely important in view of the fact that it indicates that " Cocoa type " strains of *P. palmivora* can infect *Hevea* under natural field conditions in Ceylon. This has been confirmed by growth experiments on cocoa pods carried out with certain rubber isolates of *Phytophthora*. Under these conditions the question of planting cocoa under *Hevea* must be reviewed critically ; as hitherto it has been believed that the isolates of *P. palmivora* from *Hevea* do not attack cocoa and *vice versa*. The other conclusion that can be drawn from these studies is that there may very well be physiologic races of this fungus on *Hevea* ; if further work now being carried out confirms this, it will have a vital bearing on the breeding of *Hevea* clones resistant to *Phytophthora* diseases. The fact that sexual reproduction of this fungus can occur in nature, as both plus and minus types of the fungus have been isolated from *Hevea* in Ceylon, will complicate this issue still further ; because this increases the chances of physiologic specialization of the fungus.

2.2.2.3. Physiologic specialization.—(D. M. Dantanarayana). It was observed that different isolates of *P. palmivora* showed distinct growth characteristics on agar media. Detailed studies have been carried out on the physiology and morphology of four selected isolates of this fungus as a preliminary step for the studies

*Cocoa and Coconut isolates obtained from the Department of Agriculture, Peradeniya.

on physiologic specialization in this fungus. The results obtained so far indicate that the four selected isolates are divisible into three groups on the above characteristics : the fungus isolated from infected pods and green twigs forming one, that from petioles forming another, and the isolate from the bark forming the third.

Inoculation experiments have been planned to find out whether these differences in the physiology and morphology between these isolates are reflected in their infection spectra on *Hevea* clones.

2.2.2.4. Perennation of P. palmivora.—(H. L. Munasinghe and S. K. Samaraweera). Studies on the methods by which the fungus tides over periods unsuitable for its growth have indicated that at least one situation where it can hibernate is in infected bark. In a majority of cases, Bark Rot infected trees are capable of overcoming the infection during the dry periods of the year, forming callus tissue around the points of infection and pushing out the diseased tissue. However, the fungus was isolated from the infected bark of certain trees throughout the dry period, January-April 1962.

Infected fruits, (either in the mummified condition on the trees or those that have fallen on the ground) twigs, branches and other aerial parts of the tree may harbour the fungus in an active or dormant state during dry periods which are unfavourable for its growth.

The fungus can be isolated from infected pods for a short time after they have dried out, but they soon become infested with other fungi, mainly *Gloeosporium alborubrum* and *Fusarium* spp., so that all attempts to isolate *P. palmivora* from infected pods kept in the laboratory, on soil outdoors, and from mummified fruits picked from trees have failed so far. However, this fungus was isolated from recently dead out-of-season pods as late as 21st December 1962. The failure to isolate a fungus from a particular type of infected tissue does not prove that the fungus is not present in that tissue; it may equally well be that the method of isolation used is inadequate. Field observations and recent studies have indicated that mummified pods may act as a source of primary inoculum of the fungus for the new season.

The fungus has been isolated from artificially inoculated twigs for a period of up to 8 weeks and from petioles for 2-3 weeks after inoculation. The petioles are shed soon after infection and they decompose quickly on the soil, so that they probably do not play any significant role in the perennation of the fungus.

An isolated case of leaf-fall caused by *Phytophthora* infection was observed in the Kalutara District on the 17th December, and infected out-of-season pods were picked at Dartonfield on 21st December. This indicates that the fungus can cause fresh infections, during periods of favourable weather, throughout a major part of the year, and that the fungus may perennate from one season to another by means of a series of fresh infections during short periods of wet weather. Laboratory studies and field observations are being carried out with a view to confirming this hypothesis.

2.3. Host-parasite relationship

2.3.1. Phytophthora palmivora

2.3.1.1. Phytophthora infection of the petiole and lamina of *Hevea* leaves.—(Z. E. Irugalbandara). Artificial inoculations of leaf blades and petioles have shown that the zoospores of the fungus germinate and produce appressoria within 2 hours of coming to rest on the leaf surface. Tender leaves, in the copper

resistant to Bark Rot have a higher arginine content than those susceptible to this disease. These studies are being continued along with studies on the anatomical structure of the bark, to find out whether there is any correlation between the composition and structure of the bark of various clones and their susceptibility to *Phytophthora* Bark Rot.

2.6. Assessment of waterproof applicants for bark renewal.—(Miss V. Sivapalan and D. M. Dantanarayana). Six materials comprising "Brand X", containing Indole acetic acid (manufactured by Messrs. Lunevale Products Ltd., Lancaster, England), Coal tar, Shell T. B. 192, Candarsan, Kankerdood and Bark Seal, were tested against a water control to assess their effect on the rate of bark renewal in small-scale field experiments. A circular area of bark, 8 cm. in diameter, was removed at a height of 5 feet on 35 ten-year-old PB 86 trees and one of the above materials was applied over the scraped area on each tree. The treatments were each replicated five times, water being used as a control. Measurements of bark renewal were made at regular intervals and the results analysed statistically.

It was found that none of the materials tested was significantly better than the control in the context of this experiment. The Indole acetic acid preparation was slightly better than water, but the difference was not significant at the 5% level. All the other materials ranked slightly lower than water, but the differences here too were not significant at the 5% level. Coal tar caused a slight degree of bark scorch, but even so bark renewal was not significantly retarded in comparison with water.

2.7. Inoculation experiments with Fomes lignosus.—(S. K. Samaraweera). A technique for artificially inoculating *Hevea* roots with the White Root disease fungus *F. lignosus*, has been established. This method consists of disinfecting *Hevea* roots with dilute mercuric chloride, followed by washing them in sterile distilled water and keeping them in close contact with a pure culture of the fungus, growing on small pieces of rubber wood in 500 ml Erlenmeyer flasks. This method has given almost 100 per cent success in inoculations carried out at Dartonfield during 1962.

This technique has helped in the detailed studies now being carried out on the method of penetration and disease establishment by the White Root disease fungus, some details of which have already been given in this Review. In conjunction with this, certain fundamental studies are also being carried out on the action of fungicides on root-disease fungi.

2.8. Soil micro-flora and root disease incidence.—(H. L. Munasinghe and S. K. Samaraweera). The White Root disease fungus, *F. lignosus;* being a weak parasite, there is a possibility of suppressing its growth by encouraging the growth of saprophytic fungi antagonistic to it in the soil. Studies have been started with a view to establishing the usual types of fungi, and their distribution patterns, found in rubber growing soils. Parallel investigations are being made to find out what effect the addition of various materials to the soil has on its fungal population. Preliminary results indicate that sulphur increases the acidity and is likely to reduce the overall fungal population of the soil non-selectively ; whereas copper sulphate, which changes the pH of the soil only very slightly, seems to suppress all other fungal species present in the particular soil studied, except *Penicillium* spp., the numbers of which increase significantly in treated soils.

A pot experiment has been started to find out whether the changes in the fungal flora in these treated soils have any effect on *F. lignosus*. Laboratory experiments have also been started to establish whether there is any antagonism between the fungal species surviving in the soil after treatment and root disease fungi.

brown stage, are more susceptible to infection than mature leaves. Macroscopic symptoms of infection become visible on the tender leaf lamina between 16 and 22 house and on the mature petiole between 10 and 16 hours after inoculation. The petiole appears to be more susceptible to infection than the lamina, and, in fact, lesions appear within 5 hours of inoculation on tender copper brown petioles.

Detailed studies are now being carried out on the method of penetration and establishment of the disease on the petiole and the lamina. These studies should provide useful information on the propagation of the fungus, which should facilitate the work on forecasting *Phytophthora* epidemics on *Hevea* in Ceylon.

2.3.1.2. Phytophthora Bark Rot.— (H. L. Munasinghe.) Observations on the isolation of the causal fungus of this disease from the bark and wood of infected trees have indicated that although the fungus may penetrate into woody tissue to a certain extent, the depth of penetration is relatively slight, the blackening of woody tissue being a reaction to infection by the fungus rather than an indication of the presence of the fungus itself. It has been shown in *Phytophthora* diseases of other crops, that blackening of host tissue is caused by the production of high molecular weight tannins produced by polymerisation of the products of oxidation of host polyphenols by polyphenol oxidase as a reaction to infection. This shows that it is not necessary to remove all the discoloured wood when scraping trees for Bark Rot control. It should be sufficient if all the infected bark is removed, and healthy bark separated from any discoloured wood by a barrier strip of healthy wood about $\frac{1}{2}''$ wide.

2.3.2. Mode of penetration and disease establishment by Fomes lignosus.—(Z. E. Irugalbandara). Histological studies have been carried out on *Hevea* roots naturally infected in the field and on others artificially inoculated with *F. lignosus*, the causal agent of White Root disease. It has been found that although this fungus does infect rubber roots through points of injury and anatomically weak spots such as lenticles, these are not essential to the fungus which can readily intect intact bark. The fungus penetrates into healthy bark by means of wedge-shaped aggregations of hyphae, which enter the host tissue as a unit. The fungus has never been observed to achieve penetration by means of single hyphae. There are indications that penetration is achieved initially by chemical means, following which the wedge shaped hyphal aggregations seem to exert a certain amount of mechanical pressure to facilitate their progress. Differential staining techniques have shown that the host cells are killed ahead of the advancing fungus, indicating that it secretes a toxin into host tissue.

2.4. Fungicides for bark disease control.—(Miss V. Sivapalan and D. M. Dantanarayana). Perfecting methods for the routine testing of fungicides for bark disease control took up a major part of the first half of the year. Techniques have now been established whereby all fungicides likely to be of use as panel disinfectants, received by this Institute, can be screened on agar plates for their contact fungicidal value as well as their ability to diffuse through an agar medium. The lowest concentration at which the best fungicides, selected on the basis of the above tests, were toxic to *Hevea* bark was established by means of another series of experiments. Based on the results of these tests, seven fungicides, which are highly toxic to *P. palmivora* but have a low phytotoxic value, were selected for testing on a field scale for the control of Bark Rot. A detailed description of these tests has already been published in a Quarterly Journal of the R.R.I.C.

2.5. Composition of the bark with reference to its susceptibility to bark diseases.—(Miss V. Sivapalan). Paper chromatographic analyses of the extracts of bark samples of various clones have shown that although the composition of the bark with reference to amino acids is similar in all clones tested, clones

3. LEAF DISEASES

3.1. Oidium Leaf Disease

3.1.1. General.—The incidence of *Oidium* leaf disease was generally light throughout the rubber growing districts of Ceylon, during the 1962 refoliation season. Heavy leaf-fall was recorded only on late refoliating clones, at the beginning of March, when the weather conditions became more conducive to the propagation of the fungus. The weather conditions during January and February 1962 were, in a large measure, responsible for the light incidence of *Oidium* this year. *O. heveae* is a powdery mildew fungus, and this type of fungus is favoured by relatively dry atmospheric and soil conditions associated with cool dewy nights. The weather conditions during the early period of refoliation this year were too hot and dry for the propagation of this fungus, and heavy *Oidium* infection was not observed till March, when occasional showers helped to reduce the temperature and increase the atmospheric humidity. This must not be interpreted as an indication that wet weather is favourable for the propagation of this fungus, free water is, in fact, injurious to it, as laboratory experiments have shown that the fungus will not infect a wet leaf surface ; but short showers can be beneficial to the fungus, as these help to produce temperature and humidity conditions favourable for its propagation.

When more data are available on the biology of the fungus, it should be possible to effect certain economies in the control measures adopted against this fungus, by the critical control of the timing of fungicidal applications.

3.1.2. Field Experiments.—(T. M. Fernando and S. K. Samaraweera). The Plant Pathology Department carried out two field experiments designed to compare the relative merits of spraying with that of dusting for the control of *Oidium* leaf disease.

The results of these experiments confirmed those of the two previous years that, provided adequate coverage was obtained, spraying with sulphur-based fungicides can be as effective for *Oidium* control as sulphur dusting. To obtain adequate coverage by spraying, the machine has to be carried through every row of rubber, so that the operation takes up much more time than dusting.

The rate of application of wettable sulphur and the other details regarding spraying for *Oidium* control in *Hevea* have been given in the Annual Review for 1961.

3.2. Phytophthora Leaf Disease

3.2.1. General.—The incidence of *Phytophthora* leaf disease caused by the fungus *Phytophthora palmivora* was negligible in 1962. The first symptoms of *Phytophthora* leaf disease in the Kalutara District was observed on the 22nd May at the end of a period of about 10 days of continuous wet weather. The weather conditions in this district changed during the last week of May and the rainfall for June was below average for that time of the year. The rainfall during July, August and September was about average, but the distribution of rainfall was such that there were a number of dry sunny days interspersed between the wet days during the whole of the South-West monsoon season. This type of weather is not conducive to the rapid build up of the disease inoculum which paves the way for epidemics.

The rainfall figures for the period May-September 1962 and the corresponding figures for 1959, as well as the 5 year averages are presented in Table I. The figures for 1959 are given for comparison as heavy secondary leaf-fall occurred in that year.

TABLE I

	Dartonfield			Nivitigalakelle			Hedigalla		
	5 yr. av.	1959	1962	5 yr. av.	1959	1962	5 yr. av.	1959	1962
May	18·66	16·08	33·39	19·10	18·53	31·74	20·22	18·22	30·61
June	15·94	28·30	13·38	16·80	32·71	10·33	19·11	32·40	11·11
July	12·61	12·79	11·61	11·72	15·52	10·03	12·13	14·90	12·79
Aug.	9·93	14·59	16·20	10·16	16·93	14·96	13·66	16·75	14·07
Sept.	12·07	19·16	12·25	12·22	18·10	12·86	13·22	22·07	16·01

Investigations have been started to find out whether there is a possibility of forecasting the occurrence of *Phytophthora* leaf disease epidemics by means of weather data. The preliminary indications are that the pattern of the distribution of rainfall and sunshine may hold the key to this problem.

3.2.2. Field Experiments.—All field experiments in connexion with the control of *Phytophthora* leaf disease were carried out by the Agricultural Engineering Unit in 1962, and their report will be submitted separately.

3.3. Gloeosporium Leaf Disease

3.3.1. General.—The incidence of *Gloeosporium* leaf disease appears to have increased over recent years and there were numerous requests for advice on the control of this disease during 1962. *Gloeosporium* leaf disease is not entirely a seasonal disease such as *Oidium* or *Phytophthora* leaf diseases, although the incidence of the disease is heavier during wet periods. *Gloeosporium* is especially severe on young clearings, in which the new foliage is constantly attacked by the fungus. The control of this disease, therefore, poses a fungicidal application problem, as young clearings which produce new foliage throughout the year have to be protected from infection all the year round by the application of fungicides at frequent intervals.

3.3.2. Assessment of disease incidence.—(D. L. S. Wimalajeewa). As a preliminary step for the intensive study of the *Gloeosporium* problem on *Hevea* in Ceylon a survey was carried out to assess the incidence and economic importance of this disease in this country, by circulating a questionnaire to all estates registered with this Institute. The following is a summary of the results of this survey :—

(1) More than three-fifths of the estates replying to the questionnaire have reported the presence of the disease.

(2) Approximately 90% of the estates reporting the disease carry out control measures, which include dusting and spraying of copper-based fungicides.

(3) Only a small percentage of estates have reported that losses of economic importance have been caused by this disease, but more than half those replying to the questionnaire have an intuitive belief that the disease is of economic importance.

(4) An yearly increase of the incidence of the disease has been reported by almost all the above estates.

The importance of the disease having thus been established, experiments have been started with a view to devising adequate control measures against it.

4. BARK AND STEM DISEASES

4.1. Black Stripe Disease

4.1.1. General.—The pattern of distribution of the rainfall during the South-West monsoon season, which was unfavourable for the development of the causal fungus, *P. palmivora*, helped to keep the incidence of Bark Rot at a comparatively low level during the year.

4.1.2. Field Experiments

4.1.2.1. Comparison of selected fungicides for Bark Rot control.—(T. M. Fernando). Seven fungicides, *viz.* Antimucin, Brunolinum Plantarium, Fylomac, Izal, Topane, Topane : Fylomac mixture, and Verdasan, selected on the basis of the results of experiments already described in this review, were tested under field conditions to compare their relative merits for the control of Bark Rot. These experiments have now been going on for five months, and the results obtained so far indicate that there are no significant differences between these fungicides for Bark Rot control. However, because of the low general incidence of Bark Rot during 1962, these results are not considered to be absolutely conclusive at this stage, and the experiments will be continued in 1963.

Yield records in the blocks, under the various treatments detailed above, are being maintained to find out whether any of the fungicides used have any effect on the yield of latex. It appears from the results obtained up to date that there are no significant differences between the fungicides with reference to their effect on yield of dry rubber from the treated trees.

4.1.2.2. Randomized Block experiment for Bark Rot control and yield.—(T. M. Fernando). Three of the fungicides used in the above experiment were selected entirely at random and compared with Antimucin for their effect on Bark Rot as well as on the yield of latex in a randomized block experiment where the four fungicidal treatments were replicated four times.

The results obtained up to the end of December have shown that there are no significant differences between the four selected fungicides : Antimucin, Brunolinum plantarium, Fylomac and Topane : Fylomac mixture, with reference to the criteria tested. This experiment is also being continued so as to confirm the results obtained during 1962.

4.1.2.3. Optimum time for application of panel disinfectants.—(T. M. Fernando). An experiment was carried out to establish whether the routine application of the fungicides for the control of Bark Rot should be made before tapping or at the time of latex collection. In this experiment 5 tapping blocks were each divided into two sections, and a selected fungicide was applied to the panel before tapping on one half of each tapping block and at the time of latex collection on the other half of each block. A census of Bark Rot was taken before the commencement of the experiment, and at regular intervals thereafter ; a record was also kept of the scrap obtained from each half block separately.

The results up to the end of December have shown that the application of the fungicide at the time of latex collection is significantly (at the 0.1% level) better than application before the commencement of tapping. The loss in scrap consequent on the application of fungicides at the time of latex collection, *i.e.* before the scrap has fully coagulated, was not statistically significant.

Although the results of this experiment are highly significant, it is felt that owing to the low incidence of Bark Rot generally this year, it would be necessary to confirm these results in a year when Bark Rot is severe ; as there is a possibility that the differences between the treatments may be swamped when the incidence of the disease is high. However, in an average year the application of panel disinfectants at the time of latex collection should give better results than that made at the time of tapping. Planters should bear in mind, however, that when rain comes down between the time of tapping and collection of latex, the panels are not likely to receive any protective treatment if this is normally made after tapping. Therefore, it is important to ensure that the tapping panels are treated at the first available opportunity under such circumstances.

4.2. Pink Disease — Corticium salmonicolor

4.2.1. General.—There have been no complaints regarding Pink Disease during the period under review.

5. ROOT DISEASES

5.1. White Root Disease — Fomes lignosus

5.1.1. General.—The incidence of White Root disease, caused by the fungus *F. lignosus*, in young replanted areas remained at about the same level as in previous years.

5.1.2. Field Experiments

5.1.2.1. Assessment of Tillex.—(T. M. Fernando and S. K. Samaraweera). Four field experiments were carried out during the year, on four outside estates, in order to make a critical assessment of the efficacy of Tillex, an organo-mercurial fungicide, for the control of White Root disease in the field. Seven treatments were tested in these experiments, each experiment consisting of four treatments replicated four times. The plot size was four trees so that each experiment involved the treatment of sixty-four infected trees.

The following treatments were tested :—

1. *Complete surgery only.
2. Complete surgery, followed by treatment of remaining parts of root system with Tillex.
3. Treatment with Tillex without any form of surgery.
4. **Partial surgery, followed by Tillex treatment of root system.
5. Partial surgery only.
6. Complete surgery, followed by Tillex treatment of root system and watering of surrounding soil with one gallon of 1% Tillex.
7. Control. No surgery. No Tillex treatment.

N.B.—The food base was traced and removed in all treatments including control.

*Complete surgery — excision of all infected parts of roots and removal of all superficial rhizomorphs.

**Partial surgery — excision of all infected parts of root system, leaving behind superficial rhizomorphs on roots.

The final assessment of the results of these experiments showed that there was no significant difference between the efficacy of any of the treatments tested. On the basis of these preliminary experiments there appears to be no justification for the continued use of an expensive chemical for the control of *Fomes* in *Hevea*. It must be borne in mind, however, that these results are subject to confirmation in further field experiments which have been planned for 1963.

5.1.2.2. Assessment of methods of identification and treatment of Fomes.—Three long-term field experiments have been laid down on the 1961 replantings at Dartonfield to assess the relative merits of different methods of identifying and treating *Fomes*-infected trees in replanted areas. These experiments have been laid down in the form of 4×4 Latin Squares, and are designed to compare the overall differences between two methods of disease identification and two methods of treatment, in various combinations. The results of these experiments will not be available for final statistical analysis until these replantings are at least four years old. No interesting features, worthy of being recorded here, have been observed so far in these experiments.

5.1.2.3. Effect of different manurial treatments on incidence of Fomes.—It is expected that the $2 \times 2 \times 2$ factorial experiment, with NPK at two levels with split plot arrangements for comparing two forms of magnesium (as commercial Epsom Salts and Dolomite) laid down at the Kuruwita Sub-station by the Soils Division, will give useful data on the effects of different levels of the major nutrients on the incidence of *Fomes*. Counts of *Fomes* infected plants recorded so far do not show any significant differences between treatments in this experiment.

6. PESTS AND OTHER CAUSES

6.1. General.—Damage caused by insects and other pests was of no economic importance on *Hevea* during the period under review.

6.2. " Physiologic Yellows ".—A number of yellow leaf samples were sent to the Institute and there was a spate of requests for visits to estates where yellowing of leaves on lower branches was observed. After a critical examination of this problem it was concluded that the yellowing of leaves on lower branches was the result of the physiological inactivity of those leaves caused by heavy shade. This type of " physiologic yellows " occurs every year on *Hevea*, but the unusually dense canopies that were generally produced as a result of the mild *Oidium* season this year, made this disturbance rather prominent during the months of March, April and May 1962. This subject is discussed in some detail in the Annual Report of the Plant Pathology Department for 1955, and need not be pursued any further here.

Sometimes leaf-fall resulting from physiological inactivity is confused with that caused by *Phytophthora* infection, especially during the S. W. monsoon. However, the symptoms of the latter are very distinct, with a blackening of the leaf petiole and coagulation of latex globules on the discoloured areas, and should not be mistaken for yellowing due to natural causes.

7. FIELD EXPERIMENTS

7.1. Dartonfield 1 Acre, 1953 Replanted Area.—This area is planted with mixed local and foreign Clones for studies on resistance to *Oidium* and *Phytophthora* leaf disease and for small-scale field trials.

Routine attention has been given to this area.

7.2. Defoliation experiment.—(D. L. S. Wimalajeewa). As sufficient data is not available at present to make an absolute assessment of the effect of leaf diseases on *Hevea* in Ceylon a miscellaneous experiment was started, on a 3-year-old clearing planted with Clone CH 26 at Hedigalla, in order to find out the effect of various degrees of artificial defoliation on yield.

The experiment was carried out on 125 trees, which were divided into twenty five blocks of 5 trees each. To begin with the whole area was tapped at a 100% intensity on alternate days for one month, in order to study the yield trends, following which the effect of five different levels of defoliation, *viz.* 0%, 25%, 50%, 75% and 100% on the yield of the trees was assessed, each treatment being replicated five times. Tapping was continued, but latex collection was resumed three days after defoliation.

This experiment has to be continued over a further indefinite period before any firm conclusions can be drawn ; as the overall effects of defoliation on yields as well as on the devitalization of the tree and other side effects can only be assessed after the lapse of time.

7.3. Hirst Spore Trap.—Studies on air spora, using the Hirst Spore Trap, have given useful information on the pattern of fungal spore distribution under *Hevea*. A majority of the spores trapped belong to various unidentified species of *Basidiomycetes ;* of the *Ascomycetes*, there appears to be a preponderence of spores of *Daldina concentrica*. The diurnal rhythm of spore dispersal in various fungi in Ceylon appears to conform to that observed for those fungi in other parts of the world. Only a limited amount of work has been done on this subject due to the time required to scan the slides carefully.

REVIEW OF THE AGRICULTURAL ENGINEERING UNIT

By

J. H. Lloyd

SUMMARY

This Unit has worked almost exclusively on the control of Abnormal Leaf-Fall caused by *Phytophthora palmivora*. This has involved the following investigations.

1. Laboratory assessments of rainfastness and application characteristics of spray and dust formulations of copper fungicides.
2. Assessments of application performance of spraying and dusting machinery.
3. Field evaluations of spraying and dusting for the control of Leaf-Fall and on the incidence of Bark Rot.
4. Work study observations of dusting on estates.
5. An appraisal of the epidemiology and economics of *Phytophthora* disease of rubber in Ceylon.

Results of these investigations have been as follows :

1. Of 21 spray formulations tested, five that gave the most rainfast deposits were selected for field trials. Of these, the products chosen for field trials in 1962 were : Lovo-Copper, Coprantol, and Fycol ; the ones selected for field trials in 1963 have been Lovo-Copper, Schlofog C, Brunokop, and possibly, Fycol. The dusts in general use were considerably less rainfast than the selected spray products, and it was also found that the dusts differed in their impingement and adherence characteristics. Laboratory tests showed that the rainfastness of some of the spray products was affected by : concentration of spray suspension ; wetness or dryness of leaves at the time of application ; and by the length of the interval between spraying and the onset of rain, notably in the case of the oil-borne formulations.
2. Under canopy-free conditions, the Mistral III AB, the Platz " Baby-Agricola ", and the Micronette " 75 " sprayers all demonstrated that spraying can produce deposits as large as those given by dusting at all heights up to 85 feet. In rubber plantations, however, the vertical range of spraying and dusting seemed to depend entirely on the characteristics of the canopy with regard to the height and density of foliage of the understorey, and also to the amount of canopy-free space between individual trees. Sprays and dusts seemed to be affected equally by canopy to the extent that there was hardly any spray or dust deposited beyond a height of 30 feet in a 1951 planting of PB 86 which had a dense spread of understorey. The vertical range of sprays and dusts was better in older plantings of PB 86 but it varied according to canopy characteristics. The results of various dusting tests suggested that, in general, the effective distance of horizontal distribution of deposits due to drift was no more than 18-20 yards (or 3 interrows), regardless of the age or type of planting material. There seemed to be no foreseeable likelihood that machines could be developed which

would be hand-portable and, yet, powerful enough to give adequate coverage at all heights of fully-foliated canopy, especially in young, mature plantings of PB 86.

3. For the third year in succession, the incidence of *Phytophthora* Leaf-Fall was low in all the field experiments. Two of the trials produced significant differences which showed that the effectiveness of certain spray treatments was comparable with that of weekly dusting, and cost less. However, in view of the insignificant level of disease incidence, these results were of little practical value. Clearly, similar experiments should be carried out in 1963 and perhaps, for several more years in order to assess fully the control performances of spraying and dusting. Moreover, long-term trials should be carried out in order to assess the cost of control in relation to the economics of Leaf-Fall, and to the incidence and economics of Bark Rot. Preliminary field evidence has suggested that spraying or dusting for Leaf-Fall control does not influence the course of Bark Rot epidemics.

4. Work study observations of dusting on estates have provided much useful information. It was found that vulnerable areas were generally dusted using swaths that varied in width between 20 and 100 yards. Chemical assessments confirmed that there were usually no deposits on trees that were laterally more than 8 yards from the source of the dust. Inadequate coverage may therefore have contributed to dusting failures that have been known to occur although lack of rainfastness of dusts and prevention of timely dust application by persistent rain have also been contributory. Inadequate initial distributions of dust deposits may have been due partly to the fact that dusting is performed too late in the day on most estates. It was observed that the steep and rocky nature of the terrain on some estates would make it clearly impracticable and, perhaps, impossible to treat these areas by dusting with swaths 10-14 yards wide, or by spraying with swaths 5-7 yards wide. Under these circumstances, helicopters would have to be used for spraying or, if the disease is not important enough to warrant their use, as appears to be generally the case, then the Leaf-Fall would have to be tolerated because there appears to be no other solution.

5. Assessments based on epidemiological evidence and yield records have failed to show that *Phytophthora* Leaf-Fall causes yield losses or crop damage in Ceylon, or that it occurs severely enough and frequently enough to do so on any scale. Moreover, there has been no evidence that dusting for the control of Leaf-Fall has reduced the intensity of Bark Rot in treated areas. On the contrary, Bark Rot has been reported to be severe during years and in areas where Leaf-Fall has been virtually absent. In consequence, it has been concluded provisionally that the extensive control measures undertaken annually and at increasing cost in Ceylon may be out of proportion to the economic importance of the disease. It has been concluded also that the practical core of the *Phytophthora* problem in Ceylon is Bark Rot rather than Leaf-Fall. The implications of this with regard to Leaf-Fall control methods and to further investigations have been assessed and reported.

DETAILED REVIEW

GENERAL

1.1. Staff.—The Agricultural Engineer assumed duties with effect from his arrival in Ceylon on 6th November, 1961. He was on duty throughout 1962.

Mr. E. G. Mendis and Mr. W. C. Dayaratne, Technical Assistants, were on duty throughout the year. Mr. T. Shanmuganathan took up appointment as Technical Assistant with effect from 2nd March, 1962.

1.2. Correspondence

Inward	...	285
Outward	...	132

1.3. Visits.—The Agricultural Engineer made 72 visits to estates chiefly in connexion with *Phytophthora* Leaf-Fall experiments.

2. FORMULATIONS APPRAISALS

2.1. Rainfastness tests.—In India it has been found that repetitive dusting was not effective enough for the control of *Phytophthora* Leaf-Fall because the dusts were not sufficiently rainfast. It has been demonstrated also in India that effective control of Leaf-Fall can be obtained by a single pre-monsoon application of rainfast copper-in-oil sprays. Previous investigations of spraying at this Institute were also reported to have had promising results but mild incidence of *Phytophthora* Leaf-Fall in the seasons of 1960 and 1961 prevented critical assessments. Clearly, further field investigations of spraying were required in 1962. It was apparent, however, that there were too many different spray products available for all to be tested adequately in the field. Some rapid and reliable form of selecting a suitably small number of the most eligible formulations therefore had to be employed. On the evidence of the field results from India it was concluded that rainfastness of deposits on *Hevea* leaves would be a practical criterion for assessments of formulations in the laboratory. Accordingly, a method was adopted in which a concentration of 10% w/v of metallic copper of each formulation was sprayed by a spinning disc machine on to replicated numbers of leaves. Samples were removed from the sprayed leaves for chemical determinations of copper in the deposits. The leaves were subjected to simulated rainfall treatment after a standard interval of one hour after spraying. Copper analyses were carried out after various amounts of simulated rain, and the percentages of deposits retained were calculated.

This method was a little unreal because the petiole is the usual site of *Phytophthora* infection and not the leaf. Moreover, there were slight differences of deposit tenacity on the petiole as compared with the leaf but they were found to be consistent differences which did not affect the ranking of formulations provided the ranking was based on tenacities only on leaves or only on petioles. However, leaves were generally more convenient to use than petioles for the assessments and, in consequence, leaves were used.

The products tested have been listed (Table 1) showing those that were available for screening in time before the 1962 field trials, and those that became available later and were screened for field trials in 1963.

Deposits of the most rainfast spray products were retained to extents ranging between 35% and 90% after 10 inches of simulated rainfall. In contrast, deposits of the dusts in general use were usually almost totally removed by less than one inch of rain.

It was estimated that three spray formulations were the most that could be tested adequately in the field in one season. For field trials in 1962, the three products that were chosen on the basis of best rainfastness as well as by evidence of satisfactory suspensibility and sprayability were : Lovo-Copper, Coprantol, and Fycol. The products chosen by the same procedure for field trials in 1963 were : Lovo-Copper, Schlofog C, Brunokop, and possibly, Fycol: the inclusion of Fycol would be useful as a standard product because it has been known to give effective control of *Phytophthora* Leaf-Fall by a single pre-monsoon application. A possible

TABLE I

Copper fungicide products screened for rainfastness. The percentage stated in brackets after each product is the concentration of actual copper in the product.

Products screened for field trials in 1962		Products screened for field trials in 1963	
Spray formulations	Dusts	Spray formulations	Dusts
Banacobre (50% w/w)	Blendox (4% w/w)	Aerial Perenox (50% w/w)	Blendox (4% w/w)
Caocobre (50% w/w)	Ciba, with sticker (1%w/w)	Banacobre (50% w/w)	Copper Sandoz (4% w/w)
Copper Sandoz (50% w/w)	Copper Sandoz (4% w/w)	Brunokop (50% w/v)	Oxycar (4% w/w)
Copramat (*)	Cuprosana (6% w/w)	Bordeaux Mixture : (i) 10 : 10 : 100 (0.25% w/v) (ii) 4 : 2.75 : 6 (1.7% w/v)	
Coprantol (50% w/w)	Oxycar (4% w/w)		
Cupravit (50% w/w)	Oxydust (4% w/w)†	Colloidal Copper (Shell/Duphar) (20% w/v)	
Ferguson's Copper (50% w/w)		Coprantol (50% w/w)	
Fycol 8 (72% w/v)		Fycol 8 (72% w/v)	
I. C. I. Copper-in-oil (40% w/v)**		I. C. I. Copper-in-oil (40% w/w)**	
Lovo-Copper (58% w/w)		Lovo-Copper (58% w/w)	
Riedel-Copper (20% w/w)		Potash-Burgundy mixture : 20 : 11.5 : 10 (5% w/v)	
Perenox (50% w/w)		Schlofog C (19% w/w)	
		Schering colloidal oil copper (35% w/w)	

*Mixture of 31·9% w/w actual copper as copper oxychloride and 26% Ziram w/w.

**A rainfastness assessment of this product could not be made because it was impossible to re-suspend it after storage. A replacement batch was no better than the original.

†Oxydust was stated to have the same specifications as Blendox and, in consequence, was not tested.

disadvantage of Schlofog C, Brunokop, Fycol, and other oil-borne formulations may be that their rainfastness seems to depend on the length of the interval between spraying and the onset of rain; the initial drying interval required for maximum rainfastness of these formulations may be as long as 24 hours which is, perhaps, too long to be fully practical in view of the constant likelihood of rain at the time of year when spraying has to be done for *Phytophthora* Leaf-Fall control.

The rainfastness of dusts was the same whether the leaves were wet or dry at the time of application. The rainfastness of Fycol was also the same on leaves that had been wet and dry during spraying. However, Coprantol was more rainfast on leaves that had been wet, but Lovo-Copper deposits were more rainfast on leaves that had been dry. Similar tests have not yet been carried out with Schlofog and Brunokop.

Tests of effects of concentration of suspension on rainfastness, sprayability, and suspensability of candidate sprays indicated that a concentration of 10% w/v of actual copper was the most practical optimum for spraying all the products.

2.2. Rainfastness of formulations in the field.—Under field conditions the tenacities of Lovo-Copper and Fycol were comparable, and the residues of their deposits varied between 2·4% and 17·7% of their original amounts after 3 months weathering during the South-West monsoon. The deposits of Coprantol failed to persist throughout the monsoon.

Field assessments of dust deposits showed that the first shower amounting to 0·22 inches caused an initial removal of 85 — 92% of all the products used (Blendox, Copper Sandoz, and Oxycar), and after 3 inches of rain only negligible amounts of deposits remained. There seemed to be no differences between the dusts with regard to rainfastness.

2.3. Initial adhesion of dusts.—Dusts do not deposit efficiently chiefly because the particles are light and often lack sufficient momentum to penetrate the boundary layer that surrounds all objects. In addition, dusts generally have poor adherence characteristics. In consequence, it has not been uncommon that the failure of dust particles to impinge and to adhere to vegetation has resulted in deposits amounting to only a small proportion of the emitted dust. It was therefore important to examine the deposition and adherence characteristics of fungicide dusts that are in general use for the control of *Phytophthora* Leaf-Fall. The test was carried out by hand-dusting applications of standard quantities of the different dusts to leaves suspended vertically from boards. The leaves had dry, wet, and vaseline-coated surfaces, respectively, and five leaf replicates were chemically analysed from each treatment (Table II).

TABLE II

The deposits of copper fungicide dusts on dry, wet, and vaseline-coated Hevea leaves. The amounts are micrograms of copper per sq. cm of leaf. The dusts were applied at an approximate average rate of 200 micrograms of copper per sq. cm of leaf.

Product	Leaf surface		
	Dry	Wet	Vaseline-coated
Copper Sandoz 4% dust	0·05	0·56	1·75
Blendox 4% dust	0·14	0·10	0·12
Oxycar 4% dust	0·03	0·04	0·09
Ciba 1% dust	0·05	0·03	0·02

The adherence of the dusts would have been virtually absolute on the vaseline-coated leaves so that those deposit levels were wholly due to the amounts that impinged. Clearly, the amount of Copper Sandoz that impinged was substantially larger than the amount of the other dusts as shown by the deposits on the vaseline-coated series. The deposit levels of Blendox, Oxycar, and Ciba dust were not materially different whether the leaves were dry or wet or vaseline-coated. The sizes of deposits of these three dusts were therefore determined by impingement rather than by adherence. In the case of Copper Sandoz dust, however, the size of the initial deposit was influenced greatly by adherence after impingement. The differences between the deposits of Copper Sandoz on the dry, wet, and vaseline-coated leaves indicated that the dry leaves retained only about 3% of the dust that impinged while the wet leaves retained nearly 32%. On the dry leaves there were no noteworthy differences between the deposit levels of any of the products. The lack of difference due to dryness, wetness, or vaseline-coating on the deposits of Blendox, Oxycar and Ciba dust would suggest that these materials do not have to be applied when the leaves are wet in order to obtain maximum adherence as is the case with Copper Sandoz. It has to be borne in mind, however, that these are laboratory results which are subject to confirmation in the field. The results of his exercise clearly demonstrated the low deposition efficiency of dusts which have a recovery on vaseline of only about 0·8% of the Copper Sandoz and between 0·01% and 0·06% of the other dusts.

3. MACHINERY AND APPLICATION

3.1. Spraying machinery assessments.—Assessments have been made of the vertical range of spraying and dusting machinery. These have been carried out by using a rope-and-pulley rig suspended from a height of 85 feet above the

ground. The ropes have been fitted with clips at 5-feet intervals for holding slides or leaves. The rig has been suspended over an area of cleared ground so that there have been no obstructions to impede deposit distributions of sprays or dusts. Vertical spray range tests have been carried out with the Birchmeier Mistral III AB sprayer/duster, the Micronette " 75 " sprayer, and the Platz "Baby-Agricola" sprayer/duster. The Mistral III AB has been widely used for dusting in rubber and is a well-known machine. The Micronette " 75 " is a new machine that has been specially designed for spraying rubber and coconuts in areas requiring portable machinery; the Platz " Baby-Agricola " machine was also new to Ceylon. The results of assessments carried out by spraying Sova oil are reported overleaf (Table III); Sova oil was used because it is involatile and the assessments were consequently unaffected by spray evaporation. The assessments were made using slides coated with magnesium oxide for spray sampling.

It was found that the three machines could deposit spray at all heights up to 85 feet (Table III). The most efficient recovery, coverage, and deposit distribution characteristics were shown by the Micronette " 75 " which did not give a heavy, wasteful deposition below 30 feet as occurred with the Mistral and Platz machines. The Micronette " 75 " had a practical, hand-portable design for spraying in rubber and appeared to have useful possibilities. However, the machine was marred by certain structural weaknesses which were reported to the manufacturers, but it appeared that they could not be remedied.

Extensive enquiries amongst machinery manufacturers in U.S.A. and Europe have failed to find any other machines that might be worthy of testing.

Other spraying and dusting tests were carried out with the Mistral III AB and C.C.C. " Noidium " machines and some of these have been reported below :

3.2. Vertical range of dusting and spraying. The rope-and-pulley rig was used to assess the vertical range of dusting under canopy-free conditions. Assessments were made with Blendox, Copper Sandoz and Oxycar which are the products mostly used for dusting for the control of *Phytophthora* Leaf-Fall. The effects of impingement and adherence of these dusts on vertical range were also determined by comparisons of deposits on dry, wet, and vaseline-coated leaves. Using the Mistral III AB machine, dust deposits were obtained at all heights up to 85 feet. It was found, however, that the amounts of deposits of Copper-Sandoz at heights below 50 feet were influenced by adherence but, at greater heights, the amounts of Copper-Sandoz deposited seemed to depend on impingement rather than on adherence. The amounts of deposits of Oxycar and Blendox at all heights clearly depended more on impingement than on adherence (cf. Table II).

TABLE III

Drop spectrum assessments of Mistral III AB, Micronette "75" and Platz "Baby-Agricola" spraying machines. The number of drops per square centimetre and the spray volumes recovered have both been expressed per gallon of spray emitted per acre.

Height above ground (feet)	MISTRAL III AB			MICRONETTE "75" (with Bray O nozzle)			PLATZ "BABY-AGRICOLA"		
	Mass* Median diameter (microns)	Number of drops per sq. cm.	Recovery (Imperial gal/acre)	Mass* Median diameter (microns)	Number of drops per sq. cm.	Recovery (Imperial gal/acre)	Mass* Median diameter (microns)	Number of drops per sq. cm.	Recovery (Imperial gal/acre)
0	239	21·6	0·610	114	8·8	0·025	271	41·1	1·460
10	211	28·9	0·540	121	26·2	0·080	194	56·7	0·733
20	184	17·7	0·177	70	42·5	0·025	191	47·1	0·350
30	124	25·6	0·056	98	64·4	0·110	180	59·0	0·501
40	125	18·1	0·026	68	460·6	0·230	167	35·3	0·192
50	160	16·3	0·052	82	376·9	0·260	142	33·8	0·115
60	182	17·0	0·078	75	486·9	0·300	79	28·3	0·046
70	152	24·6	0·075	61	221·3	0·081	97	16·8	0·036
80	152	32·3	0·045	57	88·1	0·031	100	15·4	0·018
85	66	26·1	0·008	68	53·8	0·025	145	15·5	0·042
Emission rate (pints/min.)		2·1			0·43			2·82 (with both regulator taps at No. 2 positions).	
Area-dosage (gal./acre)		5·7			1·6			12·5	
Walking speed (m.p.h.)		1·1			1·4			0·9	
Wind speed (m.p.h.)		1·1			0·8			0	
Temperature (°C)		24			23			24	
Relative humidity		96			96			96	

*Mass median diameters were approximate values calculated by multiplication of the surface median diameters (S.M.D.) by 1.2.

Comparisons of results of spraying and dusting with the Mistral III AB machine showed that spraying can produce deposits as large as those given by dusting at all heights up to 85 feet (Table IV).

TABLE IV

The amounts of spray and dust deposits obtained on leaves at different heights on the rope-and-pulley rig after application by a Mistral III AB machine. The amounts of spray deposits are averages of the results of three tests in which Lovo-Copper, Coprantol, and Fycol were sprayed; the amounts of dust deposits are averages of the results of three tests in which Copper-Sandoz dust was applied to wet leaves.

Height above ground (feet)	Amounts of copper per sq. cm of leaf expressed as micrograms per lb of copper emitted per acre.	
	After spraying	After dusting
0	0·823	0·134
10	0·483	0·120
20	0·550	0·147
30	0·823	0·196
40	0·550	0·181
50	0·273	0·284
60	0·187	0·105
70	0·143	0·110
80	0·117	0·057
85	0·063	0·066

3.3. The effect of canopy on dust and spray distribution.—Deistribution of dust and spray deposits were investigated in planting material of diffrent typess and ages. Comparisons of these distributions with those obtained on the rope-and-pulley rig showed that the vertical range of dusting and spraying seemed to depend entirely on the characteristics of the canopy with regard to the height and density of the foliage of the understorey, and also to the amount of canopy-free space between individual trees (Table V).

The vertical range of dusting in PB 86 at Malaboda Estate was grossly inadequate, and the restricting effect of the canopy was obvious from the deposit levels (Table V). The failure of the dust to deposit on leaves beyond 30-40 feet was presumably due to the dust particles having insufficient momentum to impinge because the dust cloud certainly reached the tree tops and drifted beyond. Moreover, the leaves were uniformly wet during both tests so that conditions were favourable for adherence (2·3). It was feasible therefore that the dense and spreading low understorey of PB 86 dissipated the force of the airstream and caused a sufficient reduction in the mass momentum of the particles in the dust cloud to prevent impingement.

TABLE V

Amounts and distributions of deposits of Copper–Sandoz dust obtained after application by a Mistral III AB machine under different conditions of canopy. The leaves were wet at the time of each application. The amounts are micrograms of copper per sq. cm of leaf recovered per lb of copper emitted per acre.

Height above ground (feet)	Rope-and-pulley rig tests			Dartonfield Estate 1947, Polyclonal planting			Malaboda Estate 1951, PB 86 planting			
							Test 1		Test 2	
	Min.	Av.	Max.	Row 1	Row 2	Row 3	Row 1	Row 2	Row 1	Row 2
0	0·076	0·134	0·101	—	—	—	—	—	—	—
10	0·042	0·120	0·141	—	—	—	—	—	—	—
20	0·097	0·147	0·069	—	—	—	—	—	—	—
30	0·019	0·196	0·264	0·584	0·128	0·041	0·525	0·075	0·300	0·225
40	0·008	0·181	0·493	—	—	—	0·010	0	0·075	—
50	0·004	0·284	0·710	0·259	0·084	0·044	—	—	0	0
60	0·007	0·105	0·257	0·088	0·025	—	—	—	—	—
70	0·002	0·110	0·311	0·003	—	—	—	—	—	—
80	0	0·057	0·159	—	—	—	—	—	—	—
85	0·002	0·066	0·195	—	—	—	—	—	—	—
Date	1-2-62	—	30-1-62	5-3-62			29-5-62		11-6-62	
Time	7-30 a.m.	—	7-30 a.m.	6-05 a.m.			6 a.m.		6.a.m.	
Emission rate (lb/min.)	7·8	—	5·0	7·6			1·0		1·0	
Area-dosage lb/acre of ground	206, of dust (8·24 of copper)	—	68·5, of dust (2·76 of copper)	116·8, of dust (4·67 of copper)			10, of dust (0·4 of copper)		10, of dust (0·4 of copper)	
Walking speed (m.p.h.)	1·0	—	2·0	0·88			2·0		2·0	
Wind speed (m.p.h.)	3·0	—	1·1	0·61			—		—	
Temperature (°C)	25	—	25	22			—		—	
Relative Humility (%)	81	—	82	96			—		—	
Canopy type	None			Open and sparse. High understorey. Foliage of low-medium density as refoliation after wintering was still going on. Trees 75′-80′ high.			Enclosed. Dense and low understorey. Foliage of high-density. Trees 50′-55′ high.			

TABLE VI

Amounts and distributions of deposits of various copper formulations after spraying with a Mistral III AB machine in different operations. Each formulation was applied at a rate of 3 lb of metallic copper in 3 gal/acre.

Height above ground (feet)	Amounts of copper per sq. cm of leaf expressed as micrograms per lb of copper emitted per acre.											
	Rope-and-pulley rig				Eladuwa Estate 1947, Wagga 6278 Planting				Malaboda Estate 1951, PB 86 Planting			
	Lovo-copper	Coprantol	Fycol	Average	Lovo-copper	Coprantol	Fycol	Average	Lovo-copper	Coprantol	Fycol	Average
0	1·70	0·69	0·08	0·823	—	—	—	—	—	—	—	—
10	0·93	0·29	0·23	0·483	—	—	—	—	—	—	—	—
20	0·77	0·46	0·42	0·550	3·873	—	1·307	2·590	—	—	—	—
30	1·18	0·49	0·80	0·823	0·350	0·230	—	0·290	0·163*	0·107	0·403**	0·226
40	0·84	0·29	0·52	0·550	0·330	0·207	0·280	0·272	0	0	0·023	0·008
50	0·44	0·21	0·17	0·273	0·150	0·440	0·053	0·214	—	—	—	—
60	0·40	0·11	0·05	0·187	0·053	0·147	0·003	0·068	—	—	—	—
70	0·31	0·07	0·05	0·143	0·010	—	—	0·010	—	—	—	—
80	0·19	0·14	0·02	0·117	—	—	—	—	—	—	—	—
85	0·10	0·07	0·02	0·063	—	—	—	—	—	—	—	—
	Canopy	None			High, Sparse understorey. Foliage of medium high density. Large areas of canopy-free spaces between trees Trees 75′-80′ high†.				Low, dense understorey. Foliage of very high density. Virtually no canopy-free spaces between trees Trees 50′-55′ high.			

*Average of 3 trees

**Average of 2 trees

†Based on measurements of trees felled by wind.

Assessments of horizontal distribution due to " drift " showed that there was a steep reduction of amount of deposit with increase of distance from the dust source. Measurements in five critical tests carried out under favourable dusting conditions showed that, in general, the effective distance of horizontal distribution was no more than 18-20 yards (3 inter-rows). Moreover, the heights at which deposits were obtained in the canopy decreased with increasing distance from the dust source. The distance of horizontal distribution also varied according to canopy characteristics, and in the dense canopy of PB 86 at Malaboda Estate it was evident that dusting of every row might have been advisable to obtain a more uniform coverage. One assessment showed that the distance of horizontal distribution was greater due to a strong wind, but the wind was so strong that it clearly reduced the vertical range of the dust to heights below those which would have been within effective deposition range under calm conditions.

Spraying was similarly limited by canopy as shown by the comparisons in Table VI (page 81)

The vertical range of spraying in the thick canopy of PB 86 at Malaboda Estate was comparable with that of dusting (cf. Table V). However, the same sprays reached considerably greater heights in the less enclosed canopy of Wagga 6278.

The Micronette " 75 " appeared to have a slightly better vertical range than the Mistral machine when both were compared for spraying Fycol copper-in-oil in a 1951 planting of PB 86 at Eladuwa Estate (Table VII).

TABLE VII

Amounts and distributions of deposits of copper-in-oil spray in a 1951 planting of PB 86, Eladuwa Estate

Height above ground (feet)	Amounts of copper per sq. cm of leaf expressed as micrograms per lb of copper emitted per acre.		
	Mistral III AB machine (Dosage : 3 lb Cu./3 gal/acre)	Micronette " 75 " machine (Dosage : 2 lb Cu./2 gal/acre)	
		Tree 1	Tree 2
30	0·555	0·750	0·300
40	0·003	—	0·220
45	—	0·200	—
50	0	—	0
55	—	0	—

Both the Mistral and Micronette machines had a greater vertical range in older plantings of PB 86 but deposit distributions varied from tree to tree presumably because of canopy differences.

Other assessments confirmed that the swath for spraying should not be more than 6-7 yards in width (1 row) in any type of planting.

3.4. Conclusions from physical assessments.—The vertical range of spraying and dusting by available methods was clearly comparable and the better horizontal distribution by dusting did not seem to be a substantial advantage. In view of the similarity of vertical range of spraying and dusting it was expected that both methods would give a similar degree of disease control provided that the deposits obtainable by both methods were maintained at comparable levels by applications repeated as required. However, a disadvantage of dusting was known to be that dusts are readily washed from foliage by rain and the rainy weather that favours *Phytophthora* may prevent timely re-dusting as in 1959. In consequence, the foliage is unprotected when the disease is at its height. By comparison, spraying with a rainfast formulation would be expected to be more effective because the deposit would be persistently available to protect the foliage at the critical time when protection is necessary and without problems of re-application. In other words, under conditions of severe disease incidence, it would not appear to be possible to maintain dust deposits at levels comparable with those after spraying (2·2). Because of this, spraying with suitable, tenacious formulations might be more effective than dusting, and would appear to be more worthy of development.

The important issues were, however, whether sufficiently good control could be obtained by the most efficient appl cation of the best of available spraying methods and, if not, whether better methods were in sight. This could be determined only by disease control investigations, but some measure of estimation was possible through relating the available physical data to the known requirements. Important features of the control problem were that *Phytophthora* Leaf-Fall seems to occur at all heights within *Hevea* canopies and, because copper fungicides act chiefly as protectants, the principal requirement for control is to have machines that can provide adequate coverage of fungicides *over the whole of the foliage* in even the tallest canopies. If this cannot be done, then parts of the canopy that have no deposits are unprotected, and are vulnerable to *Phytophthora* Leaf-Fall. In view of this, it would be expected that clone PB 86, especially in young mature plantings, would experience very considerable Leaf-Fall merely from the large proportions of the canopy which obtain no deposits at all because of the short vertical range of spraying and dusting in dense canopy. For instance, assuming that the canopy extends approximately between heights of 25 feet and 55 feet in a 1951 planting of PB 86, then the complete absence of deposit above a height of 40 feet might result in a Leaf-Fall of at least 50% of the canopy under conditions that would produce complete defoliation in the absence of any control. Although this is a hypothetical possibility it is not without practical significance especially because PB 86 is economically the most important high-yielding clone in Ceylon and is, perhaps, one of the most susceptible to *Phytophthora*, especially to Bark Rot; moreover, PB 86 has been the clone used most extensively for re-planting since 1953, which has been of added significance.

The above deductions may be held as truisms because much work, especially in India, has shown that the inadequate vertical range of available mistblowers is the main factor limiting the control of *Phytophthora* Leaf-Fall from the ground. However, there is no likelihood that better machines will become available, certainly not in the near future. Moreover, it would seem forlorn to hope that a hand-portable sprayer can be developed which is powerful enough to give complete coverage of mature *Hevea* trees. The reason for this is that mistblower specifications have been determined for spraying trees 70-120 feet in height, and these have shown that an engine of at least 25-30 h.p. is required to provide the airflow cha-

racteristics needed (S.F. Potts, 1958 : Concentrated Spray Equipment. Dorland Books). In view of this, the most that could be done in the present assignment was to determine how effectively *Phytophthora* Leaf-Fall could be controlled by the most efficient application of available machines and formulations, and to determine if the results were economically acceptable. Field trials were therefore, carried out with these objectives.

4. FIELD TRIALS

4.1. Phytophthora Leaf-Fall control trials.—Five field trials were carried out to investigate the control of *Phytophthora* Leaf-Fall by spraying and dusting; one of the experiments was designed to assess the effect of the disease on yield. The spray treatments consisted mainly of single pre-monsoon applications compared with weekly rounds of 4% copper dusts applied at a rate of 10 lb per acre per round; dusting treatments were also begun before the onset of the monsoon. Spraying was performed using swaths that were 5-7 yards in width, and for dusting, a standard swath width of 10-14 yards (2 rows) was used (3·3). Details of the experiments have been summarised (Table VIII).

TABLE VIII

Details of field trials undertaken to investigate the control of Phytophthora Leaf-Fall.

Estate	Planting	Extent of experiment (acres)	Number of treatments	Number of replicates	Period of assessment	Average percentage of Leaf-Fall caused by *Phytophthora* on the untreated control plots
Malaboda	PB 86 (1951-1956)	60	6	5*	4/6/62-27/8/62	0**
Eladuwa	WAR 4 (1946)	15	2	3	1/6/62-28/8/62	0·64
Eladuwa	PB 86 (1951)	40	5	4	11/6/62-28/8/62	1·13
Yatadola	PB 86 (1946-47)	48	8	4	9/6/62-29/8/62	0·58†
Eladuwa	Wagga 6278-(1947)	15	5	3	1/6/62-28/8/82	0·62

*Except for the untreated control plots which were 4 replicates.

**3 plots had no *Phytophthora* Leaf-Fall, but 1 plot had a Leaf-Fall of 0·42%.

†These plots had not been intended as untreated controls and had been due for treatment if the disease had shown signs of becoming severe.

Assessments of *Phytophthora* Leaf-Fall were made by relating counts of fallen diseased petioles to estimates of total petiole number in the canopy. The latter were obtained by counts of the total numbers of petioles on fallen trees which showed, for instance, that trees of clone PB 86 planted in 1949 bore about 23,000 petioles per tree. A stand of 140 trees per acre of that planting would therefore have had a canopy containing 3,220,000 petioles per acre and, if all those petioles

fell to the ground as a result of total defoliation, they would amount to an average of 665 petioles per square yard of ground. On this basis, for instance, if *Phytophthora* caused a hypothetical total fall of 66 petioles per square yard of ground in that planting in the course of a *Phytophthora* attack then the Leaf-Fall due to the disease would amount to 10 per cent. This method was not absolutely accurate but it permitted comparisons that were absolute enough to have a practical meaning as well as to show how one treatment compared with another. In view of leaf-fall caused by wind, counts of fallen petioles were classified according to whether they fell due to wind or to *Phytophthora*.

There was only a mild incidence of *Phytophthora* Leaf-Fall in all the experiments (Table VIII). Significant differences between treatments were obtained, however, in two of the experiments and these showed that certain spray treatments resulted in disease control comparable to that of weekly dusting. In view of the insignificant incidence of disease, the results seemed hardly to be of any practical value. The application details of these experiments have been given below particularly in order to show the relative costs of methods, and also to illustrate the large Leaf-Fall due to wind as compared with *Phytophthora*.

Experiment No. 3.

Purpose of experiment :	To compare dusting with spraying for the control of *Phytophthora* Leaf-Fall.
Estate :	Eladuwa.
Lay-out of experiment :	Randomized block, 4 replications of 5 treatments.
Plot size :	2 acres.
Sampling lay-out :	nine, 6′ × 6′ plots distributed regularly around 4 trees in the centre of each plot.
Planting material :	PB 86.
Year of planting :	1951.
Period of experiment, and application dates :	The first rounds of application of all treatments except for the B series were carried out between 26th and 28th April. Second rounds of application of treatments A, C and D and the first round of treatment B were applied on 6th June. Spraying and dusting were performed using a Mistral III AB machine. The experiment was ended on 28th August, 1962.

Treatment details :

Treatment	Form of application	Dosage of metallic copper per acre per round (lb)	Amount of spray or dust applied per acre per round	Number of rounds of application	Interval between applications	Total dosage of metallic copper applied per acre (lb)	Cost of treatment per acre*
A. Fycol	Spray	3·0	3 gal	2	6 weeks	6·0	Rs. 81·92
B. Lovo-Copper	Spray	1·5	3 gal	1	—	1·5	Rs. 18·62
C. Lovo-Copper	Spray	3·0	3 gal	2	6 weeks	6·0	Rs. 47·40
D. Copper Sandoz	Dust	0·4	10 lb	13	1 week	5·2	Rs. 52·52
E. Untreated Control	—	—	—	—	—	—	—

*Assuming an application cost for dusting of -/96 cents per round for dusting by 10-yard swaths, and Rs. 3/50 per acre for spraying by 5-7 yard swaths.

Summary of Results

Treatment	Average number of leaves fallen per square yard		% Leaf-Fall	
	Due to wind	Due to *Phytophthora*	Due to wind	Due to *Phytophthora*
A. Fycol 8	29·7	2·53*	4·43	0·38*
B. Lovo-Copper	30·7	2·47*	4·62	0·37*
C. Lovo-Copper	34·3	3·53*	5·16	0·53*
D. Copper-Sandoz	30·7	3·12*	4·62	0·47*
E. Untreated Control	28·7	7·50	4·32	1·13
	L.S.D. (5%)	1·74	L.S.D. (5%)	0·26

*Significantly less Leaf-Fall than on the untreated control.

Experiment No. 4.

Purpose of experiment : To compare different spray and dust products for the control of *Phytophthora* Leaf-Fall.

Estate : Yatadola.

Lay-out of experiment : Randomized block : 4 replications of 8 treatments.

Plot size : 1½ acres.

Sampling lay-out : nine, 6′×6′ plots distributed regularly around 4 trees in the centre of each plot.

Planting material : PB 86.

Year of planting : 1946 and 1947.

Period of experiment and dates of application : The first rounds of all treatments were applied between 8th and 17th May. Applications to treatment D were stopped on 12th June. A Mistral III AB machine was used for spraying, and a C.C.C. "Noidium" machine was used for dusting. The experiment was ended on 28th August.

Treatment details :

Treatment	Form of application	Dosage of metallic copper per acre per round (lb)	Amount of spray or dust applied per acre per round	Number of rounds of application	Interval between applications	Total dosage of metallic copper applied per acre (lb)	Cost of treatment per acre*
A. Copper Sandoz	Dust	0·4	10 lb	16	1 week	6·4	Rs. 64·64
B. Blendox	Dust	0·4	10 lb	16	1 week	6·4	Rs. 65·28
C. Oxycar	Dust	0·4	10 lb	16	1 week	6·4	Rs. 74·56
D. Ciba 1%	Dust	0·1	10 lb	4	2 weeks	0·4	Rs. 25·28
E. Lovo-Copper	Spray	3·0	3 gal	1	—	3·0	Rs. 23·70
F. Coprantol	Spray	3·0	3 gal	1	—	3·0	Rs. 20·00
G. Fycol	Spray	3·0	3 gal	1	—	3·0	Rs. 40·96
H. Untreated	—	—	—	—	—	—	—

*Assuming an application cost of dusting of -/96 cents per round for dusting by 10-14 yard swaths, and Rs. 3/50 per acre for spraying by 5-7 yard swaths.

Summary of Results

Treatment	Average number of leaves fallen per square yard		% Leaf-Fall	
	Due to wind	Due to *Phytophthora*	Due to wind	Due to *Phytophthora*
A. Copper Sandoz	49·0	0·37*	7·37	0·055*
B. Blendox	46·0	0·08*	6·92	0·013*
C. Oxycar	42·8	0·24*	6·43	0·043*
D. Ciba 1%	41·9	1·96†	6·30	0·298†
E. Lovo-Copper	41·6	0·53*	6·25	0·078*
F. Coprantol	48·7	1·95†	7·32	0·285†
G. Fycol	48·9	2·11†**	7·37	0·320†**
H. Untreated Control	44·1	4·24	6·63	0·580
	L.S.D. (5%) :	2·34	L.S.D. (5%) :	0·341

*Significantly less Leaf-Fall than on the untreated control.

**This treatment may have been affected by rain falling on the deposits before they had dried (2·1).

†Leaf-Fall not significantly less than on the untreated control.

It was clear that similar experiments should be repeated in 1963 in order to assess the control performances of spraying and dusting. However, a broader, and more important issue was that the incidence of *Phytophthora* Leaf-Fall has been too mild to permit conclusive control experiments in 1960 and 1961, as well as in 1962. In view of the sporadicity of the disease, experiments may have to be repeated for several years before conclusive results can be obtained. Moreover, as the disease is sporadic, it would clearly be of utmost practical importance to determine whether the high costs of controlling trivial infections in a preponderance of ' good ' years are justified by any economic gains due to control of the ' severe ' attack in the occasional ' bad ' year. For this purpose, detailed long-term trials should be carried out in areas of PB 86 which comprise replicated plots that will be sprayed, dusted, and untreated, respectively, for comparisons of yields and Bark Rot incidence.

4.2. Bark Rot assessments.—It was found that Bark Rot can occur and increase under conditions where Leaf-Fall has been virtually absent. This has been demonstrated by the results of experiments carried out by the Plant Pathologist on Malaboda Estate on the same areas used for the Leaf-Fall control trials, and where *Phytophthora* Leaf-Fall had been almost nil (Table VIII). In spite of this, and in spite of various experimental treatments, Bark Rot occurred and increased between August and November 1962 (Table IX).

While the over-all scale of infection of Bark Rot was mild as compared with a ' bad ' year, there was little doubt that incidence even on the above scale was severe enough to be of practical importance.

A similar relationship between Bark Rot and Leaf-Fall intensities was observed on Ellakande Estate where almost all the trees on one PB 86 planting had Bark Rot, and had to be scraped. By comparison, the loss of leaves due to *Phytophthora* was hardly likely to have been more than 10-20% at the most. This area had also been sprayed and dusted intensively.

Both these cases suggested that the course of Bark Rot was not influenced by spraying and dusting measures.

TABLE IX

Incidence of Bark Rot on some PB 86 plantings of Malaboda Estate in 1962

Planting	Total number of tapping blocks	Total number of trees	Percentage number of Bark Rot cases on 15/8/62	Percentage number of Bark Rot cases on 9/11/62	Percentage number of Bark Rot cases on the tapping block most infected on 9/11/62	
					15/8/62	9/11/62
PB 86 (1951)	7	1684	4·0	8·4	6·5	13·5
PB 86 (1952)	7	1510	3·3	11·2	6·3	23·6
PB 86 (1953)	16	3757	2·7	10·6	2·4	49·2

4.3. Rainguard assessments.—This Unit has been associated with a trial on Culloden Estate which was designed to assess the effect of polythene rainguards on Bark Rot incidence. The experiment has been concluded but the data have not yet been analysed.

5. OPERATIONAL RESEARCH

5.1. Time-and-motion studies were made of dusting on estates. These were supported by chemical assessments to determine distributions of fungicide deposits following routine applications. The most important conclusions reached were as follows:

(*a*) Dusting was not carried out systematically enough to ensure adequate initial coverage. Swaths in general use varied in width between 20 and 100 yards (4 to 16 rows). Leaf analysis showed that dusts were seldom recovered beyond a distance of 8-10 yards from the source of the dust, or above a height of 30-40 feet. Large areas were therefore left unprotected.

(*b*) Poor distributions of dust may have been due partly to the fact that dusting on most estates was performed too late in the day, when deposition may be reduced by turbulence.

(*c*) Dusting was not carried out regularly enough to maintain deposits. This is hardly a criticism of management by planters for there is no doubt that it may be virtually impossible to maintain a sufficient deposit under the persistent rainfall that favours *Phytophthora*. Even in 1962, which was a mild *Phytophthora* season, one area was observed that had been dusted regularly with an over-all dosage of 39 lb of 4% dust per acre, and had an attack of Leaf-Fall within 3 days of the previous dust application. The amount of Leaf-Fall was about 7% according to counts; this was not large but it suggested that the dusting had failed because few estates, dusted or undusted, were seen in Kalutara District in 1962 which had as much Leaf-Fall on any extent, other than individual trees or small groups of trees. In this case, lack of rainfastness as well as insufficient initial coverage may have been jointly contributory.

(*d*) It was clear that the terrain on some estates is too steep and rocky to permit spraying by swath widths of 5-7 yards, or dusting by swath widths of 10-14 yards. Under these circumstances, it is doubtful whether spraying or dusting from the ground would be practicable, even where it is physically possible, especially when assessed in relation to costs and probable effectiveness.

6. EPIDEMIOLOGY AND ECONOMICS OF PHYTOPHTHORA

6.1. Cost and scale of Leaf-Fall control.—It was essential to know what was the economic worth of *Phytophthora* Leaf-Fall in order to assess how much it would be justifiable to spend on its control. It was also important to know how frequently the disease occurred and how extensively it was distributed for these would influence design of method as well as over-all costs of application. Attempts have been made to resolve these issues using such evidence as has been available.

The distribution and extent of *Phytophthora* in Ceylon as shown by the control measures undertaken have been assessed in respect of estates of over 100 acres in extent. It had been gathered that few estates smaller than 100 acres either bothered or could afford to control Leaf-Fall and Bark Rot. Estimates based on information from the larger estates were therefore assumed to be representative of the total distribution and extent of control measures. Data were supplied by 160 estates in response to a *Phytophthora* Control Questionnaire, and these were used as a basis for estimation.

The assessment confirmed that *Phytophthora* is confined to the planting districts of Kalutara, Kelani Valley, Kegalle, Galle and Ratnapura. Kegalle appeared to be a marginal district with regard to incidence of *Phytophthora* while in Ratnapura and Western Kalutara Districts there were a number of estates that controlled Bark Rot but not Leaf-Fall. *This implied that Bark Rot was important on areas where Leaf-Fall presumably did not occur, or if it occurred it was not important enough to control.*

The over-all scale of control of *Phytophthora* in Ceylon during the period 1957-1961 was worked out from 149 Questionnaires received from Kalutara, Kelani Valley, Kegalle, Galle, Ratnapura and Kurunegala (Table X)

TABLE X

Estimates of scale of Phytophthora control measures in Ceylon.

	1957	1958	1959	1960	1961
Acres of mature rubber dusted	13,865	21,568	30,812	48,785	51,353
Acres of immature rubber dusted	2,302	3,325	6,139	8,313	12,789
Total weight of fungicide dust used (tons)	160	245	501	991	1,166
Acres treated for Bark Rot	38,194	43,045	49,713	55,776	60,626

Costs of estate dusting have also been estimated from the information returned (Table XI).

TABLE XI

Cost of dusting for Phytophthora control on the estates. These have assumed an average dust cost of 0.33 cents per lb., and an application cost of 0.60 cents per acre per round assuming also that 40 acres per day were dusted on an average.

Dosage of 4% copper dust used (lb/acre)	Average dosage used as assumed for costing (lb/acre)	Average cost of dust per acre (Rs./cts.)	Percentage of all the dusted acreage receiving the dosage shown	Cumulative percentage of the dusted acreages	Approximate acre-cost of dusting including application (Rs./cts.)	Estimated number of dusting rounds
10	7½	2·48	10·4	10·4	3·08	1
11–20	15	4·95	9·2	19·6	6·15	2
21–30	25	8·25	11·7	31·3	10·05	3
31–40	35	11·55	15·5	46·8	14·55	5
41–50	45	14·85	17·9	64·7	18·45	6
51–60	55	18·15	17·2	81·9	22·35	7
61–70	65	21·45	8·0	89·9	26·85	9
71–80	75	24·75	1·5	91·4	30·75	10
81–90	85	28·05	2·7	94·1	34·65	11
91–100	95	31·35	3·7	97·8	39·15	13
101–110	105	34·65	0·1	97·9	43·05	14
111–140	125	41·25	2·0	99·9	50·85	16

More than 80% of the dusted acreage was estimated to be treated at a cost not exceeding Rs. 22.35 and the median cost of dusting was actually Rs. 14.50 an acre. This cost had to be related to scale of application in order to assume economic significance and to assess its value in terms of crop losses avoided. The over-all area dusted in 1961 was estimated to be 64,000 acres so that the cost of dusting for *Phytophthora* Leaf-Fall to the industry was about Rs. 928,000/-.

The data made available by estates were analyzed in order to determine how extensively individual estates were dusted (Table XII).

TABLE XII

Percentage distribution of estates showing the percentage of individual estate areas that are dusted in relation to the sizes of the estates.

Percentage of estate area dusted	Estate area (acres)							Total
	100	100-200	200-500	500-1,000	1,000-2,000	2,000-4,000	4,000	
1–10	0	0	3·7	3·7	1·9	0	0	9·3
11–20	0·9	0·9	8·3	4·6	4·6	0	0·9	20·2
21–30	0	0	5·6	3·7	3·7	1·9	0	14·9
31–40	0	2·8	2·8	6·5	3·7	0·9	0	16·7
41–50	0	0	1·9	6·5	7·4	0	0	15·8
51–60	0	0	0·9	8·3	1·9	0·9	0	12·0
61–70	0	0	0	0	0	0	0	0
71–80	0·9	0·9	0	0·9	1·9	0	0·9	5·5
81–90	0	0	0	1·9	0·9	0	0	2·8
91–100	0	0	1·9	0·9	0	0	0	2·8
TOTAL	1·8	4·6	25·1	37·0	26·0	3·7	1·8	100·0

The conclusion from this was that few estates smaller than 200 acres do any dusting and of those estates that do dust the proportion of the area dusted is generally between 10% and 50%. The applications are therefore patchy, and presumably are directed mainly at the high-yielding rubber. In spite of the fact that only parts of most estates are dusted the acreage that is dusted on individual estates is often quite large (Table XIII) and clearly impose heavy control requirements.

TABLE XIII

A breakdown analysis of the total acreage dusted according to the acreage actually dusted per estate.

Acres dusted per estate	Total acres dusted	Percentage of total acres dusted
49	834	1·3
50–99	2,373	3·7
100–149	3,207	5·0
150–199	2,245	3·5
200–299	5,837	9·1
300–399	8,787	13·7
400–499	7,954	12·4
500	32,904	51·3
TOTAL	64,142	100·0

In view of the fact that a large proportion of the dusted acreage comprises the largest estate-units it is conceivable that spraying by helicopter would be feasible in spite of the patchy distribution of rubber requiring spraying. However, spraying by helicopter would cost at least Rs. 40/- an acre, or more than double the average cost of current control measures. It is doubtful that helicopter spraying would be justified unless its technical superiority and economic advantages would be great enough to warrant the extra costs. This emphasizes the importance of knowing the economic worth of the disease. It has to be borne in mind, however, that if the disease proved to be important enough to warrant helicopters there would still be left a need to find a ground method suitable for the estates that are too small to be dealt with by helicopter. Even with the ground method, however, the economics of disease must be known in order to know how much expenditure is justifiable with regard to the cost of formulations that have to be used and the number of application rounds that have to be carried out.

6.2. Epidemiology of Abnormal Leaf-Fall and Bark Rot.—Judging from the acreages dusted for Leaf-Fall control between 1957 and 1961 there appeared to be a steep year-by-year increase in the extent and severity of the disease (Table X). However, epidemiological evidence of Leaf-Fall in Ceylon since 1922 has indicated that the frequency and intensity of attack followed much the same course between 1957 and 1961 as it had in previous years. By the same evidence, Bark Rot has always seemed to have been rather more of a perennial problem than Leaf-Fall. Even in 1957 Bark Rot was being treated on a much larger area than Leaf-Fall (Table X) but the steep increase in Leaf-Fall control measures resulted in there being little differences between the scale of both operations by 1961. While available evidence has failed to confirm that there has been a real increase of Leaf-Fall in recent years there seems to be little doubt that Bark Rot has become a more extensive disease. Presumably, this has been due to the fact that a large proportion of the high-yielding rubber that has been brought into tapping since the mid-1950's has been Clone PB 86 which is highly susceptible to Bark Rot in Ceylon. This has been tested by statistical analysis which established a strong correlation between the extent of Bark Rot control from 1957 to 1961 and the areas of high-yielding rubber brought into tapping in the period 1956-1961. The increase in Bark Rot or the increase in area of Bark Rot-susceptible rubber may have accounted for the steep increase in dusting. This has been suggested by evidence of a wide belief amongst planters that dusting of the canopy assists control of Bark Rot by reducing the *Phytophthora* inoculum. There has been no evidence of this result and indeed, the practical experience of 1959 and 1961 has been that estates which dusted extensively still suffered severe Bark Rot attacks later in the year, and in spite of mild Leaf-Fall in 1961.

6.3. The economic importance of Phytophthora Leaf-Fall.—An extensive search has been made to compile evidence of the economic effects of *Phytophthora* Leaf-Fall on *Hevea* in Ceylon. Archives of the Rubber Research Board, reports, *Phytophthora* Questionnaires, and various estates records have been consulted but no evidence has been obtained to suggest that *Phytophthora* Leaf-Fall has ever caused yield losses or crop damage in Ceylon. The possible explanation for this is that assessments of severity of the disease in Ceylon may have been exaggerated, and that in actual fact the disease has, perhaps, never occurred severely enough to affect yields significantly. Some proof has been obtained in support of this conclusion. For instance, it has been recorded that a severe outbreak of *Phytophthora* Leaf-Fall occurred in 1935 in the Kalutara District. Another severe attack was reported to occur in 1936 which caused a " loss of leaves amounting to 25-50% on most estates in Kalutara ". There was no mention of attack in 1934 or 1937. It has been assumed that the crop in the Kalutara District in the mid-1930's must have been suffering from the effects of poor control of *Oidium* disease,

and that it would have been in a low enough condition to register a yield loss following two consecutive years of "severe" Leaf-Fall. However, the yields for the Kalutara District for the years 1934, 1935, 1936 and 1937 showed no significant differences (Table XIV) to indicate that the disease had depressed yields.

TABLE XIV

Average yields of Kalutara District for the years 1934, 1935, 1936 and 1937.

Year	Size of holdings		
	over 100 acres	10-100 acres	Less than 10 acres
1934	531	498	351
1935	532	409	335
1936	537	413	407
1937	534	410	353

It has been alleged by some planters that *Phytophthora* Leaf-Fall does lower yields in Ceylon and not in the year of attack but a year or so afterwards. This was not borne out when the yields for 1935 (Table XIV) were compared statistically with the other years. Moreover, yield trials in India, where the disease is more severe, have shown that Leaf-Fall causes a yield loss of 40% and more in the year of the attack. The extent of Leaf-Fall causing this loss was not specified. However, it has been recorded that in India a *Phytophthora* Leaf-Fall of 25% is regarded as mild and unlikely to have an adverse effect on the crop. In contrast, counts of Leaf-Fall recorded in experiments in Ceylon since 1958 have indicated that a Leaf-Fall of as much as 25% seldom occurs to any extent and is generally of the order of 1-10%. The cases of Leaf-Fall where isolated trees and patches of trees may lose 50-90% of the leaves seem to be such a small proportion of the over-all area that any fluctuations in their yield would probably be insignificant in relation to over-all yields.

In the light of these and similar assessments it has been concluded provisionally that *Phytophthora* Leaf-Fall in Ceylon is not economically important enough to warrant control on the present large scale. This endorses similar conclusions reached by Stoughton-Harris in 1926, by Murray in 1931 and by Young in 1955. This has an important bearing on the form of any control method still required and clearly confirms that aerial spraying does not seem justified. Some estates may have small areas, however, that perennially suffer severe attack of *Phytophthora* Leaf-Fall and which would justify control measures. It is unlikely that the problem will be solved soon or in the future by new machines that are better than those available. The solution, if any, therefore depends as much on economics as on technical improvements, and further research on control of *Phytophthora* Leaf-Fall in Ceylon should be directed accordingly.

7. PUBLICATIONS

A detailed account of this work is being prepared for publication as a Bulletin of the Rubber Research Institute of Ceylon.

REVIEW OF THE SOILS DEPARTMENT

By

A. J. Jeevaratnam

SUMMARY

Advisory Work

The advisory work handled by the Department was mainly concerned with the following subjects : Occurrence of deficiency symptoms in the field, backward growth of immature replantings, poor yields from mature plantings, manuring policies in relation to wind damage, cover crops, cultivation practices and weed control.

Several instances of magnesium deficiency on both immature and mature areas and two instances of potassium deficiency in mature areas, were diagnosed and confirmed by foliar analysis. Special fertilizer recommendations were made for remedial treatment.

Discolouration of foliage on only some of the branches of plants was reported in a 1959 replanting of clone PB 86 on one estate. Visual examination of the condition indicated that the discolouration may be either due to a pathological condition such as infection by *Fomes* or perhaps due to magnesium deficiency. A thorough examination of the affected plants by officers of the Plant Pathology Department and chemical analysis of leaf samples failed to confirm the visual diagnosis. Chemical analysis of discoloured leaves indicated that the levels of the three major nutrients, nitrogen phosphorous and potassium were all low, the level of potassium being markedly so. Further investigations are in progress.

Two questionnaires, one on backward growth and the other on poor yields, were prepared and sent to estates that sought advice on these subjects. This procedure reduced the number of visits that had to be made for giving proper advice.

In view of the fact that wind damage losses on commercial estates have been alarmingly high during the period under review, there were a spate of enquiries on manuring policy in relation to wind damage. In order to have a correct perspective of this subject, an article on the subject of nutrition and wind damage was prepared for publication in the Institute's Quarterly Journal. Evidence available so far, mostly from Malaya, on the influence of different major nutrients on wind damage is not absolutely clear, but it is definitely known that certain clones like LCB 1320 are more susceptible to wind damage than others. In view of this a reduction, by half, in the nitrogen content of the fertilizer mixture has been tentatively recommended as a precautionary measure for clones and areas known to be susceptible to wind damage.

Since there has been definite evidence from field experiments, that cultivation practices connected with the use of cover crops could influence growth and yield to a greater extent than even manuring, the importance of establishing and maintaining leguminous cover crops, preferably a pure stand of *Pueraria phaseoloides* and of mulching the clean weeded strips with loppings of *Pueraria* was emphasized in the course of the advisory work on cover crops.

Requests for advice on the use of herbicides for weed eradication registered an increase.

Fertilizer Recommendations

The establishment of an advisory service, for purposes of recommending special fertilizer mixtures, whenever necessary, based on the examination and analysis of soil, leaf and latex samples, which was envisaged in the programme of work of the Soils Department for 1962 was implemented only on a restricted scale. Occurrence of deficiency symptoms in the field or of backward growth in immature areas and poor yields from mature areas which were brought to the notice of the Institute, were investigated on this basis and given special recommendations.

General recommendations for fertilizer applications continue to be based on the results of field experiments.

Changes in fertilizer recommendations have been made tentatively, as given below, based on the early results from field experiments designed to study the response of rubber in tapping to fertilizer applications, and as a precautionary measure to reduce losses of rubber trees due to wind damage.

1. A reduction in the level of NPK or NPK+Mg fertilizer application to rubber in tapping from 3 to 4 lb of the mixture per tree per year to 2 lb per tree per year during the first tapping cycle and to 1½ lb per tree per year thereafter.

2. A reduction in the level of nitrogen manuring for clones and areas definitely known to be susceptible to wind damage. This may be effected by reducing the nitrogen content of the fertilizer mixture by half or by reducing the annual application of NPK mixture by half and supplying only the phosphate content of the other half in separate applications.

It should be emphasized that these recommendations are strictly provisional and may need further revision in the light of the long-term effect of lower levels of manuring on rubber in tapping, the results of which will be forthcoming in course of time.

Recommendations to apply crushed dolomite as a source of magnesium for rubber has not been withdrawn from the recommendations of the Institute as results from field experiments did not support the claim made by certain planting circles that dolomite, as a source of magnesium, has a depressing effect on the growth of *Hevea* or that it results in an increased incidence of *Gloeosporium* in the foliage.

Research Investigations

Laboratory work was mainly confined to analysis of leaf samples from experimental areas.

Studies on the variations in the mineral content of leaf and latex samples of different clones, sampled at different times of the year, will be included in the report on the applicability of the technique of " Diagnostic Physiologique " under Ceylon conditions. This report will be prepared early in 1963.

Variations in the mineral content of leaves as influenced by application of the major nutrients alone and in combinations were investigated.

Of the major nutrients only the application of potassium, alone and in combination with phosphorus, resulted in significant increased levels of potassium in the leaves.

Magnesium applied as dolomite compared with magnesium applied as $MgSO_4$ resulted in an increased level of magnesium in the leaves, which effect was statistically significant at the 5% level. The application of dolomite also resulted in a reduction in the level of copper.

Field Experiments

With the appointment of a Research Assistant in Statistics to the staff of the Institute, who assumed duties on 1st May 1962, field experiments for determining responses of *Hevea* to different fertilizer treatments and cultivation practices have been increased. Two new trials were laid down during the period under review and preliminary work in connexion with two others have been completed.

The results from field experiments in progress are grouped and reported according to age of the planting material, which is a deviation from previous procedure.

Seedling Nursery and Planting-hole applications

Application of different fertilizer treatments to seedlings in nurseries gave the following responses in growth :

1. Fertilizer treatments NP, NK and NPK were significantly better than the control, of which, treatment NP was the best.

2. Addition of magnesium to the fertilizer treatments resulted in better growth, significant at the 1% level.

Preliminary results from an experiment on the application of different fertilizer treatments to the planting hole prior to planting suggest that the application of a balanced mixture of inorganic fertilizers like R.4 : 6 : 2+Mg or animal meal (analysing 7% N, 10% P_2O_5, 5% K_2O) is more beneficial than the application of phosphate as rock phosphate only. There was no difference in efficiency between the inorganic fertilizer mixture and the organic manure tested.

Immature Hevea

Growth measurements recorded in terms of height of plants during the first year of growth (four months after planting) in one experimental area showed that applications of NP and NK combinations gave a significantly better growth than the control.

In another experimental area when growth measurements recorded in terms of height of plants during the first year of growth, was followed up with girth measurement records at the end of 2½ year's growth the results indicated that height measurement may not be a satisfactory criterion in evaluating growth response during the first year of growth. Application of nitrogen as urea which showed a significant beneficial effect in terms of height during the first year of growth showed absolutely no beneficial effect in terms of girth two and a half years from the time of planting, while the reverse was true in respect of application of a special R. 4 : 6 : 3+Mg mixture compounded with ammonium phosphate.

It appears that the poor girth increments recorded on plantings of Tjir 1 clonal seedlings in the Moneragala District cannot be attributed to a deficiency or inadequate applications of any of the major nutrients. Of two levels each of N P and K tested, only the second level of nitrogen, which is double the present level of application showed at least some beneficial effect on growth. The best average growth recorded in any single experimental plot was ten inches at the end of four years from the time of planting.

The influence of three different types of nitrogen, phosphorus and magnesium fertilizers on the growth of budded stumps of clone PB 86 measured in terms of girth at the end of one year's growth showed that only nitrogen applied as urea was significantly better than nitrogen applied as sodium nitrate. Nitrogen applied as urea was not significantly better than nitrogen applied as sulphate of ammonia.

Application of two different brands of complete concentrated fertilizers in pellet form, *viz.* " Sincat 14 : 14 : 5 : 3 and "Grannumix" 15 : 15 : 6 : 3 in quantities equivalent in nutrient content to the normal applications of standard R 4 : 6 : 2+ Mg failed to show any significant beneficial effect on growth in terms of girth of budded stumps of clone PB 86 at the end of one year from the time of planting.

Since no information is available on the growth response of different clones of *Hevea* to manurial treatments, (*i.e.* the manurial clone interaction) preliminary work has been completed to lay down a long-term factorial experiment at the Institute's Sub-station at Kuruwita to study the effect of two levels each, of the major nutrients, nitrogen, phosphorus and potassium, on four clones.

Growth response of immature *Hevea* to different fertilizer treatments could be expected to vary to a greater extent according to the cover crop policies and cultivation practices adopted in different fields than due to any differences in soil. Girth recordings on 3½ year's old PB 86 plants in an experiment designed to study growth response to applications of three levels each of potassium and magnesium in conjunction with three cultivation treatments, *viz.*, no mulching, mulching with loppings of *Pueraria* and mulching with loppings of Guatemala grass, the whole experimental area receiving a basic application of nitrogen and phosphorus, gave the following results :

(*a*) Mulching with loppings of *Pueraria* gave a significant beneficial effect on growth over no mulching, whereas mulching with loppings of Guatemala grass showed no beneficial effect.

(*b*) There were no significant responses to applications of different levels of potassium or magnesium, in spite of the fact that loppings of Guatemala grass are known to have a low magnesium content.

(*c*) The interaction between potassium applications and mulching was almost significant at the 5% level.

The reasons for the absence of any response to mulching with Guatemala grass may be due to the competition of the Guatemala grass with *Hevea* plants, brought about by the grass being planted too close to the planting rows or due to the temporary locking up of the major nutrients, nitrogen and phosphorus during the process of decomposition. These aspects are under investigation in two further experiments that have been laid down at the Institute's Sub-station at Kuruwita.

An experiment to study the role of nutrition on the incidence of wind damage of immature plants of clone LCB 1320 has been laid down in an area replanted in 1957 on a commercial estate, where losses due to wind damage have been experienced.

Mature Rubber

An experiment, that is in progress at the Institute's experimental station at Hedigalla, designed to study yield response to five fertilizer treatment combinations on four types of planting material, gave the following results :

Yields recorded during the third and fourth years of tapping, which coincide with the third and fourth years from the time the new fertilizer treatments were applied, did not show any significant differences in yield between fertilizer treatments, whereas the clones tested have been significantly different in their yielding capacities right from the time of commencement of tapping. It is also of interest to record that all clones tested responded to fertilizer treatments in a similar manner.

Investigations on the response of mature rubber in terms of yield to different manurial and cultivation treatments on areas that had received the basic recommended complete NPK mixture during immaturity have not been undertaken in the past.

Preliminary work has now been completed to lay down several experiments on plantings of mature rubber in order to get more information on the response of mature rubber to different fertilizer treatments.

A field of clone PB 86 in a commercial estate that has not received any fertilizer applications during the past ten years has been selected for field experimentation. Yield data prior to the application of treatments are now being collected.

One experiment is already under way for obtaining information on the best time for application of fertilizers to mature rubber.

The applicability of the Technique of "Diagnostic Physiologique" in Ceylon

The results from several experiments that have been in progress to test the response of immature and mature plantings of *Hevea* to fertilizer applications according to Physiological Diagnosis, are not included in this review, but will form the subject of a separate report that will be prepared early in 1963.

Soil Survey

No progress was made on the programme for a soil survey of areas that are already under *Hevea* since efforts to appoint an officer to undertake this work did not materialise till very late in the year.

Cover Crops. Several estates applied for and received rhizobial cultures for purposes of inoculating cover crop seeds. The cultures were maintained and multiplied by the Soils Department and issued to estates by the Institute, free of cost. This work was handed over to the Plant Pathology Department from November 1962.

Weed Control

Investigations on the use of herbicides for weed control in rubber estates were actively pursued during the period under review. Weed control in nurseries and in mature rubber areas were two aspects of the problem that were investigated.

It was found that weed control in nurseries could be successfully achieved by spraying the pre-emergence herbicide, Diuron, at the rate of 1 lb per acre in combination with the new contact herbicide, Paraquat, at the rate of 0.1 lb per acre.

For the successful eradication of weeds in mature areas, where sodium arsenite cannot be used, a mixture of herbicides has been found to be very effective.

Observations made during the course of these trials served to focus attention on the necessity to establish desirable species of cover crops in areas where weeds are eradicated by the use of herbicides or by manual weeding. If this cannot be done, there may be hardly any purpose served in the complete eradication of weeds. Partial eradication may be adequate.

Meteorology

A summary of the meteorological observations at Dartonfield for the year 1962 is published at the end of this review.

DETAILED REVIEW

1. GENERAL

1.1. Staff.—The Soils Chemist was on duty during the year. Mr. R. S. John, B.Sc. Ag. (Ceylon) was appointed as Research Assistant to the Soils Department with effect from 20th March 1962.

Mr. Camillus Silva, B.Sc. (Ceylon), M.S. (Hawaii) was appointed as Assistant Soils Chemist on probation with effect from 1st December 1962.

The cadre as at the end of 1962 was as follows :

Soils Chemist	...	1
Assistant Soils Chemist	...	1
Research Assistant	...	1
Senior Technical Assistant	...	1
Technical Assistants	...	5
Field Assistants	...	2
Laboratory Attendants	...	3
Field Attendants	...	2

1.2. Advisory Work.—The advisory function of the Department continued to entail a good proportion of the working time of the Soils Chemist. Estates sought advice on varied subjects such as mineral deficiencies in the field, backward growth of immature replantings, poor yields from mature budded areas, wind damage, cover crop policies, and weed control.

Due to the large number of requests for advice on backward growth of immature replantings and poor yields from mature budded areas, two questionnaires were prepared and sent to estates which sought advice on these subjects. This reduced the number of visits that had to be made for giving proper advice on these problems.

The high incidence of wind damage on commercial estates during the period under review called for special attention. Investigations revealed that wind damage in the form of branch breakage and trunk snap was confined, in the main, to certain susceptible clones like LCB 1320, and to restricted areas that experienced

severe gale force winds. In addition to this, it was realised that a large number of trees were lost by uprooting, irrespective of differences in clones, even during spells of minor gale force winds.

Though the differences in the nature of the wind damage indicated that the causes for such damage could vary significantly, the influence of nutrition on wind damage was questioned, perhaps due to the fact that work carried out in Malaya indicated a significant effect of nitrogen on wood strength, high nitrogen resulting in weaker wood. Due to the conflicting nature of the evidence available on this subject, an experiment was laid down to study the effect of different levels of nitrogen, phosphorus and potassium on wood strength and on the incidence of wind damage in an immature area of LCB 1320.

In the meantime, as an interim measure, based on some results that became available on the manurial responses of mature budded rubber, it was decided to recommend a general reduction in the level of manuring of all mature rubber areas, from 3-4 lb of an NPK or NPK+Mg mixture per tree per year to 2 lb per tree per year during the first tapping cycle and to 1½ lb per tree per year thereafter. In addition to this a further reduction in nitrogen manuring was recommended for certain clones and areas that were definitely known to be susceptible to wind damage, irrespective of age.

Several instances of magnesium deficiency were reported which were confirmed by analysis of leaf samples. It was noticed that the deficiency was more severe in replantings that showed a rate of growth which was above average, inspite of the fact that NPK+2Mg fertilizer mixture was being applied. The deficiency did not appear to have a depressing effect on the rate of growth of plants. Since results from experiments on the application of dolomite as a source of magnesium did not support the claim made in certain circles that dolomite had a depressing effect on the growth of rubber plants, the recommendation to apply dolomite as a source of magnesium for rubber was not withdrawn from the Institute's recommendations.

There were two instances of severe potassium deficiency on mature areas which were reported and confirmed. It was not possible to ascertain whether this potassium deficiency had a depressing effect on growth or yield.

There was one instance where discolouration of foliage in the field was reported which on inspection indicated a pathological condition such as an attack by *Fomes lignosus*. However a thorough examination of the root system failed to reveal any *Fomes* infection. An investigation into this condition will be taken up in 1963.

The establishment of an advisory service based on the laboratory examination of soil, leaf and latex samples for making fertilizer recommendations, on a field basis, to estates desirous of availing of such a service, which was envisaged in the research programme for 1962, was not implemented pending a reappraisal of the practical implications of such a service.

Forty-eight leaf samples, 4 latex samples and 31 soil samples were analysed in connexion with advisory work.

1.3. Correspondence

		Inward	Outward
Technical	...	521	374

1.4. Visits

	Soils Chemist	*Research Assistant*	*Senior Technical Assistant*	*Technical Assistants*
Advisory	21	—	1	—
Experiments on Institute's experimental Stations	14	—	44	40
Experiments on outside estates	23	4	1	8
Miscellaneous ...	17	—	3	11

1.5. Meetings

Fertilizer Act Committee Meetings ...	20/1, 26/2.
Soil Survey Seminar	22/1, 23/1
Soil Conservation Society...	16/3, 31/8, 16 & 17/11*
Ceylon Association for the Advancement of Science	21/11 to 24/11.**

*The Soils Chemist presented a paper on, " Conservation of water and Soil Resources in the cultivation of *Hevea* ", at the Symposium on the Conservation and Utilization of Natural Resources organised by the Soil Conservation Society of Ceylon.

**A paper on " Laterite in relation to Ceylon Agriculture " was presented at the Symposium on Laterite organised by the Section B of the Ceylon Association for the Advancement of Science at the 18th Annual Session.

1.6. Publications

(*a*) Annual Review of the Soils Department for 1961.

(*b*) Use of Herbicides for Weed Control in Seedling Nurseries. (Preliminary Report) *Rubb. Res. Inst. Ceylon. Quart. J.* 38. Parts 1 & 2 (1962) 11-12.

(*c*) Manuring and Wind Damage. *Rubb. Res. Inst. Ceylon. Quart. J.* 38 Parts 3 & 4 (1962) 62-66.

(*d*) Contributions to Question Corner of *Rubb. Res. Inst. Ceylon. Quart. J.* 38, Parts 1 & 2, (1962) 26 ; 38, Parts 3 & 4 (1962) 88-89.

2. LABORATORY WORK

Bulk of the laboratory work was devoted to analysis of leaf samples, most of which were collected from the ' DP ' experimental areas for determining fertilizer requirements. Others were collected in connexion with investigations on variation in mineral content due to differences in planting material, differences in time of sampling during the year, and due to different fertilizer treatments.

Analysis of latex samples was carried out from certain areas, whereas, routine analysis of soil samples was curtailed considerably.

In all 480 leaf samples, 120 latex samples and 31 soil samples were analysed.

2.1. Variations in mineral content of leaves and latex.—Leaf and latex samples from marked trees of different clones collected at different times of the year have been chemically analysed, so as to study the variations in mineral content of different clones at different times of sampling.

The results of these investigations will be included in the report on the applicability of the technique of Physiological Diagnosis in Ceylon to be prepared early in 1963.

2.2. Variations in mineral content of leaves as influenced by the major nutrients applied alone and in combinations. Leaf samples, collected from plants in the experimental plots receiving different fertilizer applications in the 2^3 NPK factorial experiment with magesium as commercial Epsom Salts and as dolomite on split plots, after two applications of the different fertilizer treatments were chemically analysed for their N,P,K, Ca, Mg, Mn and Cu contents.

The results showed that

(*a*) application of potassium alone and in combination with phosphorus increased the level of potassium in the leaves which was significant at 1%.

(*b*) Application of magnesium as dolomite increased the level of magnesium and reduced the level of copper in the leaves which effects were again statistically significant at 5%.

(*c*) Application of P alone or in combination with N and K did not show any significant increase or decrease in the levels of N, P or K or any other elements in the leaves.

2.3. Soil Investigations.—The Research Assistant has commenced investigations on the following projects.

(*a*) The behaviour of different sources of magnesium when applied to soils.

Investigations to study changes in the exchangeable magnesium content of soils on addition of magnesium as calcined magnesite, commercial Epsom Salts and dolomitic limestone are in progress.

(*b*) Availability of potassium in different soils.

Since it is believed that the availability of potassium can vary widely in different soils encountered in the rubber growing districts, preliminary investigations have been commenced by the Research Assistant to fractionate-potassium in a micaceous soil and a red and yellow podzolic soil containing ferralitic material, by chemical methods.

3. FIELD EXPERIMENTS

There were ten field experiments in progress at the beginning of the year. Two experiments were commenced during the year and preliminary work has been completed to lay down two more trials. In addition, the field experiments laid down to investigate the effectiveness of fertilizer applications according to physiological diagnosis were also in progress. A separate report on the latter experiments will be prepared early in 1963.

The results from the field experiments are grouped and reported according to age of the planting material in this year's review, which is a deviation from previous procedure.

3.1. Seedling Nursery

3.1.1. Manurial Trials

(*a*) Nursery Manurial Trial, Nivitigalakele 1960.

2^8 NPK Factorial Experiment with and without Mg as commercial Epsom Salts in sub-plots.

Girth measurements taken in June 1962 in the second nursery manurial trial that commenced in August 1960, indicated that treatments NP, NK and NPK gave significantly better growth than the control. Treatment K and PK showed a depressive effect which was not statistically significant. Addition of magnesium to the fertilizer treatments gave a beneficial effect that was significant at the 1% level.

Treatment NPK with magnesium as magnesium sulphate was not better than treatment NPK with magnesium as dolomite.

Manuring with animal meal (10% N, 7.5% P_2O_5, 5% K_2O) from August 1960 to June 1962 was not as good as manuring with the best inorganic fertilizer combination.

3.2. Planting-hole Applications

3.2.1. Manurial Trials

(a) Fertilizer applications to planting hole prior to planting — 1960 Replanting of clone PB 86 Gallawatte Estate — a randomized block experiment testing six treatments in four replicates.

A critical examination of the earlier observations recorded on the planting-hole experiment, and subsequent observations made at the later stages of growth of plants in the same area which is now considered as an experiment on immature rubber, reported under section 3.3.1. (c), indicate that the criteria used for determining the efficiency of applications of different fertilizer treatments to the planting-hole, should be restricted to observations at the initial stages of growth, such as the vigour of the bud shoot or surface area of matured leaves at different intervals after planting. It is likely that girth measurements recorded at the end of one year's growth, reported in last year's review, may not be the correct criterion for determining the efficiency of planting-hole applications. Since vigour of the bud-shoot can be influenced to a great extent by several other factors, such as the age and size of the seedling stock, age of the bud that has been budded and the period that lapses between budding and transplanting, not to mention the variation in treatment meted out to budded stumps during uprooting and planting operations, any experiment designed to study the differences between planting-hole applications will prove extremely difficult to evaluate.

It would appear that this aspect of the cultural operation, though important, is of less significance compared to other cultural operations that influence availability of moisture from the soil immediately after planting, etc.

However, for the present, it seems advisable to restrict our conclusions and state that the results from a preliminary investigation suggest that the planting-hole application of a balanced manure, either in the form of an inorganic mixture like R. 4 : 6 : 2+Mg or as animal meal with a composition of 7%N, 10% P_2O_5, 5% K_2O may be more beneficial than application of only phosphate as rock phosphate. There is no difference in efficiency between an inorganic fertilizer mixture and the organic manure tested.

3.3. Immature Rubber

3.3.1. Manurial Trials

(a) 2^3 NPK Factorial Experiment with magnesium as commercial Epsom salts and as dolomite on split plots. R.R.I.C. Sub-station, Kuruwita.

Date of Planting — June 1961.
Planting material — Clone PB 86.
Height measurements were recorded in September 1962.

In this experiment the incidence of *Fomes* has been particularly high. A census taken in December 1962 revealed that as much as 20% of the experimental plot trees (*i.e.* excluding guard rows) were affected by *Fomes*. Due to this high incidence of *Fomes*, the number of trees on which height measurements was recorded in each plot varied, and therefore statistical analysis was done on adjusted heights, by covariance. Treatments NP and PK showed significantly better growth than the control.

Application of magnesium as dolomite showed a beneficial effect on growth compared to application of magnesium as commercial Epsom salts, though this effect was not statistically significant. The latter result is reported to indicate that dolomite did not have a depressing effect on growth.

(*b*) 2^3 NPK Trial — (without the nil level)

Kumarawatte Group — Moneragala District.

Growth response of stumped Tjir 1 clonal seedlings to applications of 2 levels each of nitrogen, phosphorus and potassium.

Girth measurements recorded at the end of 1961 and 1962 have been statistically analysed and the results indicate that manuring with the second level of nitrogen, *i.e.* double the present level, could have a beneficial effect on growth (significant at the 10% level), whereas increased levels of phosphorus and potassium showed no beneficial effect.

The best average girth recorded in any single experimental plot was of the order of 10 inches, at the end of four years from the time of planting. It is, therefore, apparent that deficiency, in any, of the major nutrients is not one of the main causes for the poor rate of girthing generally experienced in the Moneragala District.

(*c*) Effect of continued application of nitrogen, phosphorus and different NPK mixtures on the growth of *Hevea*.

Randomized Block Experiment testing six treatments in four replicates. Area replanted in 1960 with clone PB 86 at Gallawatte Estate. (Former experiment on planting-hole application).

The experimental plots that were used for testing the efficiency of applications of different fertilizers to the planting-hole prior to planting, were made use of to obtain more information on the effect of continued applications of different fertilizers on the growth of budded stumps of clone PB 86 during the period of immaturity.

Six treatments were tested in an experiment of randomized block design of four replicates. The treatments were control, phosphorus as Rock Phosphate, nitrogen as urea, and three NPK mixtures, *viz.* R . 4 : 6 : 3+Mg (standard mixture), R . 4 : 6 : 3+Mg (special mixture compounded with Ammonium phosphate) and a proprietary brand of animal meal analysing 7% N, 10% $P_2 O_5$ and 5% $K_2 O$.

Budded stumps planted on 29th April 1960 at which time the planting-hole applications were made were given two applications of 3 oz each of the different fertilizers on 18th July and 22nd October and height measurements were recorded on 18th January 1961. The treatment effects showed significance. Growth in height of plants that received applications of urea, and NPK mixtures as R. 4 : 6 : 3 (standard) and animal meal (7%N, 10% $P_2 O_5$ and 5% $K_2 O$) were significantly better than the control at the 5% level. Of these treatments, application of nitrogen as urea gave the highest increase in height. Thus, growth of immature *Hevea* in terms of height of the plant, was best with application of nitrogen as urea, and was poorest with application of phosphorus as rock phosphate. Application of special NPK mixture compounded with Ammonium phosphate was not as effective as applications of the standard NPK mixture or animal meal.

Three further applications, one of 4 oz and two of 8 oz each of the same fertilizers were given on 11th May 1961, 16th June 1962 and 11th October 1962 respectively. Girth measurements at a height 3 feet from the bud union were recorded at different intervals and finally in January 1963, after a period of 2 years and 9 months from the time of planting, and three months from the time of the final application of fertilizers. These results were statistically analysed when the NPK (special mixture) treatment showed a favourable effect on growth in terms of girth which was almost significant at the 5% level.

It is of interest to note that application of nitrogen as urea which showed significant beneficial effect on growth in terms of height in 1961 showed absolutely no beneficial effect on growth in terms of girth in 1962, while the reverse is true for treatment NPK special mixture.

On the basis of this information, one is tempted to draw the inference that growth in terms of height, which is often quoted as a good indication of growth during the first year is not a safe criterion in evaluating growth standards.

(*d*) Experiment to study the effect of nitrogen, phosphorus, and magnesium supplied by different fertilizers on the growth of *Hevea*. Nitrogen supplied as urea, sulphate of ammonia and sodium Nitrate. Phosphorus supplied as Saphos rock phosphate, ammonium phosphate and super phosphate. Magnesium supplied as commercial Epsom salts, Kieserite and Dolomite. Potassium was applied as muriate of potash to all treatments.

3 × 3 × 3 Factorial design. Gallawatte Estate.
Date of planting — June 1961.
Planting material — Clone PB 86.

Height measurements recorded at the end of one year's growth showed no significant differences between treatments, but girth measurements recorded showed that application of nitrogen as urea resulted in significantly better growth than application of nitrogen as sodium nitrate. Nitrogen applied as urea was not significantly better than sulphate of ammonia.

(*e*) Proprietary Fertilizer Comparison Trial.

This experiment was laid down in an area replanted in 1961 on Gallawatte Estate to test the efficiency of two brands of concentrated compound fertilizers compared with the inorganic fertilizer mixtures applied as R. 4 : 6 : 2+Mg or as determined by foliar diagnosis. The treatment intended to receive the inorganic fertilizer mixture as determined by foliar diagnosis was also given three applications of R. 4 : 6 : 2+Mg mixture as the plants were not big enough to carry out leaf sampling for foliar diagnosis. In the meantime a third brand of concentrated complete fertilizer was submitted for trial and, therefore, this was substituted in place of the treatment that was to receive the inorganic fertilizer mixture as determined by foliar diagnosis so as to restrict this trial to a comparison of three brands of concentrated complete fertilizers and the standard R. 4 : 6 : 2+Mg inorganic fertilizer mixture.

Girth measurements taken in July 1962 gave the indication that there was no significant difference in growth between the different treatments at the end of the first year's growth.

3.3.2. Manurial Clone Trials

(*a*) Experiment to investigate the effect of high and low potash mixtures on six clones. Randomized block experiment testing four treatments on six blocks, each block planted with a different clone.

Girth measurements recorded in January 1963 gave the following results.

Mean girth in inches of plants receiving different treatments

Treatment	*Mean girth in inches*	*Difference over R. 4 : 6 : 2*	*Significant Diff. (5%)*
R. 4 : 6 : 2	14.44		
R. 4 : 6 : 3	14.43	—0.01	
R. 4 : 6 : 5	14.16	—0.28	±0.735
R. 4 : 6 : 8	14.04	—0.38	

It will be noted that there is a tendency for the higher levels of potassium to have a depressing effect on the growth, though the depressing effect of the highest level of potassium applied was not statistically significant.

Mean Girth in inches of Different Clones

Clone	*Mean girth in inches*	*Difference over PB 86*
PB 86	12.23	
GT 1	14.64	+2.41
RRIC 28	14.91	+2.68
RRIC 45	15.04	+2.81
IRCI 2	14.52	+2.29
RRIM 605	14.26	+2.03

Of the clones tested clone RRIC 45 recorded the highest girth measurement whereas clone PB 86 recorded the lowest. The layout of the experiment does not permit the statistical evaluation of the differences in growth between clones, or of interactions between clones and fertilizer treatments.

(*b*) Preliminary work has been completed to lay down a 2^3 factorial experiment in an 8×8 latin square with four clones in split plots in an area to be replanted in 1963 at the R.R.I.C. Sub-station at Kuruwita.

The fertilizer treatments will be two levels each of nitrogen, phosphorus and potassium, without the nil level, which will be applied from the time of planting up to the time of commencement of tapping. The treatments have been arranged in such a manner that the treatments applied up to the time of tapping could be nullified and a fresh set of treatments applied to the same plots from the time of commencement of tapping so as to study the yield response to two levels each of N, P and K (including the nil level).

This arrangement will ensure that the growth response obtained during the period of immaturity does not influence yield response to treatments applied from the time of commencement of tapping.

A fundamental experiment of this nature was considered necessary to study the fertilizer responses of some of the promising RRIC clones during the period of immaturity and after commencement of tapping.

In an experiment of this nature it will also be possible to evaluate the interaction between fertilizer treatments and clones on a statistical basis.

3.3.3. Manurial-cum-cultivation treatments experiments

(*a*) $3 \times 3 \times 3$, K × Mg and cultivation treatments experiment with basic application of N and P.

Parambe Group. 1959 replanting of clone PB 86.

Girth measurements recorded at the end of 1961 and 1962 have been statistically analysed, and the results for 1962 are reported below :

Treatment		Mean girth in inches	Difference over the control	Sig. Difference
	levels			
K	0	11.67		±0.43 (5%)
	1	11.99	+0.32	
	2	11.87	+0.20	
Mg	0	11.82		
	1	11.89	+0.07	
	2	11.84	+0.02	
Mulching	0	11.70		
	1	12.21	+0.51	
	2	11.63	—0.07	

(i) Mulching with *Pueraria* loppings showed a significant beneficial effect on growth over no mulching, whereas, mulching with loppings of Guatemala grass had no beneficial effect.

(ii) Application of potassium at normal levels showed a beneficial effect, though not statistically significant at the 5% level, and the response to applications of the higher level of potassium is of a quadratic nature, which is again not significant.

(iii) Application of magnesium as commercial Epsom Salts did not influence growth in any way. Response to applications of different levels of magnesium showed a tendency to be of a quadratic nature, which again was not significant.

(iv) The interaction between application of potassium and mulching was almost significant at the 5% level.

(*b*) 3×3×3 N×P×Cultivation Treatment experiment with basic application of K and Mg.

(*c*) 3×3×3 K×Mg×Cultivation Treatment experiment with basic application of N and P.

R.R.I.C. Sub-station, Kuruwita.

These experiments have been laid down in a field of PB 86 replanted in 1961. The fertilizer applications have been made according to schedule. The mulching treatments were applied only after a year from the time of commencement of the experiment, due to the fact that the growth of *Pueraria* and Guatemala grass were not adequate for lopping to be carried out during the first year.

In view of this, no height or girth measurements have been recorded in the above experiment.

Towards the end of 1962 a further treatment was introduced in the above experiments in order to obtain some information on the differential response to mulching with loppings of Guatemala grass obtained from within and outside the experimental plots. This will help to determine whether the poorer response obtained with Guatemala mulching as against *Pueraria* mulching in the Parambe experiment is due to differences in the quality of the mulching materials or whether it is due to the competition for moisture and nutrients when the Guatemala grass is cultivated along with the rubber.

3.3.4. Manuring and Wind Damage.—Experiment on nutrition and susceptibility to wind damage.

In view of the high incidence of wind damage that has been reported from time to time, particularly on clone LCB 1320, an experiment was laid down to study the effect of manuring with three levels each of nitrogen and potassium and two levels of phosphorus on wood strength and incidence of wind damage.

A field of LCB 1320 replanted in 1957 was selected for the purpose and the first application of fertilizers according to experimental layout has been given.

3.4. MATURE RUBBER

3.4.1. Manurial Trials.—Effectiveness of fertilizer application to mature rubber.

(*a*) A 15 acre field of clone PB 86 that has not been manured for the last ten years has been selected in the Kalutara District to test the effectiveness of fertilizer application on mature rubber.

Preliminary yield records were obtained prior to laying down the experiment.

(*b*) Time of Fertilizer application trial. Dewalakande Estate.

Preliminary work was completed to test the following treatments in respect of time of fertilizer application on the yield of mature trees of clone PB 86.

1. NPK+Mg fertilizer application before wintering.
2. NPK+Mg fertilizer application prior to refoliation.
3. Application of P and K fertilizers prior to wintering and N fertilizers after refoliation.
4. NPK+Mg fertilizer application after refoliation in March/April.
5. Control. No fertilizer application.

An area was selected for the experiment and preliminary yields were recorded on the area. The first fertilizer application will be made early in 1963.

3.4.2. Manurial/Clone Trials

(*a*) 5×5 Latin Square Experiment testing treatments O, P, NP, PK and NPK on four clones. 13½ acres. New planting 1953. Hedigalla.

The trees that had reached tappable girth were brought into tapping in 1959. The yield records for 1961 and 1962 *i.e.* the third and fourth years of tapping which coincide with the third and fourth years from the time fresh treatments were applied, have been statistically analysed and the results are as follows. The yield is expressed in grams dry rubber per tree per tapping.

Fertilizer Treatment	Control	P	NP	PK	NPK	Sig. Diff. 5%
Mean yield 1961 ...	17·4	16·5	17·4	16·9	17·4	±2·59
Mean yield 1962 ...	18·6	16·9	17·6	17·5	18·5	±1·85

Clone	AVROS 255	PB 86 crown budded with LCB 870	PB 86	LCB 870	Sig. Diff. 0·1%
Mean yield 1961 ...	19·9	16·2	26·1	6·2	±3·24
Mean yield 1962 ...	23·0	16·0	26·3	5·9	±2·88

(*a*) Difference in yield between fertilizer treatments are not significant.
(*b*) The clones tested continue to be significantly different in their yielding capacities, clone PB 86 being the highest yielder.
(*c*) There was no interaction between the fertilizer treatments and clones tested, *i.e.* all clones responded to the fertilizer treatments in a similar manner.

3.5. Field Experiments to test the response of immature and mature Hevea to fertilizer applications according to Physiological Diagonosis.

The several experiments that were laid down in 1960 and 1961 in different areas of Ceylon to determine the differential response to manuring according to Physiological diagnosis, based on the results of leaf and latex analysis, compared with normal fertilizer applications in immature and mature rubber areas were continued during the period under review.

The girth increment data from immature areas and yield data from mature areas maintained in 1961 were analysed and none of the treatment differences were statistically significant in any one of the experiments. Most of these experiments have been in progress for periods ranging from one to two years. The absence of any significant difference in growth or yield due to treatment even over a period of two years is in contrast to the situation reported in Vietnam where substantial yield increases were observed six months after fertilizer application based on physiological diagnosis.

A comprehensive report on the applicability of the technique of Physiological Diagnosis under Ceylon conditions, embodying the results obtained in 1962 will be prepared early in 1963.

4. SOIL SURVEY

There was no work undertaken under this heading as efforts to appoint an Assistant Soils Chemist to undertake this work materialised only in December 1962.

5. COVER CROPS

5.1. Rhizobial Strains for Nitrogen Fixation in Leguminous Cover crops.

Rhizobial cultures were issued to estates that applied for them. Some estates reported favourably on the effectiveness of the strains for nitrogen fixation under field conditions.

The work involved in screening and maintaining cultures of rhizobia was handed over to the Plant Pathology Department of the Institute with effect from November 1962.

6. WEED CONTROL

Work on weed control has been actively pursued during the period under review. Though there are no indications of a ban being imposed on the use of sodium arsenite in Ceylon, the use of this herbicide is restricted in practice due to its possible poisonous hazards. In attempting to find suitable substitutes for sodium arsenite several herbicides have been tested.

Weed control in mature rubber areas and weed control in nurseries are two aspects of the problem that have been investigated.

6.1. Weed Control in nurseries.—A preliminary report on the use of herbicides for weed control in seedling nurseries has been published in the combined 1st and 2nd Quarterly Journals for 1962.

The main findings were that pre-emergence herbicides could be safely and successfully used in seedling nurseries. Though pre-emergence herbicides are recommended for application after clean weeding operations, it was found better to

use pre-emergence herbicides in combination with contact herbicides at very low concentrations. The new contact herbicide, Paraquat, at the rate of 0·1 lb per acre showed no harmful effects on the young rubber seedlings. Pre-emergence herbicide Simazine, Diuron and Ciba 2059 in combination with Paraquat were found to give weed free conditions for a period of three months after the first spraying.

An important point to remember when using herbicides to control weeds in nurseries, sited on steep land is to spray the weeds growing along the banks of the terraces as well.

6.2. Weed Control in Mature Areas.—A mature budded area at the R.R.I.C. experimental station at Hedigalla was selected for these trials.

Various combinations of contact herbicides and pre-emergence herbicides were tried.

Preliminary trials have indicated that the following combinations of herbicides give satisfactory weed control.

1. Paraquat at 1 lb per acre plus Simazine at 2 lb per acre.
2. Paraquat at 1 lb per acre plus Ciba 2059 at 2 lb per acre.
3. Paraquat at 1 lb per acre plus Diuron at 2 lb per acre.
4. Atlacide (Sodium Chlorate and Diuron) at 20 lb per acre.
5. " Veedkil " (proprietary mixture) 4 lb per acre

These trials have given the indication that in weed control work, there is a need to formulate herbicide mixtures according to the composition of the weed population, in relation to cost of material and application. It may be pertinent to mention that eradication of weeds from mature areas should be followed up by the establishment of the desirable species of cover crops.

7. METEOROLOGY

After a lapse of several years meteorological observations at Dartonfield for a full year have been recorded. These observations were made at the meteorological station established and maintained by the Soils Department. A summary of this data is published at the end of this review.

Recording of rainfall distribution and intensity was continued at ten different locations on estates.

The data on rainfall distribution and intensities from two stations was made use of for a talk delivered at the Symposium on the subject of Conservation and Utilization of Natural Resources, organised by the Soil Conservation Society of Ceylon.

Rubber Research Institute of Ceylon, Dartonfield, Agalawatta

Summary of Meteorological Observations

January—December 1962

Longitude — 80° 09′ E

Latitude — 6° 32′ N

Height above mean sea level } 215 ft.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1. Mean maximum temperature	87·2	90·7	90·4	90·0	87·1	86·9	86·4	84·5	84·2	84·0	85·8	86·3
2. Mean minimum temperature	71·6	71·0	71·7	73·2	73·6	73·4	72·9	71·1	74·3	70·2	69·3	68·9
3. Average of max. & min. means	79·4	80·9	81·1	81·1	80·4	80·2	79·7	77·8	79·3	77·1	77·6	77·6
4. Highest max. temperature	90·8	104·8	94·8	93·3	91·8	88·8	92·8	89·8	89·3	93·3	90·8	91·8
5. Lowest min. temperature	65·2	67·7	68·2	69·7	70·7	70·7	70·7	79·4	69·9	68·9	67·4	63·9
6. Lowest max. temperature	81·8	87·8	81·8	82·3	77·8	83·8	79·8	82·3	80·8.	80·3	80·8	81·3
7. Highest min. temperature	73·7	73·7	74·7	76·2	77·7	75·7	75·7	68·9	76·9	77·9	73·4	71·9
8. Mean relative humidity (8.30 a.m.)	82·7%	75·5%	77·0%	80·7%	83·9%	82·1%	82·5%	81·9%	82·6%	76·4%	76·0%	77·7%
9. Monthly rainfall in inches	6·80	3·68	12·39	13·35	33·61	13·38	11·61	16·20	12·25	17·41	15·99	6·94
10. Cum. rainfall in inches	—	10·48	22·87	36·22	69·83	83·21	94·82	111·02	123·27	140·68	156·67	163·61
11. No. of rainy days (> 0·01″)	15	7	16	22	21	20	22	20	27	26	21	15
12. Most rain in one day	1·10	1·10	2·15	1·82	7·75	4·84	3·10	1·73	2·13	3·42	2·20	2·15
13. Total hours of bright Sun shine	144·5	194·3	163·4	123·1	92·0	146·9	142·9	141·4	105·9	109·1	157·2	154·6
14. Daily mean hours of Sun shine	4·66	6·94	5·27	4·10	2·97	4·90	4·61	4·56	3·53	3·52	5·24	4·99
15. Mean earth temperature at 8″	82·7	83·7	84·1	84·4	83·1	83·6	82·8	82·4	82·3	82·2	82·6	83·2
16. Mean earth temperature at 4′	83·9	84·3	85·2	85·8	84·7	84·7	84·2	84·5	84·0	84·3	84·1	84·2

REVIEW OF THE CHEMISTRY DEPARTMENT

By

M. Nadarajah

SUMMARY

Besides the usual advisory activities and the routine analyses and experiments connected with them, investigations on the copper, manganese and iron content of lower grade rubbers have been continued. It has been suggested that the present limits of 10 p.p.m. for manganese should be specified for latex rubber only and higher values should be tolerated for the lower grades.

The extent of copper contamination caused by spraying has been investigated and has been found to be higher than that caused by dusting.

Some trials have been carried out on the possibility of bleaching scrap rubber by treatment with sulphur dioxide or sulphurous acid.

The analysis of latex and rubber from 23 clones has been continued and the content of fatty acids has also been determined.

Investigations have been carried out for the determination and isolation of the metal containing enzymes in scrap rubber and in tree bark.

Investigations on oil-extension of natural rubber at the latex stage are in progress.

Investigations into the causes of discolouration of latex are being continued. A method has been devised to extract phenolic substances from the latex and chromatographic studies of the phenolic extracts are in progress.

Preparations have been made in co-operation with an estate for the manufacture of SP Crepe.

Experiments on treatment of effluents from rubber factories have been continued.

DETAILED REVIEW

1. GENERAL

1.1. Staff.—The Department consists of the Acting Rubber Chemist, Mr. M. Nadarajah, the Research Assistant, Mr. S. W. Karunaratne, the Senior Technical Assistant, Mr. D. S. Muthukuda, three Technical Assistants, Messrs. M. T. Veerabangsa, G. G. Gnanasegaram and O. M. R. Sirisena and 13 Minor Staff Officers. The use of casual labour was stopped from 1st February. The Rubber Chemist, Dr. K. F. Heinisch resigned and left the island on 14-9-62 and the Assistant Rubber Chemist, Mr. M. Nadarajah was appointed to act for the Rubber Chemist from that date.

1.2. Advisory Services, Correspondence, Visits.—The volume of advisory work has been heavy. It included correspondence, visits, preparation of reports, examination of technical literature and experiments and tests in the laboratory and factory relevant to the advisory services provided by the Department :

	1962
Correspondence incoming	545
Correspondence outgoing	446
Unsolicited samples for report or analyses ...	35
Visitors to the Department	65
Visits by the Staff of the Department (details below)	412

	R.R.I.C. Estates	*Commercial Estates*	*Other Visits*	*Total*
Rubber Chemist ...	—	12	23	35
Assistant Rubber Chemist	29	64	14	107
Research Assistant ...	19	5	8	32
Senior Technical Assistant	60	36	2	98
Technical Assistants ...	33	55	52	140
Total ...				412

1.3. Analytical Section.—The volume of samples and routine determinations in the analytical laboratory has been as follows :

	1962
Samples from R.R.I.C. estates ...	488
Samples from commercial estates ...	257
Determination of :	
Dirt content ...	404
Ash content ...	95
Copper	891
Manganese ...	636
Iron ...	703
Magnesium ...	205
Phosphorus ...	70
Calcium ...	218
Potassium ...	178
Water extract ...	246
Alcoholic Potash extract ...	240
Acetone extract ...	245
Yellow fraction ...	260
D.R.C. ...	261
T.S. ...	267
Nitrogen ...	160
Viscosity ...	266
Miscellaneous ...	82

1.4. Publications.—The publications during 1962 to which members of the Department have contributed, include the following :—

1. Review of the Chemistry Department for 1961.
2. Kupfer and Mangan in Natur Kautschuk, *Gummi-Asbest — Kunstoffe*, 15 (1962).

3. Preservation of Sheet Rubber Against Mould. Part 2. Mould Growth on Smoked Sheet. *Rubb. Res. Inst. Ceylon, Quart. J.* 38 (1962) 40-46.
4. Copper, Manganese and Iron Content of Lower Grade Estate Rubbers. *Rubb. Res. Inst. Ceylon, Quart. J.* 38 (1962) 67-74.
5. Short notes on the following subjects for inclusion in the "Question Corner" of the Institute's Quarterly Journal :

Copper Content of Rubber.

Dirt in Crepe Rubber.

1.5. Meetings, Lectures, Visits.—Nearly all the members of the staff attended the talk given by Mr. C. A. K. Salgado of the Rubber Research Institute of Malaya on "Technical Classification of Rubber" on 18-4-62 and the talk given by Dr. E. D. C. Baptiste on "Properties and Competitive Prospects of Natural and Synthetic Rubbers" on 28-8-62, at a meeting of the Ceylon Branch of the Institution of the Rubber Industry.

2. The Acting Rubber Chemist gave a talk to Smallholdings officers on "Sheet Rubber Manufacture" on 10-11-62 at their annual field day.

3. The Research Assistant attended the sessions of the Ceylon Association for the Advancement of Science from the 22nd to the 25th of November.

2. LATEX

2.1. Determination of d. r. c. of Latex.—On several estates which reported a considerable shortage of the factory weight, trial coagulations and testing of the metrolacs have been carried out. In most cases the discrepancy was mainly due to the fact that the latex from young budded trees thickened on the addition of one part of water to one part of latex and did not give a correct reading. The addition of two parts of water to one part of latex remedied this defect. If a correct reading could not be obtained after adding two parts of water to one part of latex, the application of anti-coagulants in the field improved the situation. Assistance has been given to estates to draw up corrected ready reckoners by comparing metrolac readings with values obtained from trial coagulations of 100 ml latex samples.

2.2. Control of coagulation.—Bromo cresol green indicator papers prepared at the Institute are regularly supplied to estates for the control of latex coagulation. During 1962, 1080 booklets have been distributed.

2.3. Despatch of Latex.—Samples of latex of clone PB 186 collected in vessels surrounded by ice have been sent monthly in polythene containers packed in ice in a thermos flask, to the laboratories of the Natural Rubber Producers' Research Association at Welwyn Garden City, England, for research purposes.

2.4. Adulteration of Latex.—Several samples of latex suspected to be adulterated by tappers have been received for analysis. The most common adulterants used to cause a high metrolac reading are starchy substances. When the latex is coagulated, most of the starchy adulterants go into the serum. It has been found that sulphites as well as organic substances in the serum interfere with the Iodine test for starch. These interfering substances could be removed by dialysing the serum against running water for 10 hours, boiling the dialysed serum and filtering off the precipitated proteins. The Iodine test for the presence of starch can then be satisfactorily performed on the cold filtrate.

2.5. Clonal Analysis.—The analysis of latex and rubber from 23 different clones grown in Ceylon has been continued. The results expressed as mean values over 1962 are summarized in Table I.

TABLE I

Analyses of Clonal Latex—Mean values 1962

Clone	D.R.C. %	T.S. %	Yellow Fraction %	Water Extract % (on T.S.)	Acetone Extract % (on T.S.)	Alcoholic Potash Extract % (on T.S.)	Copper (p.p.m.)	Iron (p.p.m.)	Magnesium (p.p.m.)	Calcium (p.p.m.)
PB 186	40·34	43·63	14·0	1·5	4·71	0·50	6·2	21·4	438	206
PB 86 (old)	37·10	40·69	22·3	2·3	4·74	0·51	5·8	22·3	1141	195
PB 86 (young)	33·45	36·62	22·7	2·4	4·64	0·42	5·4	23·4	1133	291
PR 107	37·74	40·98	15·4	1·6	4·92	0·48	5·5	20·9	639	206
Nab 12	36·01	39·77	14·0	1·9	5·86	0·50	7·2	23·3	817	280
Nab 15	39·70	43·55	15·5	2·0	4·83	0·21	4·8	20·6	645	190
Nab 20	38·53	42·06	16·7	1·6	4·93	0·36	5·0	16·2	909	335
RRIM 500	35·10	38·70	22·8	1·5	5·06	0·48	5·3	20·2	1457	267
RRIM 501	35·59	38·69	24·3	1·1	6·14	0·56	6·9	26·9	523	326
RRIC 5	34·80	38·22	26·6	1·6	4·41	0·45	6·3	19·1	838	330
RRIC 7	38·22	41·61	24·1	2·2	4·67	0·45	5·3	17·0	818	296
RRIC 41	33·50	37·23	13·7	2·4	5·73	0·33	3·1	23·7	813	225
RRIC 45	27·58	30·86	15·8	2·6	5·38	0·44	5·5	28·4	829	323
RRIC 52	36·76	40·15	19·9	1·5	4·84	0·45	5·2	15·3	665	209
RRIC 86	36·45	39·65	24·5	1·7	4·77	0·49	7·6	15·4	1059	315
Tjir 1	37·84	41·34	22·2	2·7	4·58	0·48	4·9	17·1	1225	296
Mil 3/2	39·87	43·28	17·3	2·6	4·72	0·52	5·1	26·6	673	275
AVROS 255	34·08	37·02	23·4	2·3	4·87	0·52	5·5	27·4	686	188
AVROS 352	35·81	39·45	23·6	2·5	6·87	0·50	6·7	18·7	847	261
LCB 1320	34·36	37·63	22·0	2·1	4·99	0·53	5·6	22·4	1313	186
Wagga 6278	37·48	40·89	21·4	3·2	5·08	0·41	3·3	20·3	1654	286
Glen 1	36·66	40·30	23·8	1·8	4·32	0·41	5·7	29·4	2774	274
H. benthamiana ($F_4$4537)	31·18	34·27	11·3	2·0	6·06	0·45	5·2	21·8	560	220

The fatty acid content of the clonal latex, expressed in % stearic acid on total solids, has been determined. For the determination of the fatty acids the rubber (dried film) is dissolved in 5 : 1 Toluene : Ethanol-mixture and titrated with a 0.1% alcoholic sodium hydroxide solution against meta-cresol purple indicator. It was found convenient to use a 3g. sample of rubber and to use a 25 ml aliquot of the 250 ml rubber solution diluted to 100 ml with fresh solvent, for the titration.

The results obtained are given in Table II

TABLE II

Clone	Fatty Acid (as % stearic acid)
Tjir 1 (budded)	0·64
PB 86 (old)	0·89
PB 86 (young)	0·81
PB 186	0·81
RRIM 501	0·72
Nab 15	0·60
Nab 12	0·56
Nab 20	0·72
RRIM 500	0·81
Mil 3/2	0·85
AVROS 255	0·68
AVROS 352	0·77
LCB 1320	0·64
PR 107	0·60
RRIC 5	0·64
RRIC 7	0·81
RRIC 86	0·68
RRIC 52	0·60
Wagga 6278	0·64
H. benthamiana F 4537	0·60

2.6. Colour of Latex.—Experiments are being carried out for a direct determination of the colour of latex. The colour is to be expressed in percentage of the white content in comparison with a Barium sulphate standard. For the colour determination a photeoelectric instrument (Leucometer) is used in combination with a Multiflex-Galvanometer.

3. SHEET RUBBER

3.1. Defects in Smoked Sheets.—Frequent enquiries regarding various defects in smoked sheet have been received and several estates have been visited for detailed investigations of the cause, which could be traced mainly to the use of acetic acid as the coagulant, or to pre-coagulation of the latex, or to the use of excess of sodium bisulphite, or to too long a dripping time or to inadequate smoking and drying conditions.

With increasing crops, estates tend to invest in tanks with partitions to coagulate their latex, but continue to use hand-operated mills. Slab coagulum from tank coagulation is really meant to be rolled by sheeting machines. Milling of such coagulum through hand-operated mills is often tedious and causes a high proportion of cuttings and clippings, due to overhandling. This results in the percentage outturn of No. 1 quality sheets being rather low.

3.2. Tarry Drippings.—Enquiries have been received from several estates as to the cause of tarry substances falling on to sheets from the roof or ceiling of smokehouses. This defect is usually due to (a) inadequate air circulation in the

smokehouse or (b) failure to seal the space between the ceiling and the roof of the smokehouse. A fault of this nature allows moisture to condense on the ceiling from the humid smokehouse atmosphere. This moisture then absorbs dark coloured substances from the smoke and drops from the ceiling on to the sheets causing dark sticky stains.

3.3. Modified RSS-type smokehouses. With increasing crops, estates are replacing the internal trolley or pit furnaces of the smokehouses with an outer brick furnace and underground flues, and the bulking room has been converted into an additional smoking space giving at least a 50% increase in capacity. It has been found that the amount of air that gets in through the air inlet space of the furnace is often inadequate and hence it is necessary to have additional ventilators at the bottom of the walls of the smokehouse.

3.4. Mould on sheet.—Experiments on the prevention of mould growth on sheet rubber by means of fungicides have been continued.

3.5. Oil-extended sheets.—Dutrex L which is a naphthenic oil and Dutrex R which is a highly aromatic oil, obtained from the Shell Co. of Ceylon, were used for the experiments. The trials so far carried out show that a fairly satisfactory smoked sheet could be obtained by the addition of up to 30% of Dutrex L to the latex. The results obtained by the addition of Dutrex R in the same quantities have not been promising as the sheets are discoloured and prone to surface damage.

In this connexion it is worth mentioning that in addition to polyisoprene which is a synthetic rubber, pushed as a 100% substitute for natural rubber, an oil-extended form of polyisoprene containing 25 parts of a light naphthenic oil is on sale in the market.

4. CREPE RUBBER

4.1. Colour of Crepe.—The colour of crepe made from latices from Ceylon clones as well as from foreign clones grown in Ceylon, examined during 1962, was as follows :—

Deep yellow	PB 186, RRIC 5.
Yellow	RRIM 500, *H. benthamiana* (F 4537), RRIC 7 Tjir 1, Nab 12.
Pale Yellow	RRIC 86, Nab 15, RRIM 501, Nab 20, RRIC 52, AVROS 352, Mil 3/2, Glen 1, AVROS 255, PB 86 (young), LCB 1320, RRIC 45, RRIC 41.
White	PR 107, Wagga 6278, PB 86 (old).

Enzymatic discolouration can cause latex and the crepe made from it to be discoloured.

The natural tendency of latex to darken may be noted by examination of tree scrap or cup lump. Observation of tree scrap gave the results shown in Table III.

TABLE III

Enzymatic Discolouration

Not discoloured	Slightly discoloured	Discoloured	Badly discoloured
PB 86 (old)	PB 86 (young)	Nab 12	RRIC 7
Nab 15	H. benthamiana	PR 107	
Nab 20	(F 4537)	Wagga 6278	
Glen 1	RRIM 500	RRIC 5	
Tjir 1	AVROS 352		
RRIM 501	PB 186		
Mil 3/2	RRIC 52		
	LCB 1320		
	AVROS 255		

The cause of dullish colour of crepe in most estates have been traced to the bulking of the latex from slaughter tapped trees with latex from normally tapped trees. It is necessary to bulk and coagulate the latex from slaughter tapped trees separately to ensure a good colour of the crepe.

4.2. Dilution of Latex.—Dilution of latex with water to a metrolac reading of about 1½ lb/gallon has improved the appearance of the finished crepes, especially on estates where the percentage of yellow latex harvested each day is rather high.

4.3. SP-rubber.—One estate showed considerable interest in the manufacture of SP-rubber and arrangements are being made in co-operation with the department for a production of about 2 tons SP crepe per day.

4.4. Bleaching of Scrap Crepe.—Experimental trials were carried out to obtain a suitable method for improving the colour of the finished scrap crepes. Freshly milled scrap laces were treated for a period of 24 hours with sulphur dioxide gas or with sulphurous acid with a sulphur dioxide content of about 1%. Both treatments gave satisfactory results and yielded a considerably lighter coloured scrap crepe. The possibilities of a bleaching procedure for scrap rubber will be investigated on a larger scale.

4.5. Copper and Manganese content of Brown Crepes.—Observations on occasionally-occurring high copper and manganese content of lower-grade rubbers initiated some investigations into the extent and distribution of these naturally-occurring contaminants and some figures have been presented in the Review of the Chemistry Department for 1961, as well as in two publications.

Individual samples of unwashed panel scrap very often show a much higher copper content than the corresponding latex and generally, have also a very high manganese content (Table IV).

TABLE IV

Copper and Manganese Content of unprocessed Panel Scrap (in p.p.m.)

	Copper	Manganese
No. of samples	200	200
Mean Value	7·2	30·8
Highest value	29·5	90·0
Lowest value	1·6	5·1
% above 8 p.p.m.	23·5	—
% above 10 p.p.m.	—	98·0

Accordingly, Brown Crepes manufactured from scrap rubber show a similar increase. From a statistical distribution curve of the copper and manganese content of the combined Brown Crepes (1X, 2X, 3X) it appears that the percentage of this grade of rubber exceeding the specification of 8 p.p.m. and 10 p.p.m. respectively amounts to about 20% for copper and 40% for manganese. Copper shows a left asymmetric distribution curve with a maximum at about 5 p.p.m.

The distribution curve for manganese has two distinct maxima, one at 3 p.p.m. and one at about 19 p.p.m. The first maximum represents the grades which have been manufactured mainly from cup lumps, whereas the second maximum is representative of the grades which have been manufactured mainly from panel scrap.

About two hours after cessation of the latex flow a higher copper content and a considerably increased manganese content may be observed in the fresh panel scraps. A fractionation of the latex during the flow shows an increase of the copper and manganese concentration towards the end of the latex flow as indicated in Table V. The last two fractions are usually not collected in normal estate work in the form of latex but in the form of cup lumps.

TABLE V

Copper and Manganese content in latex fractions (in p.p.m.)

Fraction	Clone PB 186		Clone PB 86	
	Copper	Manganese	Copper	Manganese
4×20 ml	8·4	1·2	4·5	1·9
4×10 ml	9·0	2·0	4·5	2·8
2× 5 ml	11·6	5·4	4·8	4·6
1× 3 ml	19·9	8·7	9·3	5·6

Microscopical examination of latex fractions indicated a higher amount of lutoids in latex collected at the end of the latex flow period. A separation of the yellow, lutoid-rich fraction by centrifugation showed that it has a higher content of copper, manganese and iron (Table VI).

TABLE VI

Distribution of Copper, Manganese and Iron (in p.p.m.)

Sample	Copper	Manganese	Iron
Latex	5·9	2·3	25·5
Yellow fraction	7·6	5·2	75·5
White fraction	1·6	0·9	9·5

It has been found that the increase of the copper and manganese content of scraps is caused by the absorption of copper-containing and manganese-containing enzymes from the bark. Investigations on the isolation of these enzymes have been initiated.

If scrap rubber is soaked in fresh rubber serum for 1 to 2 days a great part of the naturally-occurring copper is dissolved and complexed by the amino acids present in the serum. Brown Crepes manufactured from scraps, treated in the above manner, show a reduction of the copper content below the specification of 8 p.p.m. A part of the manganese is also removed during this treatment, but the final manganese content of the resulting Brown Crepe still remains high.

A treatment of the panel scraps with a hot 5% solution of the tetra sodium salt of ethylene diamine tetra acetic acid (EDTA) seems to be rather effective in reducing the manganese content below 10 p.p.m., but for technical and economic reasons it is at present not feasible to introduce such a procedure on commercial estates.

The present maximum value of 10 p.p.m. for manganese may be considered as a sufficiently high and safe limit for sheet and crepe rubber manufactured from latex under normal conditions. Any excess above this value may be considered as an indication of a foreign contamination.

For all types of lower grade rubbers prepared from tree scraps and lumps (Brown Crepe grades) this limit must, however, be considered too low. According to the present advice in the " Green Book " an increased manganese content would be regarded as foreign contamination, although its presence in the rubber is due to unavoidable absorption of naturally-occurring metal-containing enzymes from the tapping cut.

In the strict sense of the word this is a contaminant, but it seems necessary to make a clear distinction between avoidable foreign contamination, as dirt, copper dust, etc., and unavoidable contamination by the absorption of manganese by panel scrap during the normal tapping procedure.

It would, therefore, be desirable, if the future specifications would consider to a certain extent this natural circumstance in the lower grade and would make the necessary allowance and tolerate higher values in the lower grades.

The limits should be established at such a ceiling, to allow 95% of the commercial rubber to fall below the specified maximum. From the statistical analysis on Brown Crepes sampled during 12 months from 5 estates the proposed limits would be 25 p.p.m. for manganese.

This problem has been brought to the attention of the Rubber Manufacturers' Association of New York and it is expected that it will receive further consideration.

In this connexion it would be interesting to note that the N.R.P.R.A. has found that naturally-occurring copper and manganese in amounts up to 3 times the upper limits specified in the RMA " Green Book " appeared to have no deleterious effect.

4.6. Bleaching of Crepe. Uvitex 1392, a proprietary product manufactured by Messrs. Ciba Ltd., Basle, was sent by their agents, Messrs. A. Baur & Co., Ltd., Colombo, for tests on its effect on latex manufactured into crepe.

Uvitex 1392 is a milky liquid, the active principle of which has a very low acute toxicity. Unlike RPA 3 it mixes freely with water and does not need an emulsifier for dispersing it. Uvitex 1392 is an optical brightener and improves the white colour of bleached or unbleached crepe by absorbing the invisible ultra-violet wave-length of a light and re-emitting them as light of a visible fluorescent wave length. Field latex was taken and Sodium bisulphite was added at 0·5% on the dry rubber content. Uvitex 1392 was added at the rate of 0, 0·1, 0·2, 0·5, 1, 2 and 5% on the dry rubber content. The latex was coagulated with formic acid and with oxalic acid. It was found that Uvitex, though markedly improving the whiteness of the finished crepe, is not a substitute for RPA 3 as a bleaching agent.

The results of the physical testing and the Mooney viscosity of the crepe made from untreated latex and from latex treated with Uvitex 1392 and with RPA 3, which are given in Table VII show that Uvitex 1392 has no adverse properties on the rubber.

TABLE VII

Uvitex 1392 treated latex crepe

Treatment	A.C.S. 1 pure gum Mix Cured for 40 min @ 140°C						Mooney Viscosity of crepe
	600 % Modulus	Tensile strength in Kg/cm²	Elongation at break %	Mooney	Strain	Strain Corrected for V/c	ML 4
No bleaching agent F.A.	26·7	119·9	866·7	45·0	75·6	78·4	94·5
No bleaching agent O.A.	27·2	117·0	862·5	48·0	76·8	81·2	93·5
0·1% RPA 3 F.A.	26·2	119·1	866·7	42·5	73·4	74·7	94·0
0·1% ,, O.A.	26·9	118·1	866·7	43·0	79·0	81·0	92·5
0·2% ,, F.A.	26·1	115·9	868·3	44·5	78·7	81·5	91·0
0·2% ,, O.A.	25·6	108·2	866·7	46·0	79·8	83·7	90·0
0·1% Uvitex F.A.	25·1	121·8	876·7	40·0	79·9	79·9	95·0
0·2% ,, ,,	26·7	120·3	871·7	48·0	75·7	80·0	96·0
0·5% ,, ,,	27·1	121·3	870·0	42·0	76·2	77·2	96·5
1% ,, ,,	24·6	125·7	888·3	42·0	80·3	81·7	94·5
2% ,, ,,	24·4	115·3	870·0	52·0	79·5	86·7	94·5
5% ,, ,,	26·1	125·5	890·0	42·0	76·6	77·8	96·5
0·1% ,, O.A.	25·8	107·1	860·0	41·0	77·5	78·2	93·5
0·2% ,, ,,	24·8	122·0	883·3	51·0	75·3	81·2	94·5
0·5% ,, ,,	26·8	110·8	861·7	43·0	75·5	77·3	94·0
1% ,, ,,	26·6	121·3	875·0	43·0	76·9	78·8	94·0
2% ,, ,,	24·5	115·6	878·3	41·0	80·9	81·8	94·0
5% ,, ,,	23·8	108·9	873·3	34·0	83·6	79·2	91·0

Uvitex 1392 is said to be very stable towards heat treatment and hence should be of value in the preparation of vulcanized latex prior to the manufacture of bleached SP crepe.

4.7. Oil-extended Crepe.—The oils used were Dutrex R and Dutrex L. They were added as a 50% emulsion to the latex. The emulsion was prepared by mixing 1500 parts of oil with 60 parts of Duponol OS and diluting with 1440 parts of water.

Field latex was taken and Sodium bisulphite added at 0·5% on the dry rubber content. 3000 ml of this latex were taken and 50% oil emulsion was added in the volumes given in Table VIII and the latex was coagulated with formic acid. The coagulum set in a few minutes ensuring that no oil was lost in the serum. The coagulum with increasing oil content showed softness but could be milled. The results obtained are also given in Table VIII

TABLE VIII

Sample No.	1	2	3	4	5
Volume of field latex in ml	3000	3000	3000	3000	3000
Volume of 50% Dutrex R in ml	0	180	360	540	900
Volume of water in ml	900	720	540	360	0
Volume of 2% acid in ml	200	200	200	200	200
Colour of Blanket crepe	White	Yellowish White	Brownish Yellow	Yellowish Brown	Yellowish Brown
Wt. of Rubber in grams	960	1085	1200	1252	1471
Wt. of oil	0	125	240	292	511
% oil on original rubber	0	13	25	30	53
Hoekstra Plasticity	0·64	0·54	0·40	0·29	0·21

Since the addition of oil makes the rubber softer, benzidine was added to the latex-oil mixture to harden the rubber. 1·8 grams of benzidine was dissolved in 4 ml of formic acid and added to the latex-oil mixture before the addition of the coagulant which was 100 ml of 2% formic acid. The results obtained are given in Table IX

TABLE IX

Sample No.	1	2	3	4	5
% oil on original rubber	0	14	28	38	49
% benzidine	0·2	0·2	0·2	0·2	0·2
Time taken for laces to dry in days at 95°F	3	3	3	3	3
Hoekstra Plasticity	1·04	0·84	0·71	0·57	0·39

When Dutrex L was the oil used instead of Dutrex R the crepe produced had a better colour. However Dutrex L is much more expensive than Dutrex R. The results obtained by using Dutrex L with and without benzidine is given in Table X.

TABLE X

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12
% oil on original rubber	0	8	17	28	37	43	0	8	18	28	34	43
% benzidine	0	0	0	0	0	0	0·2	0·2	0·2	0·2	0·2	0·2
Time taken for laces to dry in days at 95°F	3	6	6	6	6	6	0	6	6	6	6	6
Hoekstra Plasticity	0·64	0·50	0·38	0·30	0·24	0·20	1·01	0·84	0·73	0·48	0·38	0·40

It was noted that Dutrex L retards the drying of the laces.

A 50% oil emulsion of Dutrex R and of Dutrex L was also prepared by heating the oil to 95°C and adding concentrated solutions of detergents, *e.g.*, Sunlight soap, so that the concentration of the detergent was 1% on the oil. The oil was then mixed with an equal volume of water which had been heated to 95°C.

5. COMPOUNDING AND TESTING

5.1. TC — Rubber.—The position in Ceylon with regard to Technically Classified rubber has remained unchanged, and no commercial production of TC rubber is anticipated in the near future. The Department collaborated in the yearly inter-laboratory cross-check test arranged by the Rubber Research Institute of Malaya.

5.2. SP rubber.—Preparations are being made for the testing of SP rubber The co-operation of the Rubber Research Institute of Malaya regarding the details of its manufacture and testing has been promised.

5.3. Technological testing of oil-extended crepe and sheet.—The results of physical testing of oil-extended crepe and sheet with and without benzidine are given in Table XI and Table XII. The oil used was Dutrex L.

TABLE XI

Oil-extended Latex Crepe
A.C.S. 1 pure gum mix cured for 40 minutes @ 140°C

Sample	600% Modulus	Tensile Strength in Kg/cm²	Elongation at break %	Mooney	Strain at 5 Kg/cm²
Latex crepe only	35·59	117·19	804·1	50·5	59·2
Latex crepe+10%Dutrex L	25·15	103·00	850·5	44·5	90·6
Latex crepe+20%Dutrex L	18·68	80·95	863·8	40·5	119·3
Latex crepe+30% Dutrex L	14·52	70·09	901·5	32·5	147·0
Latex crepe+40%Dutrex L	16·90	60·02	932·5	27·0	149·9
Latex crepe+50% Dutrex L	16·76	61·89	930·8	26·0	168·9
Latex crepe+0·2% Benzidine	66·18	124·64	715·5	62·5	49·1
Latex crepe+0·2% Benzidine +10% Dutrex L	47·77	104·60	727·3	61·0	68·6
Latex crepe+0·2% Benzidine + 20% Dutrex L	44·99	84·60	769·0	56·0	79·9
Latex crepe+0·2% Benzidine +30% Dutrex L	25·41	75·74	783·8	34·5	103·3
Latex crepe+0·2% Benzidine +40% Dutrex L	16·10	61·03	816·3	25·5	137·0
Latex crepe+0·2% Benzidine +50% Dutrex L	14·91	49·91	817·5	25·5	172·6

TABLE XII

Oil-extended R.S.S.
A.C.S. 1 mix cured for 40 minutes @ 140°C

Sample	600 % Modulus	Tensile Strength in Kg/cm²	Elongation at break %	Mooney	Strain at 5 Kg/cm²
R.S.S. only	30·71	108·17	807·0	47·0	64·4
R.S.S+10% Dutrex L	19·27	80·85	849·0	33·5	109·3
R.S.S.+20% Dutrex L	13·87	65·17	879·3	34·0	149·0
R.S.S.+30% Dutrex L	10·78	52·02	907·8	27·0	201·0
R.S.S.+0·2% Benzidine	31·14	76·23	769·5	72·0	58·0
R.S.S.+0·2% Benzidine+10% Dutrex L	27·56	75·65	798·3	63·0	80·2
R.S.S.+0·2% Benzidine+20% Dutrex L	23·58	66·08	806·0	48·0	115·7
R.S.S.+0·2% Benzidine+30% Dutrex L	14·44	53·78	823·3	44·0	158·9
R.S.S.+0·2% Benzidine+40% Dutrex L	12·12	39·79	843·5	35·0	175·2

5.4. Physical Testing of Crepe.—The average results of the physical testing of crepe made from latex obtained from 21 different clones for the months January to June 1961 are given in Table XIII

TABLE XIII

Clonal Latex Samples — Mean Values, Jan-June 1961
A.C.S. 1 pure gum mix cured for 40 minutes @ 140°C

Clones	600% Modulus Kg/cm²	Tensile Strength Kg/cm²	Elongation at break %	Mooney	Strain at 5 Kg/cm²	Strain Corrected for V/C at 5 Kg/cm²
PB 186	21·5	95·4	877·6	28·0	97·1	88·8
PB 86 (old)	25·5	103·3	864·2	35·6	84·8	81·2
PB 86 (young)	23·6	102·8	867·9	44·8	82·9	86·4
PR 107	26·2	103·8	848·9	36·7	80·4	78·4
Nab 12	25·6	97·0	847·5	39·3	85·2	84·0
Nab 15	24·0	99·5	860·0	44·3	88·7	89·6
Nab 20	22·7	88·8	859·2	34·5	90·8	88·2
RRIM 500	25·4	104·8	863·3	39·8	86·5	85·4
RRIM 501	28·9	100·8	825·6	33·3	85·7	70·5
RRIC 5	24·5	103·3	862·8	33·8	90·9	85·9
RRIC 7	22·4	100·4	872·7	41·0	89·3	89·3
RRIC 52	23·4	91·6	858·9	37·3	90·2	87·9
RRIC 86	20·2	92·8	885·0	40·7	98·2	97·4
Tjir 1	25·1	105·2	866·7	41·2	87·3	87·9
Mil 3/2	26·2	112·9	863·5	41·7	80·3	79·4
AVROS 255	22·5	100·6	864·0	40·8	93·5	89·0
AVROS 352	30·9	120·0	831·6	34·6	69·2	66·3
LCB 1320	23·4	105·3	875·5	36·5	83·3	80·2
Wagga 6278	24·4	108·5	873·4	43·5	90·0	91·6
Glen 1	21·4	92·7	870·7	39·4	101·4	104·0
H. benthamiana (F 4537)	17·6	72·7	858·5	27·8	130·1	104·0

6. MISCELLANEOUS

6.1. Contamination due to Copper Spraying.—Samples of panel scrap from experimental areas, treated by the Agricultural Engineer with different copper sprays, have been analysed to determine the extent of copper contamination. It appears that the copper content of panel scrap is extremely high after the first spray application due to direct contamination. In all the subsequent tapping rounds, the copper content of the scraps is within rather reasonable limits, being somewhat higher for the spray formulations than for copper dusts. It is not possible to indicate whether the higher copper content of the scraps is caused by direct contamination of copper washed down the tree or due to absorption through the leaves and participation in the metabolism (Table XIV).

TABLE XIV

Copper Contamination with different formulations
(Cu in p.p.m.)

	Copper Spray				Copper Dust
	Control	I	II	III	
1st collection after spray application					
Latex film	6·4	6·3	4·7	3·5	—
Panel scrap	11·1	51·3	34·3	79·5	—
Mean value of 10 consecutive tapping days					
Latex film	3·3	3·0	3·5	2·9	2·6
Panel scrap	7·8	17·0	18·6	22·8	13·0

For copper spray applications the following measures are recommended to reduce the copper content of the final rubber :

(1) No tapping on the day of application.

(2) Inversion of the cups on the day of application and if feasible, washing of the cups after application.

(3) The panel scraps collected on at least 10 tapping days after application should be treated in the following manner :

  (*a*) Soak for 24 hours in a solution of 0·2% of a detergent (Detergent 40E or Teepol CH 31) + 0·2% Trisodiumphosphate.

  (*b*) Wash in scrap washer.

  (*c*) Soak for 24 hours in fresh rubber serum.

  (*d*) Process on the mills to laces, preferably by blending with scraps from untreated areas.

(4) All scrap collections after this period should be soaked for 1-2 days in five to ten times the volume of fresh serum, to which 0·1% Detergent 40E or Teepol CH 31 may be added.

6.2. Effluents.—Experiments have been continued on the treatment of effluents on one estate, using a tank of approx. 1500 gallon capacity. A considerable part of the proteins of the serum are precipitated in the tank. It is reported that the bad smell, which has been caused by the untreated effluents, discharged in an open drain, has almost disappeared when treated effluents are discharged.

6.3. Enzymes in scrap rubber.—Polyphenol oxidase (Tyrosinase), a copper-containing enzyme which is surmised to be the cause for the increased copper content of panel scraps due to absorption from the bark has been shown to be present in the fresh bark of the rubber tree. Bark was exhaustively extracted with chilled acetone to remove polyphenols, dried *in vacuo* and then extracted with phosphate buffer at pH 7.0 under cold conditions.

Ammonium sulphate was added to the solution up to one-third of the amount required for saturation to remove excess proteins.

After 24 hours the precipitate was filtered off and the filtrate was saturated with ammonium sulphate. The precipitate was filtered, dispersed in water and dialysed in the cold against distilled water. After filtration the dialysed solution showed a high activity on the addition of catechol. The enzyme activity was completely inhibited after addition of sodium diethyldithiocarbamate, or on dialysis of the solution against potassium cyanide.

6.4. Phenols in Latex.—Polyphenolic bodies which are believed to be the cause of discolouration of latex were isolated from latex by the following method :

Field latex (10 ml) was collected in 40 ml of 0.6 M Tris-Mannitol Buffer (0.11 M tris — 0.4 M Mannitol — 0.10 M HCl, pH 7.0). The suspension was centrifuged at 14,000 r.p.m. for 20 min. to concentrate the polyphenolic bodies in the bottom fraction. The bottom fraction was then separated and suspended in methanolic sodium hydroxide (0.01M) to extract the phenolic bodies which may be free or trapped in vesicles or absorbed on the membrane surface. The suspension was centrifuged at low speed and the supernatant solution containing the phenols were decanted off and acidified to release the phenols.

A concentrated extract was used without further purification for chromatographic studies and the presence of several polyphenolic compounds were observed in the extract. Some of these compounds were found to be amino-phenols.

REVIEW OF THE SMALLHOLDINGS DEPARTMENT

By

A. B. Dissanayake

SUMMARY

The work of the Smallholdings Department both in the field and in office increased during this year. The C.A.O.S., S.A.A.O., A.A.O. (N) and A.A.O.(S) were on duty throughout the year.

The Departmental Mechanic left and a Mecnic and a Temporary Typist/ Clerk were appointed during the year.

A conference of the Supervisory Staff was held on 31-8-62. The C.A.O.S. attended a Rubber Replanting Advisory Board meeting, an Administrative Committee meeting and served on two committees of inquiry.

The sudden death of a Rubber Instructor is regretfully recorded.

Two ranges were reorganised and renamed.

Mr. J. E. Morris of the Rubber Research Institute, Malaya and Dr. K. F. Heinisch, Rubber Chemist, R.R.I.C. visited and made a tour of inspection in Colombo District in the company of the C.A.O.S.

This Department participated in two school exhibitions.

Loans for the purchase of vehicles were granted to four officers and a further three officers were given loans to repair their vehicles.

The Smallholdings Leaflet No. 9 was published both in Sinhala and English. The detailed leaflet on Tapping is ready for printing.

Lining for soil conservation and planting points was carried out by the field staff. They also advised smallholders on the correct methods of tapping, sheet making and disease control, etc. 7½ tons of rubber mixture were purchased through this Department at concession rates by a Multipurpose Co-operative Society and a small estate owner. 214 sq. feet of mesh and 1, 186 aluminium pans were sold at concession rates to smallholders by way of assistance for better sheet making.

The Annual Field Day of the Department was held at Ananda Sastralaya, Matugama. The Chairman, the Director, the Acting Plant Pathologist, the Acting Rubber Chemist of the R.R.I.C., and the C.A.O.S. attended the Field Day.

A total of 33,013 visits were paid to areas which were being replanted and to replanted smallholdings inclusive of 24,193 visits to permit areas in previous years. 8,820 visits were made to replanting areas on 1962 permits during the year. 1,599 subsidy holdings for which replanting permits have been issued in 1962 totalling 2,331 acres 1 rood 25 perches were lined by Rubber Instructors and Assistants for soil conservation work and 2,091 permit areas of 2,969 acres 0 rood 37 perches for planting holes in 1962 permit areas. In addition to this, 738 holdings of previous

year's permits were lined by officers to an extent of 1,117 acres 3 roods 19 perches for soil conservation works and an extent of 1,157 acres 0 rood 03 perches in 775 permit areas for planting holes. In 732 subsidy holdings Rubber Instructors marked a total of 30,220 trees of suitable girth for tapping.

Field officers of this Department carried out random checks on planting material issued by the Rubber Controller at the Commodity Purchase Depots to subsidy replanters and a total of 19,408 plants were checked at 215 visits to various Depots.

1,900 Preliminary Reports on the suitability of holdings for new planting of rubber were submitted to the Rubber Controller. 3,929 visits were made by the field staff to new planting and new planted permit areas of this year and previous year for advice and lining. Instructors and Assistants lined 320 new planting areas of 454 acres 1 rood 27 perches for soil conservation works and 446 acres 3 roods 32 perches in 330 holdings for planting holes in this year's permit areas. Similarly 162 permit-areas of 255 acres 2 roods 20 perches in extent were lined by Rubber Instructors and Assistants for soil conservation works and 149 permit-areas of 231 acres 3 roods 27 perches in extent for planting holes in 1961 new planting permit-areas. Rubber Instructors marked 6,914 tappable trees in 118 new-planted holdings. Rs. 5,779/99 were paid as soil conservation grants to 106 peasant-class permit-holders. The new rates of payment for soil conservation works are now made in two instalments.

2,997 Final Inspection Reports were sent to Rubber Controller to enable him to register these lands as rubber holdings.

The State-aided Sulphur Dusting Scheme organised by this Department successfully organised 95 co-operative dusting groups during the year. A total of 9,597 acres (2,927 holdings) were successfully dusted.

Dusting operations commenced on 6-1-62 in Uduwa sulphur dusting group in the Undugoda Range. The dusting operations for the season were concluded on 22-3-62 when the last holdings of the Ethkandura group were given the fifth round of dusting.

It has been observed that whilst undusted holdings were infected by *Oidium* the degree of attack being less than that observed last year, the dusted holdings generally escaped attack. In a very few cases where wintering was late and where rain interfered with sulphur dusting a slight amount of infection was noticed in the dusted holdings.

Arrangements have been completed for dusting from January to March 1963 of approximately 10,221 acres of rubber in 3,202 holdings. A total of 101 sulphur dusting groups were accepted by the end of 1962.

The Publicity Unit has functioned successfully throughout the year. 126 Publicity Meetings-cum-Exhibitions and Slide Shows were held during the year. 5 sets of colour slides on various aspects of rubber planting were shown at these shows. The Publicity Unit also participated in a school science exhibition and in 4 Publicity Meetings-cum-Exhibitions at various Farm Schools for Farm Students. It is now increasingly felt that a complete film on rubber should be shown by this Unit.

The Divisional Advisory Officers conducted a series of lectures on rubber for Farm School students at various Agricultural Farms.

Rubber Instructors conducted 855 sheet making, 788 tapping, 485 disease control and 502 miscellaneous demonstrations during this year. 45 demonstration smokehouses and 82 ordinary smokehouses were started of which 41 demonstration smokehouses and 48 ordinary smokehouses were completed.

A scheme for training of smallholders in tapping was initiated. 6 training classes were started in 6 divisions and these classes trained a total of 108 candidates, and 69 of them were found to be successful at the conclusion of an eight-week course of training including 16 classes in tapping. Mr. T. C. A. de Soysa, the Chairman of the Rubber Research Board awarded certificates to 51 trainees at the Field Day at Matugama and the balance 18 trainees received their certificates from Mr. W. P. H. Dias, J.P., Smallholders' Representative on the Board, at a function held at the Undugoda range. The 47 Range Rubber Instructors would be trained in tapping and training classes for smallholders would be organised by them in their respective ranges in 1963.

The rainfall survey is being continued.

The survey to find out the economics of a replanted smallholding was continued throughout the year.

At the request of the Rubber Replanting Advisory Board a survey of tapping undergirth trees replanted from 1953-1956 under the subsidy scheme was started. The survey was carried out in all holdings planted under the subsidy scheme in the specified period in 4 random villages per range in all ranges. The survey was therefore carried out in 168 villages having 2,253 permits covering an acreage of 3,770 acres 0 rood 02 perches. Of the 2,253 holding inspected 1,437 holdings covering an acreage of 2,438 acres 1 rood 02 perches had not been tapped. Of the 816 tapped holdings covering an extent of 1,131 acres 3 roods 00 perches, in 471 holdings tapping had been done at the required girth and correct stage, while in 218 holdings tapping had commenced when about 40-50% of trees attained a girth of 20″ but with a few undergirth trees, and in 127 holdings tapping had commenced when the majority of trees were undergirth. (This survey also revealed that out of 2,253 holdings inspected, 608 holdings were not maintained properly and were full of weeds while 305 holdings had tapping cuts at the wrong heights or angles.)

DETAILED REVIEW

Introduction.—The work of the Smallholdings Department both in the field and office increased during the year under review. Fairly large numbers of Subsidy Replanting and New Planting permits were again issued and the consolidation of the old sulphur dusting groups and the organisation of new groups and supervision of all the groups were again undertaken. The Publicity Unit functioned in the field throughout the year. Assistance was given in the form of advisory visits, lining for planting holes and soil conservation works and the usual advisory services were continued to be given to rubber smallholders in general.

1 GENERAL

1.1. Staff.—Mr. A. B. Dissanayake, Chief Advisory Officer Smallholdings, was on duty throughout the year.

Mr. H. H. Peiris, Senior Assistant Advisory Officer, Mr. K. Wilson Silva, Assistant Advisory Officer (North) and Mr. D. E. A. Abeywickrema, Assistant Advisory Officer (South) were on duty throughout the year.

Mr. B. Kobbekaduwa, Mechanic, left the Department on 1-1-62 and Mr. K. A. Siripala was appointed to the vacant post with effect from 15-6-62.

Mr. D. G. Dhanapala was appointed as a Temporary Typist/Clerk from 1-6-62 to assist in Sulphur Dusting work.

A conference of the Supervisory Officers of the Smallholdings Department, convened by the C.A.O.S., was held at the Smallholdings Headquarters on 31-8-62.

The C.A.O.S. attended, on invitation, a meeting of the Rubber Replanting Advisory Board regarding the Survey of tapping undergirth trees in subsidy holdings.

The C.A.O.S. also attended an Administrative Committee Meeting at Head Office by invitation in regard to Departmental Estimates and Programme of Work for the year 1963.

C.A.O.S. also served as a member of two committees of inquiry.

It is regretfully recorded that Mr. W. G. V. de Silva, Rubber Instructor, Talgampola, died unexpectedly on 17-12-62. He came over to this Department from the Government New Rubber Planting Scheme in 1948 and counted over 14 years' service in this Department.

1.2. Reorganisation of Ranges.—In order to facilitate field work, Giriulla and Kegalla ranges were reorganised and renamed Polgahawela and Rambukkana ranges respectively. The Instructors are now stationed at Polgahawela and Rambukkana.

1.3. Visits.—Mr. J. E. Morris of the Rubber Research Institute of Malaya and Dr. K. F. Heinisch, Rubber Chemist, R.R.I.C. visited smallholders' replantings and inspected smallholders' sheet rubber manufacture in the Colombo District in the company of the Chief Advisory Officer on 13th January.

1.4. Exhibitions.—This Department participated in the Science Exhibition at Rahula College, Matara, on 5th and 6th April and in the Science Exhibition at Dharmaraja College, Kandy, for a period of 3 days from 28th July.

1.5. Loans.—Loans for purchase of vehicles were given to four officers the amount being Rs. 14,010/-. Further, 3 loans amounting to Rs. 4,700/- were given to 3 officers for repairing their vehicles.

1.6. Correspondence.—The following figures in regard to correspondence are an indication of the volume of work performed both in the field and at the smallholdings Department Headquarters :

General :

Inward	7,781	
Outward	12,971	

With the Rubber Controller :

Inward	1,191	(from Rubber Controller with New Planting applications, etc.)
Outward	6,198	(including 1,900 Preliminary Reports, 2,997 Final Inspection Reports and 1,296 Special Reports).

From field officers to permit-holders :—4,583 not included in the above figures.

1.7. Publications.—The new Smallholdings Department leaflet No. 9 on Soil Conservation was published in both Sinhala and English. This leaflet is more detailed in that it contains more details regarding the theory and is better illustrated by the use of diagrams and actual photographs taken of smallholdings. The detailed leaflet on Tapping was prepared and is ready for printing. It is hoped however to sell this leaflet for a nominal sum to cover part cost of printing.

2. ASSISTANCE TO SMALLHOLDERS

Lining for soil conservation works and for planting points was carried out by the field staff. They also advised smallholders on the correct tapping procedure, disease control methods, manuring and sheet making.

3½ tons of the R 4 : 6 : 5 manure mixture were bought through this Department at concession rates for the Multipurpose Co-operative Society at Udagoda Government Colony for smallholders there. A further 4 tons of R. 4 : 6 : 3 manure mixture were bought through this Department at concession rates for a small estate owner at Bulathkohupitiya.

214½ square feet of mesh for strainers and 1,186 aluminium pans were sold at concession rates to smallholders during the year by way of assistance for better sheet-making.

3. ANNUAL FIELD DAY

The Annual Field Day of the Department was held at the Ananda Sastralaya, Matugama, on 10th November, 1962. The day's proceedings were held according to the following programme :

8-00— 9-45 a.m.	...	Field Work.
9-45—10-00 a.m.	...	Tea Break.
10-00—10-15 a.m.	...	A few words by : 1. The Chairman, R.R.B. 2. The Director, R.R.I.C. 3. The Smallholders' Representative.
10-15—10-45 a.m.	...	Lecture by Dr. O. S. Peries, Acting Plant Pathologist.
10-45—11-00 a.m.	...	Question Time.
11-00—11-30 a.m.	...	Lecture by Mr. M. Nadarajah, Acting Rubber Chemist.
11-30—11-45 a.m.	...	Question Time
11-45—12-00 Noon	...	Assembling Smallholders.
12-00—12-15 p.m.	...	Talk in Sinhala by the Chief Advisory Officer Smallholdings explaining the Training Scheme of Tapping for Smallholders.
12-15—12-30 p.m.	...	Presentation of certificates to Smallholders successful in the Training Scheme, by the Chairman, R.R.B.
12-30—12-40 p.m.	...	Short talk in Sinhala by one Smallholder.
12-40 p.m.	...	Any other short talks by Chairman, Director, S.H. Representative, etc. Conclusion of Programme.

The Chairman, Mr. T. C. A. de Soysa, the Director, Dr. E. D. C. Baptiste, the Acting Plant Pathologist, Dr. O. S. Peries, the Acting Rubber Chemist, Mr. M. Nadarajah and the Chief Advisory Officer attended the field day. Mr. W. P. H. Dias, J.P., the Smallholders Representative on the Board of Management sent a letter expressing his inability to attend the field day owing to an illness but wishing the Department and Staff all success.

The field demonstrations of the day's programme were held at Horawala from 8-00 to 9-45 a.m. These comprised the treatment of a *Fomes* infected budded plant with Tillex liquid by Mr. J. D. W. Jayawardane, Rubber Instructor, Matugama, and the treatment of Bark Rot and stem Canker on a mature rubber tree with Antimucin and Kankerdood by Mr. D. E. A. Abeywickrema, the Assistant Advisory Officer (South).

The next part of the day's proceedings took place at Ananda Sastralaya, Matugama. The Chairman in welcoming the staff of the Smallholdings Department said that the Board of Management of the Institute appreciated the work done by this Department and stressed the necessity to convince the rubber smallholders whose lands amount to 40% of the Island's acreage the value of self-help by training them to correctly manage their smallholdings.

The Director in his short speech stressed the importance of not tapping undergirth trees and on adopting the correct methods of tapping in all smallholdings. With this in view he said that, at the request of the Chief Advisory Officer Smallholdings 6 Divisional Advisory Officers and 6 Rubber Instructors were trained in tapping at Dartonfield for starting training classes for smallholders.

Thereafter the guest speakers, Mr. Nadarajah and Dr. Peries, delivered their lectures. Mr. Nadarajah gave an interesting lecture on 'Sheet Rubber Manufacture' and dealt in detail with collection of latex, dilution and coagulation of latex, rolling and smoking of sheet and defects in smoked sheet.

Dr. Peries in his lecture on 'Diseases of Rubber' covered the range of diseases that attack the foliage, trunk and roots of the rubber tree with special mention being made of *Oidium* and *Phytophthora* and the methods available for their control

Several questions were asked by the field staff from the lecturers and the subjects were discussed at length, the Director, R.R.I.C. and the Chairman, R.R.B. joining in the discussion.

After assembling the smallholders the Chief Advisory Officer Smallholdings explained the Training Scheme of Tapping for smallholders in Sinhala and invited the Chairman to distribute the certificates to the successful trainees.

A short talk in Sinhala by one smallholder thanking the Chairman, Director, Chief Advisory Officer Smallholdings and his Department ended the field day proceedings.

4. REPLANTING

Considerable attention was paid by the field staff in assisting smallholders and small estate owners in replanting their permit-areas according to the requirements of the Rubber Replanting Subsidy Scheme. The following subsidy replanting permits issued in respect of the year 1962 were in force at the end of the year :

	No. of Permits	*Acres*	*Roods*	*Perches*
Estates over 100 acres ...	412	7,179	0	39
Estates between 10-100 acres ...	499	3,900	1	11
Smallholdings under 10 acres ...	4,501	6,544	2	39
	5,412	17,623	1	09

Everyone of the above 4,501 smallholdings was visited by a Rubber Instructor. 33,013 visits were paid during the year to areas which were being replanted and replanted smallholdings inclusive of 24,193 visits to permit areas of previous years 8,820 visits were made to 1962 replanting permit areas during the year.

During the year Rubber Instructors and Assistants lined, 1,599 permit areas totalling 2,331 acres 1 rood 25 perches for soil conservation works and 2,091 permit areas of 2, 969 acres 0 roods 37 perches for planting holes in 1962 permit areas.

Similarly, the field staff has lined a further 738 permit areas of 1,117 acres 3 roods 19 perches in extent for soil conservation works and 775 permit areas of 1,157 acres 0 roods 03 perches in extent for planting holes in permit areas of the previous year. 232 special reports on subsidy replanting permit areas were submitted to the Rubber Controller.

A total of 30,220 tappable trees in 732 subsidy holdings have been marked for tapping by Rubber Instructors by way of demonstration.

A total of 215 visits were made by field staff for the purpose of random checking of the planting material issued at the various Commodity Purchase Depots to replanting smallholders. In all 19,408 plants were examined at these visits. Whenever smallholders' sheets were examined by Rubber Instructors at such visits to Depots all defects seen in sheet were pointed out to smallholders and full advice given on methods of avoiding the defects in smoked sheet.

5. NEW PLANTING

Apart from replanting work Rubber Instructors devoted part of their time in visiting, advising and assisting rubber new-planting smallholders. Each new smallholding for which new-planting rights were desired was visited and reported on by a Rubber Instructor before a permit was issued by the Rubber Controller. 1,900 such preliminary inspections were made and reports sent to the Rubber Controller throughout the year. 1,303 new planting permits covering approximately 1,798 acres were issued during the year. 3,929 visits were made by the field staff to new-planting and new-planted permit areas of 1962 and 1961 for advice and lining assistance. A new record sheet (yellow form) was entered up for each of the year's new-planting permit areas visited. The condition in which the previous year's new-planted areas were found and the work recommended to be done were recorded in the relevant form of each such permit area visited in 1962. 2,997 Final Inspection Reports and 1,296 Special Reports were made by Rubber Instructors during the year.

Rubber Instructors and Assistants lined 320 permit areas of 454 acres 1 rood 27 perches in extent for soil conservation works and 330 permit areas of 446 acres 3 roods 32 perches in extent for planting holes in this year's permit areas.

Similarly, 162 permit areas of 255 acres 2 roods 20 perches in extent were lined by Rubber Instructors and Assistants for soil conservation works and also 149 permit areas of 231 acres 3 roods 27 perches in extent for planting holes in last year's new-planting permit areas. Divisional Advisory Officers have checked such lining in the field in 198 new-planting permit areas.

Rubber Instructors marked 6,914 tappable trees in 118 new-planted smallholdings.

5.1. Soil Conservation.—Rs. 5,779/99 were paid as soil conservation grants to 106 peasant class permit holders. 129 holdings were measured by Rubber Instructors, vouchers prepared and submitted. Of these, 116 measurement forms were checked by Divisional Advisory Officers in the field.

The present new rates of payment are as follows :

		Rate per acre
Type I—Near flat	1 in 10 and under	Rs. 50·00
Type II—Gentle to Moderate Slope	1 in 10 to 1 in 3	,, 80·00
Type III—Strong slope	1 in 3 to 1 in 2·5	,, 120·00
Type IV—Steep to Very Steep	1 in 2·5 and over	,, 240·00

Payments are now made in 2 instalments. The first instalment of 75% is paid at the time of construction of soil conservation works while the balance 25% is paid one year after, if the soil conservation works are being maintained. A further 10-15% is paid if the smallholder has established good covers or constructed additional soil conservation works, or carried out both.

6. SPECIAL INSPECTIONS FOR RUBBER CONTROL DEPARTMENT

The following inspections were undertaken at the request of the Rubber Controller in addition to the normal advisory visits mentioned in this report :

Visits for Preliminary Reports	1,900
Visits for Final Inspection Reports	2,997
Visits for Special Reports	1,296
Visits for random checking of Planting Material ...	215

7. WHITE ROOT DISEASE

The *Fomes* Survey in smallholdings replanted between 1953 and 1955 was concluded during 1959.

No follow-up survey was carried out during 1962.

8. SULPHUR DUSTING

The State-aided Co-operative Sulphur Dusting Scheme which is organised for the purpose of controlling *Oidium* leaf Disease on smallholdings was successfully completed for the year 1962. In organising this scheme the Smallholdings Department provided sulphur dusting machines to the smallholders free of charge and the necessary technical advice and guidance in organising the sulphur dusting groups and carrying out the dusting, while sulphur dust of approved quality was supplied at a subsidised rate of half the price to smallholders (owning under 10 acres.)

As a result of the publicity given to the State-aided Sulphur Dusting Scheme it was possible to reach a figure a little in excess of the target fixed for the year 1962.

Necessary instructions regarding the correct procedure of dusting were given to all staff prior to commencement of dusting. These instructions covered the proper maintenance of dusting machines, supervision of dusting, submitting daily, weekly and monthly reports on the progress and results of dusting and the checking of accounts of incidental expenses of different co-operative dusting groups. All the forms necessary for these purposes were distributed among the staff well in time.

Each accepted co-operative dusting group was issued a sulphur dusting machine on loan. Spare machines were made available at central spots to avoid interruption of dusting due to machine breakdown. The Departmental Mechanic was not available for repairs in the field during dusting as he left the services of the Department on 1st January, 1962. All light repairs during dusting had to be attended to by local mechanics. Major repairs, however were handed over to the Agents of the machines.

Applications were received from 97 tentatively formed groups. Two groups however could not be included in the scheme due to insufficient acreage in the group, failure in making payment for sulphur in time and general lack of co-operation among the smallholders. Thus only 95 dusting groups (Annexure 1) comprising 2,927 holdings giving a total acreage of 9,597 were accepted for dusting.

As in previous years Kalutara continued to be the single district with the largest acreage dusted, *i.e.*, 2,530 acres as against 2,347½ acres last year. This year the smallest acreage dusted in a single district was Kandy with 60 acres.

District	No. of Groups 1962	No. of Holdings 1962	Acreage 1962
Kalutara	24	759	2530
Kegalla	28	744	2039
Colombo	23	820	2386½
Ratnapura	12	341	1273¾
Galle	7	150	774¾
Matara	5	97	533
Kandy	1	16	60
Total	95	2927	9597

This year 13 old co-operative sulphur dusting groups were made to function on their own with no help from the Department. In these groups under the guidance of their energetic Group Organisers, collecting of money, transport and distribution of sulphur dust, dusting and all other work in connection with dusting were done by the group members themselves.

Dusting operations commenced on 6-1-62 in Uduwa Sulphur Dusting Group in the Undugoda Range. The first dusting group to complete dusting was

the one organised at Uduwa (Undugoda Range) where the final round was completed on 15-2-62. The dusting operations for the season were concluded on 22-3-62 when the last holdings of the Ethkandura Group (Galle District) were given their fifth round of dusting.

It has been observed that whilst undusted holdings were infected by *Oidium* the degree of attack being less than that observed last year, the dusted holdings generally escaped attack. In a very few cases where wintering was very late and where rain interfered with sulphur dusting a slight amount of infection was noticed in the dusted holdings :

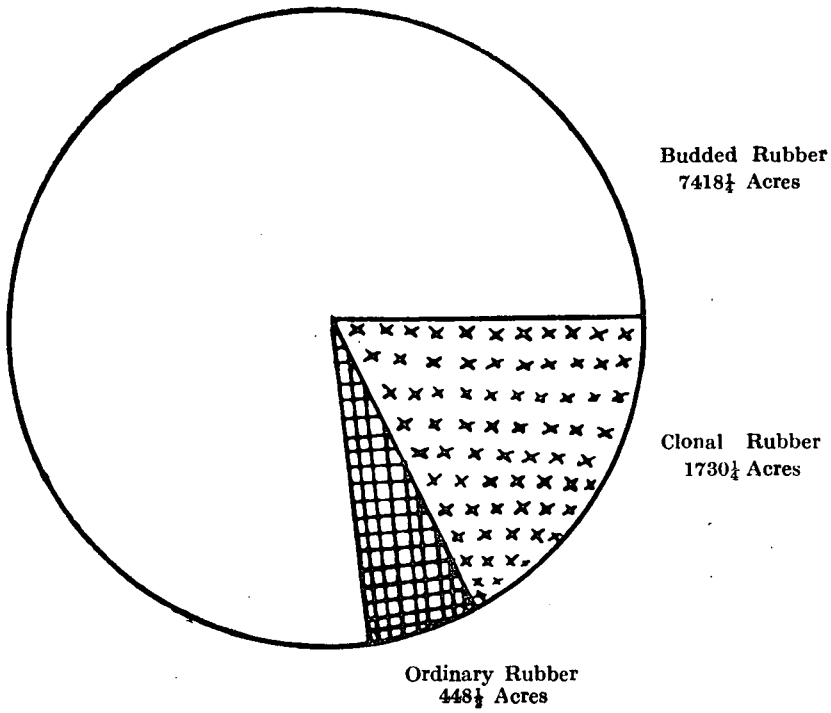
Summary.

Acreage dusted	9,597
Number of holdings dusted	2,927
Number of groups which functioned ...	95
Number of machines used	132
Acreage per machine	72·7
Average size of a holding...	3·3 acres
Size of the smallest holding	¼ acre
Size of the largest holding	30 acres
Average number of holdings in a group ...	31 approx.
Average cost of dusting an acre, including sulphur	Rs. 12·39

The total extent of 9,597 acres dusted in 1962 constitutes the largest extent of smallholdings dusted against *Oidium* in a single season.

The smallest holding to be dusted was ¼ of an acre in extent. The total acreage dusted consisted of 7,418¼ acres of budded rubber, 1,730¼ acres of clonal seedling rubber and 448½ acres of ordinary unselected seedling rubber.

Acreage classified according to type of rubber



Of the total acreage, 7,568 acres *i.e.*, 80% were provided with subsidised sulphur at a rate of Rs. 6.05 per acre and 2,029 acres were supplied with sulphur dust at the non-subsidised rate of Rs. 12.10 per acre. The total average cost of dusting an acre was Rs. 12.39 including the cost of sulphur. A follow-up questionnaire was distributed a month after dusting to note the results of sulphur dusting.

The answers reveal that :

1. Almost all the dusted holdings were free of *Oidium* while on the other hand the undusted holdings were infected.

2. Incidence of disease in general has been less heavy than last year in undusted holdings.

3. In dusted holdings specially in the very late winterers infection of *Oidium* appeared on a very small scale.

4. Almost all *i.e.*, the smallholders who took part in this scheme this year, have expressed their willingness to participate in this scheme in the coming year as well.

8.1. Sulphur Dusting during 1963.—Arrangements have been completed for the dusting in January to March 1963 of approximately 10,221 acres of rubber in 3, 202 holdings. A total of 101 sulphur dusting groups were accepted by the end of 1962. The distribution according to Revenue Districts would be as follows :—

Districts	*No. of Groups*
Kalutara	26
Colombo	22
Kegalla	26
Ratnapura	13
Galle	9
Matara	4
Kandy	1
Total	**101**

The sulphur dust of the required quality has been purchased and is being distributed among all smallholders taking part in the scheme. Sulphur dust at the subsidised rate is issued for dusting 3,058 holdings each below 10 acres in extent. Detailed instructions have been given in all aspects of dusting, including maintenance and proper care of machines. The sulphur dusting demonstrations for training machine operators of new groups will begin in January 1963. In all 17 sulphur dusting demonstrations will be held in the 6 Departmental divisions.

9. PUBLICITY UNIT

The Publicity Unit has functioned successfully throughout the year. 126 publicity meetings cum-exhibitions and slide shows were held throughout the rubber growing areas of the island during the year. Five sets of colour-slides were shown on Soil Conservation Works, *Fomes*, Tapping, *Oidium* and Posters discouraging undergirth tree tapping.

The Publicity Unit also participated at the Science Exhibition at Rahula College, Matara, where this Department had a stall of its own. This year four Publicity Meetings-cum-Exhibitions for Farm Students were held at the Ambepussa, Mapalana, Horana and Batangala Farms where the smallholders of the area too were allowed to attend.

It is now increasingly felt that a comprehensive film on rubber cultivation, manufacture and marketing of sheet should be shown by the Publicity Unit to smallholders and small estate owners whose replanted holdings are now coming into production in large numbers.

10. LECTURES, DEMONSTRATIONS AND TRAINING CLASSES

10.1 Lectures.—The Divisional Advisory Officers visited, on request, the Government Farm Schools at Ambepussa, Horana, Batangala and Wagolla and conducted a series of lectures in Sinhala on rubber planting, sheet manufacture and allied subjects to the students taking courses in practical agriculture.

10.2 Demonstrations.—Rubber Instructors conducted 855 sheet making demonstrations. Instructors paid 1,007 and 2,026 visits to demonstration smoke-houses and ordinary smoke-houses respectively for advice and instructions on sheet improvement.

In addition to the above mentioned sheet making demonstrations, 788 tapping, 485 disease control and 502 miscellaneous demonstrations were given by the field staff.

For the purpose of improving the smoking of smallholders' sheet, Rubber Instructors persuaded smallholders to commence building 45 demonstration smoke houses of which 41 were satisfactorily completed and a grant of Rs. 75/- each was paid per range for the year. Rubber Instructors persuaded smallholders to commence building 82 ordinary smoke-houses and 48 of these ordinary smoke-houses were satisfactorily completed during the year.

10.3. Practical Training Classes in Tapping.—A scheme for training of smallholders in tapping rubber trees was initiated. The 6 Divisional Advisory Officers and 6 selected Rubber Instructors from the 6 divisions were first given a training on tapping methods at Dartonfield.

The following smallholders were eligible to join the training classes as trainees under this scheme :

1. *Bona-fide* smallholders who own and manage their own smallholdings.
2. Relatives of smallholders who work in the smallholdings of their relatives.
3. Tappers employed by smallholders in their holdings.

Six training classes were started in the six divisions commencing on 6th August and continued for a period of eight weeks. The distribution of trainees who participated and those who were successful is given below :

Division	*Range*	*No. of Trainees who Participated*	*No. Successful*
Kegalla	Warakapola	16	14
Avissawella	Undugoda	20	18
Colombo	Kesbewa	18	14
Ratnapura	Ingiriya	19	7
Matugama	Matugama	15	10
Galle	Pitigala	20	6
	Total	108	69

Those who attended almost all the classes and showed satisfactory proficiency at an oral test were issued with certificates to say that they have successfully completed an eight week course of training including 16 classes in tapping.

Certificates were issued to 69 successful trainees. Mr. T. C. A. de Soysa, the Chairman of the Rubber Research Board gave away the certificates to 51 trainees, of the classes held at Warakapola, Kesbewa, Ingiriya, Matugama and Pitigala, on the Field Day of this Department held at Matugama on 10th November, 1962.

Mr. W. P. H. Dias, J.P., the Smallholders' Representative of the Rubber Research Board presided and distributed the certificates to the 18 successful trainees of the Undugoda range, on the 15th December.

In 1963, all the 47 Range Instructors would be trained in tapping and training classes for smallholders would be organised in all 47 ranges.

11. SURVEYS

11.1. Rainfall Survey.—Rubber Instructors continued to send the daily rainfall returns for the survey which commenced in April, 1961. The survey is being continued.

11.2. Survey of the Economics of a Rubber Smallholding.—This Survey which was started in 1961 to find out the economics of a Replanted Smallholding was continued throughout the year. Rubber Instructors have started sending in the Forms ES 3, 4 and 5 which aim at finding out the cost of Replanting a Smallholding, and the cost of maintenance in the first and the second year respectively.

11.3. Tapping Survey.—At the request of the Rubber Replanting Advisory Board a survey of tapping undergirth trees replanted from 1953 to 1956 under the Rubber Replanting Subsidy Scheme was started. The Instructors were made to note the following :

(*A*) *Tapping.*

1. Holdings where tapping has commenced at the correct stage (Girth of 20″ at 3 feet over 60% of the plantation).
2. Holdings where tapping has commenced when about 40 to 50% of trees in the plantation had attained a girth of 20″, but with a few undergirth trees also brought into tapping.
3. Holdings where tapping has commenced when the majority of trees are undergirth.

(*B*) *Maintenance.*

1. Holdings not maintained properly (very weedy lands).
2. Holdings with tapping cuts opened at the wrong heights and angles.

(*A*) *Tapping.*

In category 1 we have the smallholder who have tapped at the required girth and correct stage.

In category 2 we get holdings where only 40-50% of the trees in a plantation have attained the required girth of 20″ at 3′ above ground level. Tapping of these trees is carried out with a few undergirth trees included either to get sufficient trees for a day's task or to get sufficient latex to cover costs incurred in tapping.

Plantations of this category would have attained the 60% stage in about another 6 months. In any case within one year the trees of these plantations would be at the correct girth. Smallholders who adopt this can be regarded as not doing any irreparable damage to their plantations.

Under category 3 we get holdings which are tapped undergirth. These smallholders do considerable damage to their plantations and have therefore to be prevented.

The survey was carried out in all holdings planted under the Subsidy Scheme in the specified period in 4 random villages per range in all ranges. The survey was therefore carried out in 168 villages having 2,253 permits covering an acreage of 3,770 acres 0 roods 02 perches.

During this period 1953-1956 (both years inclusive) a total of 11,199 permits had been issued. Thus the survey had been carried out in approximately 20% (exact figure is 20·1%) of the total number of permits.

Of the 2,253 holdings inspected 1,437 holdings (63·8%) giving an acreage of 2,438 acres 1 rood 02 perches had not been tapped yet. These would include almost all the area planted in 1956 and part of that planted in 1955.

Of the 816 tapped holdings giving an acreage of 1,131 acres 3 roods 00 perches 471 holdings (57.7% of the total tapped) fall into category 1 while 218 holdings 26·7%) fall into category 2 and 127 holdings (15·6%) fall into category 3.

The percentages in acreage figures closely follow those calculated on holdings basis (Tables I and II annexed).

(*B*) *Maintenance.*

The second part of the survey dealing with :

(*a*) Plantations not maintained properly ; and
(*b*) Plantations with tapping cuts at the wrong heights and angles,

have revealed that of the 2,253 holdings inspected, 608 holdings (27%) were not maintained properly and were full of weeds (Table III annexed), while 305 holdings (37·4% of the area tapped) had tapping cuts at the wrong heights or angles (Table IV annexed).

(*C*) *Suggestions.*

Before any suggestion could be made regarding how this could be prevented, it is desirable to see why smallholders tap undergirth plantations.

1. Ignorance — They may not know the required girth, correct height and angle of cut, etc.

2. Poverty — The absence of other means of existence other than the rubber plantation ; or

other forms of Agriculture in a very limited scale.

The first can be reduced by propaganda and training classes while that due to the latter cannot be prevented unless other avenues of employment are made available to them.

TABLE I

Acreage data on the 3 different categories of tapping, total acreage tapped and untapped and the total acreage on which the survey was carried out.

DIVISION	Tapped at Correct stage		Tapped when 40-50% trees only are at correct girth with few undergirth trees included		Tapping when majority of trees are undergirth		Total acreage tapped		Total acreage untapped		Total acreage on which Survey was carried out	
	a	b	a	b	a	b	a	b	a	b	a	b
	No. of Holdings	Acreage	No. of Holdings	Acreage	No. of Holdings	Acreage	No. of Holdings	Acreage	No. of Holdings	Acreage	No. of Holdings	Acreage
Colombo	118	193·0·15	45	78·1·34	33	56·2·00	196	328·0·09	222	377·3·05	418	705·3·14
Avissawella	44	63·2·29	34	60·0·29	25	36·2·32	103	160·2·10	148	228·1·37	251	389·0·07
Kegalla	53	85·0·00	24	39·1·29	13	27·0·33	90	151·2·22	204	326·0·37	294	477·3·19
Ratnapura	63	130·1·02	35	55·2·36	15	19·2·08	113	205·2·06	235	396·0·12	348	601·2·18
Matugama	115	167·3·11	41	67·1·17	14	12·1·35	170	247·2·23	348	517·3·38	518	765·2·21
Galle	78	126·2·18	39	67·0·30	27	44·2·02	144	328·1·10	280	591·2·33	424	830·0·03
TOTAL	471	766·1·35	218	368·1·15	127	196·3·30	816	1331·3·00	1437	3428·1·02	2253	3770·0·02

TABLE II

Percentage of holdings which come under the 3 different categories of tapping

	No. of Holdings	Percentage of Total	Acreage	Percentage of Total
1. Tapped at correct girth	471	57·7	766·1·35	57·5
2. Tapped when 40-50% of trees are at correct girth with a few under-girth trees included	218	26·7	368·1·15	27·6
3. Tapped undergirth	127	15·6	196·3·30	14·8
	816		1331·3·00	

TABLE III

Acreages not maintained properly

DIVISION	Not maintained properly	
	No. of Holdings	Acreage
Colombo	152	261·1·06
Avissawella	63	111·0·32
Kegalla	88	139·2·33
Ratnapura	132	217·2·30
Matugama	53	64·3·21
Galle	120	245·0·30
TOTAL	608	1039·3·32
Percentage of total Inspected	27·0	27·6

TABLE IV

Acreages with tapping cuts at the wrong heights or wrong angles

DIVISION	Tapping cuts at wrong heights or angles	
	No. of Holdings	Acreage
Colombo	75	133·3·23
Avissawella	46	71·2·01
Kegalla	37	65·3·29
Ratnapura	46	81·2·14
Matugama	43	61·3·37
Galle	58	79·1·23
TOTAL	305	494·1·07
Percentage of total tapped	37·4	37·1

ANNEXURE I

CEYLON
SULPHUR DUSTING SCHEME 1962
Showing
Distribution of Dusting Groups

/ / / Rubber

O Dusting Groups

KANDY
1

COLOMBO
23

KEGALLE
23

KALUTARA
24

RATNAPURA
12

GALLE
7

MATARA
5

	No. of Groups
Colombo District	23
Kalutara ,,	24
Kegalla ,,	23
Galle ,,	7
Matara ,,	5
Ratnapura ,,	12
Kandy ,,	1
	95

REVIEW OF THE ESTATE DEPARTMENT

By

L. Wijeyegunawardene

SUMMARY

The Institute's stations at Dartonfield, Nivitigalakele and Hedigalla, in extent 1,491 acres 0 roods and 30 perches, carry a planted acreage of 1002 of which 760 acres were in tapping during the year. Fifty seven acres were under nursery for the Rubber Replanting Subsidy Scheme at Hedigalla.

Weather conditions were not conducive to the harvesting of crop. The South-West monsoon rains were protracted, causing fairly extensive wind damage in the outlying divisions of the Group, and finally merged with a comparatively mild North-East monsoon.

A crop of 459,747 lb was harvested representing an average yield of 604·7 lb per acre.

The immature rubber acreage was reduced from 303 acres, 2 roods, 33 perches in 1961 to 223 acres, 3 roods, 6 perches in 1962.

The incidence of *Oidium heveae* during refoliation of early winterers was light in comparison with the past few years. The late wintering clones, however, registered a fairly heavy leaf fall. A satisfactory control of the disease was achieved by sulphur dusting.

Phytophthora leaf-fall was very much reduced this season and presented no difficulties for the control of the disease. The dusting technique employed using copper-based fungicides proved adequate. There were, however, indications of a marked increase in the incidence of *Gloeosporium* in young clearings. Bark Rot among the better known clones was negligible. A few marked cases were observed and treated, particularly at Hedigalla where numerous clones are under test for experimental purposes. The organo-mercurial furgicides used as a control measure proved effective.

Budwood of the RRIC clones continued to be much in demand and issues of a nucleus supply of material to all estates and small holdings were met. Routine weeding, cultivation and other agricultural operations were carried out in all mature and immature areas of the Group.

The Rubber Replanting Subsidy Scheme Nursery at Hedigalla under the Rubber Controller continued to be supervised throughout (1962). The nursery was in full production.

Estimates for 1963 connected with the working of the Group, field and factory experiments, etc., were prepared by the writer and approved by the Rubber Research Board. In connection with the Hedigalla Nursery an estimate for 1968 was prepared and submitted to the Rubber Replanting Advisory Board.

DETAILED REVIEW

1. GENERAL.

1.1. Staff.—The Superintendent, Mr. L. Wijeyegunawardene, was on duty during the year. Mr. M. R. T. Mendis assumed duties as Assistant Superintendent on 2nd April 1962 and was throughout on duty. He was stationed at Hedigalla Division.

Mr. D. C. Thambawita was appointed Correspondence Clerk (Assistant Staff Grade II) with effect from 1st February 1962.

Messrs. N. L. D. Eron, K.P. Siriwardene and A. K. Martin were appointed Field Attendants, Botany Department, on 2nd April, 1962, and were stationed at Dartonfield, Hedigalla and Nivitigalakele respectively.

Mr. W. A. C. Wijesinghe, Laboratory Attendant, Rubber Chemistry Department, was promoted as Field Assistant, Botany Department on 5th April, 1962. He was stationed at Hedigalla Division.

Mr. B. H. Withanachchi was appointed Junior Clerk (Assistant Staff Grade III) on 17th April, 1962, and was stationed at Hedigalla Division.

The death of Mr. H. A. Mendis, Senior Field Assistant, Nivitigalekele Experimental Station, on 5th August, 1962 is recorded with regret.

Mr. A. Fernando, Dispenser stationed at Hedigalla Division, resigned on 31st October, 1962.

The Estate Department cadre stood at 50 at the close of the year, made up as follows :

Senior Staff	...	...	1
Intermediate Staff		...	1
Assistant Staff	...	...	24
Minor Staff	...	...	24

1.2. Visiting Agent.—Mr. W. B. Jonklaas paid two visits to the Institute's properties during the year. Reports on these visits were submitted to the Rubber Research Board.

1.3. Correspondence.

Inward	...	...	766
Outward	...	...	1,300

1.4. Weather (Estate Gauge).—Comparative rainfall figures (inches) for 1961 and 1962 are given below.

Month	Dartonfield		Nivitigalakele		Hedigalla	
	1962	1961	1962	1961	1962	1961
January	6·80	11·16	6·18	5·38	9·78	9·39
February	3·66	1·74	2·25	1·08	8·98	6·65
March	12·39	10·95	6·76	10·30	16·26	16·26
April	13·35	11·74	12·85	14·28	11·44	14·41
May	33·39	23·51	30·61	23·07	31·74	20·33
June	13·38	9·99	11·11	10·18	10·33	9·80
July	11·61	13·13	10·03	13·88	12·79	13·34
August	16·20	16·49	14·96	14·29	14·07	19·27
September	12·25	24·57	12·86	23·66	16·01	19·70
October	17·41	18·21	14·60	16·22	18·95	20·74
November	15·99	21·66	16·18	16·76	20·09	16·07
December	6·94	12·37	4·63	11·15	12·50	13·86
	163·37	175·52	143·02	160·25	182·94	179·82
Average (5 year period)	151·53″		152·84″		186·21″	
Total No. of Wet days	232	255	242	239	267	267

The rainfall for the year at Dartonfield, Nivitigalakele and Hedigalla Divisions amounted to 163·4″, 143·0″ and 182·9″ respectively and was above the quinquennial average by 11·9″ at Dartonfield and fell short of the average by 9·8″ at Nivitigalakele and 3·3″ at Hedigalla. A significant feature of note was that the first six months of the year was as wet as the second half of the year, the rainfall being approximately equal. In the early stages of the South West monsoon severe wind damage was caused in some of the more exposed planted areas.

1.5. Acreage Summary — Dartonfield Group.

Rubber	Dartonfield			Nivitigalakele			Hedigalla			Total		
	A.	R.	P.	A.	R.	P.	A.	R.	P.	A.	R.	P
Mature ...	85	1	39	131	2	19	543	0	21	760	0	39
Immature ...	40	3	20	15	0	0	167	3	26	223	3	06
Nurseries ...	6	0	0	11	3	07	—	—	—	17	3	07
Total ...	132	1	19	158	1	26	711	0	07	1001	3	12
Abondoned due to wind damage, etc. ...	—	—	—	4	2	04	—	—	—	4	2	04
Building sites ...	39	0	36	7	3	29	8	1	18	55	2	03
Pinewood Plantation ...	—	—	—	—	—	—	1	0	34	1	0	34
Roads ...	6	2	22	0	3	27	9	0	04	16	2	13
Swamp Area ...	—	—	—	0	2	08	0	2	20	1	0	28
Streams and reservations	0	0	29	—	—	—	13	0	29	13	1	18
Jungles, etc. ...	—	—	—	1	3	38	395	0	0	396	3	38
Grand Total ...	178	1	26	174	1	12	1138	1	32	1491	0	30

The total cultivated acreage of the Group stood at 1001 acres, 3 roods and 12 perches by the end of the year.

1.6. Crop.—An unfavourable distribution of rainfall not conducive to both tapping and harvesting of crop was experienced throughout the year resulting in a slight reduction of the crop harvested as against the estimated crop for the season.

	1962		1961	
Estimated ...	461,000 lb		352,000 lb	
Harvested ...	459,717 ,,		417,537 ,,	
Deficit ...	1,283 lb	Excess	65,537 lb	

Comparative Yield Records of Individual Fields

Dartonfield	Acreage in tapping	Total yield in lb 1962	Total yield in lb 1961	Yield in lb per acre 1962	Yield in lb per acre 1961
1938 Replanted Areas	4½	5,104	4,721	1,134·2	1,049·1
1941 ,, ,, ...	5	3,226	3,275	645·2	655·0
*1947 ,, ,, ...	4	5,315	4,876	1,328·7	609·5
1950/51 ,, ,, ...	25¾	15,764	17,858	612·2	693·5
1952 ,, ,, ...	27	19,855	17,743	735·4	633·7
1953 ,, ,, ...	11½	5,065	3,542	440·4	308·0
1954 ,, ,, ...	7¾	1,256	664	162·1	85·7
	85½	55,585	52,679	650·1	582·1

Nivitigalakele	Acreage in tapping	Total yield in lb 1962	Total yield in lb 1961	Yield in lb per acre 1962	Yield in lb per acre 1961
1926 Replanted Area ...	—	—	14,005	—	1,338·8
*1927/28 ,, ,, ...	15¾	5,589	25,561	354·9	1,262·3
*1935 ,, ,, ...	28½	20,695	25,561	726·1	896·9
1939 ,, ,, ...	10¼	7,147	7,672	697·2	748·5
1940 ,, ,, ...	9¾	7,437	7,276	762·8	746·3
1940 Swamp Area ...	3¼	3,535	3,669	1,087·6	1,128·9
1941 Clearing ...	7	6,537	6,709	933·8	958·4
1942 ,, ...	4½	4,868	5,037	1,081·7	1,119·3
1948 ,, ...	7	4,783	5,321	683·3	760·1
1944 ,, ...	4½	4,757	4,777	1,057·1	1,061·6
1946 Replanted Area ...	21	24,694	25,405	1,175·9	1,209·8
1953 Clearing ...	10	6,247	—	624·7	—
1954 ,, ...	10	10,087	8,531	1,008·7	853·1
	131½	106,376	139,524	808·9	1,022·2

Hedigalla	Acreage in tapping	Total yield in lb 1962	Total yield in lb 1961	Yield in lb per acre 1962	Yield in lb per acre 1961
1943 Clearing ...	10¼	9,825	10,045	958·6	980·0
1944 ,, ...	11¾	9,734	9,752	828·4	829·9
1945 ,, ...	22¼	21,414	23,512	962·4	1,056·7
1946 ,, ...	12¾	10,807	12,680	847·6	994·5
1947 ,, ...	45	30,454	33,057	676·8	734·6
1949 ,, ...	34¾	26,735	25,059	769·4	721·1
1950/51 ,, ...	20	15,280	11,403	764·0	570·2
1952 ,, ...	79½	42,661	33,536	536·6	448·6
1953 ,, ...	142	68,597	49,838	483·1	365·1
1954 ,, ...	125	42,301	13,130	338·4	145·9
1955 ,, ...	40	19,948	—	498·7	—
	543¼	297,756	222,012	548·1	484·7
Total for the Group ...	760¼	459,717	414,215	604·7	604·7
Slaughter tapping at Dartonfield ...	—	—	3,322		
	760¼	459,717	417,537		

1.7. Tapping.—(a) Tapping was resumed after a fortnight's rest during refoliation on the 25th and 27th February and 5th March at Dartonfield, Nivitigalakele and Hedigalla respectively. Tapping panels were marked with the appropriate bark consumption in keeping with the systems of tapping adopted in the various experimental clearings.

(*b*) In the 1947 Replanted Area at Dartonfield, the increase in yield per acre is due to intensive tapping and use of stimulants.

(*c*) The 1927/28 clearing was uprooted for replanting in July/August this year and represents yield for only half the year.

(*d*) A marked drop in yield in the 1935 Clearing at Nivitigalakele is due to the area being under intensive tapping for the previous two years and partly under experiment on various tapping systems.

(*e*) In the 1946 and 1947 Clearings at Hedigalla, the drop in yield is due to heavy wind damage and removal of trees around the buildings.

1.7.1. Analysis of tapping rounds on Dartonfield Group for 1962 (1961 figures in brackets).

Dartonfield	Early tapping	Late tapping	No Tapping Winter rest	Rain	Holidays
1st Quarter	46 (53)	19 (13)	16 (16)	3 (2)	6 (6)
2nd ,,	41 (39)	23 (24)	— —	22 (24)	5 (4)
3rd ,,	42 (32)	23 (30)	— —	27 (30)	— —
4th ,,	49 (40)	30 (35)	— —	12 (14)	1 (3)
	178 (164)	95 (102)	16 (16)	64 (70)	12 (13)

Nivitigalakele	Early tapping	Late tapping	No tapping Winter rest	Rain	Holidays
1st Quarter	63 (63)	9 (6)	16 (16)	— (2)	2 (3)
2nd ,,	54 (39)	15 (29)	— —	17 (17)	5 (6)
3rd ,,	49 (39)	21 (27)	— —	22 (26)	— —
4th ,,	59 (61)	18 (19)	— —	14 (12)	1 —
	225 (202)	63 (81)	16 (16)	53 (57)	8 (9)

Hedigalla	Early tapping	Late tapping	No tapping Winter rest	Rain	Holidays
1st Quarter	48 (52)	11 (21)	22 (28)	8 (2)	1 (1)
2nd ,,	46 (40)	13 (14)	— —	27 (30)	5 (7)
3rd ,,	36 (24)	14 (23)	— —	42 (45)	— —
4th ,,	47 (38)	9 (27)	— —	35 (27)	1 —
	177 (154)	47 (76)	22 (23)	112 (104)	7 (8)

1.8. Manufacture.—A summary of the various forms of manufacture during the year is given below :

Latex Grades	Total in lb	Percentage
Smoked sheet No. 1 ...	3,547	0·77
,, ,, ,, 3 ...	127	0·03
Pale Crepe ,, 1 ...	293,229	63·78
,, ,, ,, 2 ...	19,670	4·28
,, ,, ,, 3 ...	69,308	15·08
Latex for Experiments ...	412	0·09
	386,293	84·03

Scrap Grades	Total in lb	Percentage
Scrap Crepe No. 1 ...	50,464	10·98
,, ,, ,, 2 ...	12,992	2·82
,, ,, ,, 3 ...	9,968	2·17
	73,424	15·97
Grand Total ...	459,717	100·00

With the additional acreage of experimental areas of numerous clones with diverse latices coming into bearing, the production of a high percentage of uniform crepe No. 1 is made increasingly difficult.

1.9. Miscellaneous.

Field and Factory Experiments.—The Chemistry, Botany, Plant Pathology and Soils Departments were given assistance in carrying out their field and factory experiments.

Estimates.—Estimates of Capital and Revenue Expenditure for 1963 in respect of Dartonfield Group, prepared and submitted by the writer to the Rubber Research Board, were approved.

Estate Roads.—All motorable roads and paths were maintained in good condition throughout the year.

Manuring.—Mature areas of the Group received their quota of fertilizers in keeping with the R.R.I. programme.

2. PESTS AND DISEASES

2.1. Oidium heveae.—The incidence of *Oidium* was light in general. The numerous clones on a per acre basis planted in close proximity to each other, resulted in an uneven wintering. This necessitated a protracted spell of spot dusting at the initial and later stages of refoliation. Regular dusting rounds were maintained in areas where possible, and a very satisfactory control was achieved. The trees carried an exceptionally good canopy of foliage not seen for many years.

2.2. Phytophthora palmivora.—Contrary to expectations, there was a comparatively mild attack of *Phytophthora* this year. Weather conditions changed in June and the rainfall for June was below average. The distribution of the rainfall in the months of July and August with intermittent dry sunny days, inhibited the possible activity of the fungus. Due to the humid conditions prevailing at Hedigalla, protracted dusting with copper-based fungicides together with the dusting technique employed, effectively sealed off any spread of the fungus.

2.3. Bark Rot.—Among the better known clones, the incidence of Bark Rot was negligible. A few clones under test, particularly at Hedigalla, showed marked susceptibility to Bark Rot and these received attention.

2.4. Gloeosporium.—The incidence of *Gloeosporium* was observed to be increasing in intensity annually in both young clearings and nurseries.

2.5. Root Diseases.—A few scattered cases of *Fomes lignosus* and *Ustulina zonata* were found on the mature areas and routine measures of control were adopted. Details of loss of trees due to various causes were given in the monthly reports of this Department.

2.6. Wind Damage.—The loss of trees due to wind damage on Dartonfield, Nivitigalakele and Hedigalla were 121, 237 and 862 trees respectively.

3. CAPITAL ACCOUNT — AGRICULTURAL DEVELOPMENT.

Dartonfield Division—Immature Replanted Areas.

1953	Replanted Area (Planted in 1956)	5 acres
1955/56	,, ,, ...	4¾ ,,
1960/61	,, ,, ...	31½ ,,
		41¼ ,,

Nivitigalakele Division—Immature Areas.

1962 Replanted Area	16¾ acres

Hedigalla Division—Immature Areas.

1954	Clearing	52½ acres
1955	,, ...	38 ,,
1956	,, ...	60 ,,
1957	,, ...	17¼ ,,
		167¾ ,,

Routine weeding, cultivation and other agricultural operations were carried out. The immature areas are in good condition and were maintained up to the required standards of sound agricultural practice.

3.1. Number of Trees Uprooted—Immature Areas.

Dartonfield	1953	1955
Wind damage	3	2
Fomes noxius	—	4
Fomes lignosus	—	2
	3	8

Hedigalla	1955	1956	1957
Wind damage ...	22	8	8
Fomes noxius ...	2	2	3
	24	10	11

3.2. 1961 Replanted Area (31 acres) at Dartonfield.—In accordance with the requirements of the Botanist two tapping tasks of each of the clones, RRIC 7, RRIC 45, RRIC 52, RRIC 88, RRIC 89, PB 28/59, PB 86 and RRIM 513 were planted in this replanted area and the plants are growing well throughout. The Plant Pathologist has laid out an experiment on 'control of diseases' in this replanted area. RRIC 45 and RRIC 52 show very vigorous growth and clonal characteristics. Supplies were made where necessary. Payment of instalments under the Rubber Replanting Subsidy Scheme were duly received.

3.3. 1962 Replanted Area (16¾ acres) at Nivitigalakele.—This area was planted in the ' South West ' at a planting distance of 12′×20′ on the old contour platforms. The clones being RRIC 5, RRIC 39, RRIC 51, RRIC 86, RRIC 90, RRIC 91, RRIC 92, RRIC 93, RRIC 94, RRIC 95, RRIC 96, RRIC 97, PB 86, IAN 45-717, RRIM 623, RRIM 628, RRIM 701 and 17 ten-tree clones. The area was well weeded, manured and all *Fomes* patches carefully attended to. The plants are coming up well. Payment of instalments under the Rubber Replanting Subsidy Scheme were duly received.

3.4. 1963 Replanted Area, (13¾ acres) at Nivitigalakele.—Felling and clearing operations including fencing were completed by the end of the year, in preparation for replanting during the South West monsoon of 1963.

4. NURSERIES

4.1. Dartonfield Seedling and Budwood Nurseries.

(*a*) Routine weeding and clearing of drains were carried out in all the nurseries. Plants were manured in accordance with the Institute's recommendations.

(*b*) Overgrown plants bearing over-matured budwood were lopped systematically.

4.2. Nivitigalakele—Seedling and Budwood Nurseries.

(*a*) Weeding, clearing of drains and manuring were done.

(*b*) Vigorous growing stocks in these nurseries were budded to meet the following requirements :

Nivitigalakele nursery planting	466	budded	stumps
Nivitigalakele—1962 Replanted area	3,669	,,	,,
Dartonfield—1961 Replanted area	650	,,	,,
Kuruwita and Kumarawatta (PB Section) ...	5,633	,,	,,
Outside Estates (Illuktenne Group)	1,200	,,	,,
Botany Department experiments	21	,,	,,
	11,639	,,	,,

(*c*) Overgrown plants bearing overmatured budwood were lopped for obtaining fresh budwood.

(*d*) 987 yards of budwood of various clones were despatched to estates and smallholdings, 50 yards to Rubber Replanting Subsidy Scheme Nursery at Hedigalla, 846 yards for Nivitigalakele and Kuruwita budgraftings, 7 yards to Monteragala Breeding Station, 9 yards to Rubber Control Department and 225 yards to Kuruwita Sub-station.

5. LABOUR AND HEALTH

(*a*) The regular labour force was inadequate and temporary casual labour was employed to meet requirements.

(*b*) Line room accommodation was satisfactory. Repairs to all cottages were carried out according to the programme.

(*c*) Wages were paid during the year in accordance with the Wages Board Ordinance in force.

Dartonfield Group.

		Resident	Non-Resident	Total
Working Ceylonese				
Men	...	114	173	287
Women	...	84	110	194
Children	...	1	—	1
Working Immigrants				
Men	...	37	—	37
Women	...	29	—	29
Children	...	—	—	—
		265	283	548

Annual Holidays.—Annual holidays with pay were given to all labourers who were entitled to these in accordance with the Ordinance.

Maternity Benefits.—Thirty-six full maternity benefits and six medical wants benefits payments were made.

Feeding Children and Milk Foods.—Free rations and $\frac{1}{4}$ lb bread were issued to each non-working child. Milk foods were issued to all infants whose mothers were incapable of nursing them.

Health.—The health of the members of the Institute's staff and of the estate labourers was satisfactory during the year.

Anti-Mosquito Measures.—DDT/Gammexane spraying was carried out throughout the year, at regular intervals, in and around the bungalows and lines under the supervision of the Apothecary and the Dispenser.

Births.—Fifteen children were born during the year on the Group.

Deaths.—There were two deaths on the Group this year.

A list of diseases treated by the Institute's Apothecary and the Dispenser is given below :

Influenza	...	...	...	1,442
Ulcers	...	...	...	496
Ankylostomiasis	...	...	...	178
Diarrhoea and Enteritis		...	...	207
Ear diseases	...	...	...	20
Other diseases	...	...	...	3,240
			Total ...	5,583

6. RUBBER REPLANTING SUBSIDY SCHEME NURSERY AT HEDIGALLA.

6.1. Supervision.—The Estate Superintendent, R.R.I.C., paid supervisory visits to this nursery during the year.

6.2. Staff.—Mr. L. Samaranayake, Assistant Nursery Manager.

6.3. Rainfall.—182·94 inches were recorded as against 179·82 inches in 1961. There were 267 wet days in the year.

6.4. Seedling Nursery.

(*a*) The acreage of the nursery stood at 57 as in the previous year. One third of the total nursery area was allowed to fallow for one year on a three year rotation basis. This area not planted with rubber seedlings was sown with *Crotolaria anagyroides*.

(*b*) During the second quarter of the year, nineteen acres of nursery beds were prepared to receive Tjir 1 seed from the July/August seed fall. This area was fully planted by the end of September.

6.5. Budwood Nursery.—4,539 planting points made up of buddings of PB 86 and RRIC 52 supplied the entire quantity of budwood from this nursery for the North-East and South-West issues of planting material for the Rubber Control Department.

6.6. Maintenance.—The seedling and budwood nurseries were satisfactorily maintained throughout the year. Routine weeding, manuring and attention to paths and drains were carried out.

6.7. Pests and Diseases.—The incidence of *Oidium* was very light and a few rounds of sulphur dusting was carried out in February and March.

A mild attack of *Phytophthora* and *Gloeosporium* occurred during the wet months of September, October and November necessitating several rounds of spraying with Perenox and Colloidal Copper as recommended by the Visiting Agent.

6.8. Planting Material.—79,430 budded stumps of clone PB 86 and 58,733 Tjir 1 clonal seedlings were issued from this nursery by the Rubber Control Department during the South-West and North-East planting seasons.

6.9. Estimates.—An estimate for maintenance of the nursery for 1963 was prepared and submitted to Rubber Replanting Advisory Board.

6.10. Visiting Agent.—Mr. E. O. B. Lover paid regular visits to this nursery.

REVIEW OF THE R.R.I.C. SUB-STATION, KURUWITA

By

B. Cocking

1. GENERAL

1.1. Staff.—Mr. L. P. de Mel, the Senior Field Assistant, who has been in charge of the Sub-station since its inception was transferred back to Dartonfield at the end of the year. I am pleased to record my appreciation of the good work done by this Officer during his tour of duty here at Kuruwita. He has been succeeded by Mr. H. B. H. de Silva with effect from 1st January, 1963. Mr. D. G. A. Weerasooriya continues to be responsible for manufacture and tapping and our field works supervisory staff consists of two Kanganies.

Mr. W. B. Jonklaas visited the Sub-station on the 14th of March and again on the 3rd of September. His advice and assistance on all matters concerning the Sub-station has been most helpful to us.

1.2. Acreage

		A.	R.	P.
Mature Poly-clonal	...	48	3	32
Old Seedling	...	27	2	27
Replanted 1961	...	83	3	20
Replanted 1962	...	38	3	00
Cleared for Replanting in 1963	...	22	1	37
Nurseries	...	2	1	24
Roads, Deniyas, Forests and Building sites	...	23	2	10
Total	...	247	2	30

Further surveys have been carried out during the year and various field acreage discrepancies have been corrected. The acreage statement given above now coincides with the total acreage in the original Survey Department plan prepared in 1960

1.3. Rainfall in Inches

Comparative Figures for 1961 and 1962

		1961	1962
January	...	6·86	6·14
February	...	7·73	4·04
March	...	10·76	8·78
April	...	21·34	15·29
May	...	27·48	29·16
June	...	14·19	9·20
July	...	15·06	9·15
August	...	21·05	14·90
September	...	20·59	18·93
October	...	16·52	23·03
November	...	11·18	17·00
December	...	6·58	5·29
Total	...	179·34	160·91

Weather conditions during the year have generally followed the pattern of the previous season with heavy rainfall during the months August to October. Whilst overall rainfall is approximately 19 inches less than the previous season its distribution has been less favourable to tapping.

1.4. Crop

		1961	1962
Estimated	...	72,000 lb	50,000 lb
Harvested	...	51,639 lb	54,544 lb

Despite unfavourable weather during the latter part of the season the estimated crop has been exceeded by 4,544 lb which also shows an increase over the previous season despite a reduced acreage in tapping in 1962. The extension of yield stimulant experiments to the $48\frac{3}{4}$ acre poly-clonal area is largely responsible for this satisfactory result.

1.5. Manufacture.—Latex crop has been manufactured into smoked sheet throughout the year and our sales average, inclusive of unmanufactured scrap, is 89·62 cents per lb. Manufacturing costs have been enhanced by lack of water supply during the first six months of the year and by the very slow rolling process involved by the use of hand rollers. Our present harvests, likely to diminish further in the next four years, do not justify expenditure on more expensive equipment.

Curing cost estimated	2·58 cts. per lb
,, ,, spent	6·28 cts. per lb

1.6. Tapping

		1961	1962
Estimated	...	35·28	35·14
Actual cost	...	32·95	27·11

The cost of tapping shows a pleasing reduction in comparison with 1961 and is 8·03 cts. per lb less than the estimated figure. The standard of tapping is good and tappers have been most regular in their turn-out to work.

1.7. Weeding.—Weeding in mature areas was restricted to two rounds of cheddy weeding. Ground conditions are satisfactory.

2. BUILDINGS

The installation of the lighting set and the water pump was completed by July and all buildings including bungalows, factory buildings and labourers' cottages are now served with both electricity and pipe-borne water supply. Two Junior Staff Bungalows were erected during the year and two old sets of six-room lines were converted into useful store rooms. A further set of old lines was demolished and the salvaged materials used for the repair and reconstruction of our original weighing shed which now serves as a creche and rice store.

The Senior Field Assistant's bungalow roof and the factory roof have both been treated with aluminium paint.

3. LABOUR

The labour force has worked well during the year and there has been no unrest or correspondence with Labour Unions. Several of the ex-Paradise labourers left our employment for better prospects elsewhere and have been replaced by selected non-resident village labour.

Labour Statement. As at 31st December, 1962

	Men	*Women*	*Children*	*Total*
Resident workers	14	9	—	23
Non-resident workers	23	46	—	69
	37	55	—	92

4. CLEARINGS

1961 Replanting, 83A. 3R. 20P. Despite *Fomes* infection in some areas, this clearing is making good progress and *Pueraria* cover crops are particularly luxuriant. The treatment of *Fomes* infected trees has been regularly carried out with applications of Tillex and sources of infection have been traced and removed. Strip weeding has been introduced in the Soils section of this clearing whilst the remainder is under monthly circle weeding.

1962 Replanting, 38A. 3R. 00P. The planting of this clearing was completed in July and comprises 23 plots of experimental clones. Cover crops are now well established and the young plants are growing well. With more time and earlier planning it was possible to completely burn off all old roots and stumps before planting and it is anticipated that *Fomes* infection will be much reduced in consequence.

1963—22½ Acres—Preparatory Work. The uprooting, clearing and stacking of the old stand of trees was completed in November and burning off is presently in progress. Lining and holing will be completed by the end of February to facilitate an early planting of this clearing in 1963.

5. ROADS

Field roads have been well maintained during the year and the P.W.D. have completed the tarring and metalling of the main cart road from Gonapitiya turn-off to a point just beyond the factory. Transport to Kuruwita railway station is thus much facilitated. Unfortunately we are still dependent on outside transport for all our requirements and a suitable vehicle for general purposes is an urgent requirement here.

6. SUMMARY OF COSTS

Revenue Expenditure estimated Rs. 44,900/- being 89·80 cts. per lb
spent Rs. 41,362/80 being 75·83 cts. per lb

Capital Account.

2 Junior Staff Bungalows	Rs.	21,510·05
Road metalling and surfacing	,,	13,340·45
Conversion of 2 sets of lines into store rooms ...	,,	4,690·32
Power and water supply	,,	47,271·50
Constructing drains and latrines	,,	337·00

Our agricultural and building programmes have been completed and results for the year may be considered satisfactory with a saving of 13·97 cts. per lb on Revenue Account.

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