THE

RUBBER RESEARCH INSTITUTE OF CEYLON

ANNUAL REVIEW FOR 1963

CONTENTS

THE RUBBER RESEARCH INSTITUTE OF CEYLON

ANNUAL REVIEW FOR 1963

DIRECTOR'S REVIEW

By

C. A. De Silva

General

Mr. C. A. de Silva, Director, and Mr. M. Nadarajah, Acting Head of the Rubber Chemistry Division attended a three-day seminar organized by the Chemistry Division of the Rubber Research Institute of Malaya from 1st to 3rd April. The Director also took the opportunity of meeting Heads of Divisions of the Rubber Research Institute of Malaya and of visiting the Experimental Station at Sungei Buloh, where he was able to see the 'Exchange' clones imported from Ceylon growing under Malayan conditions. After the seminar, a programme from 4th to 12th April was arranged for Mr. Nadarajah by the R.R.I.M. for discussions and visits of interest.

The Director also attended a meeting of the Chief Executives and Directors of Research and Development held in Paris on 20th May, and the International Rubber Research & Development Board Meeting the following day. After the meetings he spent about 14 days vacation leave in England and took the opportunity of visiting the Natural Rubber Producers' Research Association, Welwyn Garden City, for discussions of mutual interest with the officers of the Association.

An Editorial Board consisting of Dr. O. S. Peries, Head of the Plant Pathology Division, Dr. R. T. Wijewantha, Head of the Botany Division and Mr. A. J. Jeevaratnam, Head of the Soils Chemistry Division, with the Director as Editor-in-Chief, was appointed to edit the Institute's publications.

The Rubber Research Board agreed that the Institute should participate in the Ceylon Government's Industrial Exhibition to be held in December 1964.

Samples of fresh latex of clone PB 186 were sent monthly to the Natural Rubber Producers' Research Association, England, at their request. This material is used in research work on the structure and the biochemistry of fresh latex. The latex is collected in vessels surrounded by ice and is despatched by air freight, in polythene containers packed in ice in a thermos flask. The bottom fraction of samples of latex from *Hevea benthamiana*, *Hevea spruceana* and the progeny of interspecific crosses of these clones with *Hevea brasiliensis* were also sent to the N.R.P.R.A. for biochemical studies.

The Botany Division of the R.R.I.C. moved into the newly constructed two-storey laboratories which also include a basement and an auditorium.

Staff

Mr. C. A. de Silva, Acting Director, was confirmed as Director with effect from 20th March. He was nominated by the Rubber Research Board to replace Dr. E. D. C. Baptiste as a member of the International Rubber Research & Development Board and of its Standing Committee. He was on duty throughout the year.

Dr. R. T. Wijewantha, Head of the Botany Division, reported for duty on 6th June, after the successful completion of his post-graduate studies in Plant Genetics and Plant Breeding at the University of California, under the International Co-operation Administration of the United States of America. He was on duty during the rest of the year.

Dr. O. S. Peries, Acting Plant Pathologist, was promoted to the post of Head of the Plant Pathology Division with effect from 1st January. He was appointed to co-ordinate research work carried out on leaf and bark diseases in all Rubber Research Institutes affiliated to the International Rubber Research & Development Board. He was on duty during the year.

Mr. J. H. Lloyd, the Agricultural Engineer, who was assigned to the Institute under the Colombo Plan, left the Institute on 8th April.

Mr. A. J. Jeevaratnam, Head of the Soils Division, Mr. M. Nadarajah, Acting Head of the Rubber Chemistry Division, Mr. A. B. Dissanayake, Chief Advisory Officer Smallholdings and Mr. L. Wijeyegunawardene, the Estate Superintendent, were on duty throughout the year.

Mr. C. D. de Fonseka, Chief Administrative Officer, was appointed Secretary to the Rubber Research Board with effect from 1st January. He was on end-of-contract leave for 1 month from 11th June to 10th July. Mr. B. C. Moldrich, Assistant Administrative Officer acted for him during this period.

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

Mr. L. B. Chandrasekera, Botanist and Mr. D. M. Fernando, Plant Breeder, were on duty during the year.

Mr. Camillus G. Silva, Assistant Soils Chemist, was promoted as Soils Chemist with effect from 1st December.

Mr. R. Satchuthananthavale, Assistant Botanist, proceeded to U.K. on 25th September for post-graduate studies at the Nottingham University under the Technical Co-operation Scheme of the Colombo Plan, but was subsequently transferred to the University of Sheffield.

Mrs. V. Satchuthananthavale, Assistant Plant Pathologist, proceeded to U.K. on 25th September for post-graduate studies at the University of Exeter under the Technical Co-operation Scheme of the Colombo Plan, but was subsequently transferred to the University of Sheffield.

Mrs. S. C. Goonetilleke was designated Librarian & Publications Officer with effect from 1. 2. 1963.

The following Intermediate Staff Officers were on duty :

Mr. D. L. S. Wimalajeewa	Assistant Plant Pathologist
Mr. R. S. John	Assistant Soils Chemist
Mr. S. W. Karunaratne	Assistant Rubber Chemist
Mr. V. B. Solomon	Assistant Statistician
Mrs. S. C. Goonetilleke	Librarian and Publications Officer
Mr. B. C. Moldrich	Assistant Administrative Officer
Mr. P. C. J. F. Keerthisinghe	Works Engineer
Mr. M. R. T. Mendis	Assistant Estate Superintendent
Mr. H. H. Peiris	Senior Assistant Advisory Officer, Smallholdings
Mr. K. W. de Silva	Assistant Advisory Officer, Smallholdings
Mr. D. E. A. Abeywickrema	Assistant Advisory Officer, Smallholdings

Assistant Staff

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

HEAD OFFICE

Correspondence Section	*Accounts Section*	*Works Section*	*Library*
One Office Assistant	One Accounting Assistant	One Clerk	One Library Assistant
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		

One Personal Assistant to the Director

Mr. S. P. Fernando was appointed Personal Assistant to the Director with effect from 1st July 1963.

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 (Heads of Divisions)		7
Senior Staff (Non-Heads of Divisions)		3
Intermediate Staff	...	14
Assistant Staff	...	149
Minor Staff	...	71
		244

Meetings

The Director attended the following meetings :—

Rubber Research Board	7	18/2, 26/4, 28/6, 23/8, 5/10, 22/11, 16/12	Director
Administrative Committee, R.R.B.	8	24/1, 25/3, 27/5, 15/7, 7/9, 23/9, 5/10, 22/11	Director
Estate & Experimental Committee, R. R. B.	3	8/4, 23/9, 30/10	Director
Sub-committee R.R.B. re. R.R.I.C.E. Union Delegation	3	27/2, 10/4, 5/6	Director
Sub-committee, R.R.B. re. overpayment of wages on Dartonfield	1	13/5	Director
Salaries Committee, R.R.B.	1	4/3	Director
Medical Fund Committee, R.R.B.	5	11/2, 10/4, 5/6, 15/7, 7/9	Director
Ad hoc committee, R.R.B. to consider applications for the the post of Director	1	22/7	Director
Smallholdings Selection Committee, R.R.B.	3	12/8, 27/8, 19/11	Director
Rubber Replanting Advisory Board	6	5/2, 9/4, 2/7, 3/9, 15/10, 17/12	Director
Planters' Association of Ceylon	3	29/3, 29/8, 15/10	Director
District Planters' Association	1	20/3	Director
Low-Country Products Association	1	23/3	Director
Rubber V.A. Conference	1	18/1	Director
Central Board of Agriculture	1	12/6	Director
Ceylon University Commission	1	1/3	Director
International Rubber Research & Development Board Meeting held in Paris	1	21/5	Director
Rubber Conference in Malaya	1	1st-3rd April	Director
Commonwealth Agricultural Bureau Meeting	1	25/9	Director
Language Policy Meeting	1	4/9	Director
Symposium at C.I.S.I.R. Soil Conservation Society	1	14/11	Director
Smallholders' Meeting	1	5/12	Director
Staff Meeting R.R.I.C.	2	19/7, 3/10	Director

Visitors

Visitors to the Institute included the following :—

Mr. L. Horton, Assistant Director, Tropical Products Institute, London, W.C. 1.

Mr. Frederick Lewis of the National Institute of Land Reform, Havana Cuba.

Dr. Henry Martin of the Scientific Department of CIBA Ltd., Basle, Switzerland.

Dr. O. S. Meierhans, CIBA Ltd., Basle, Switzerland.

Dr. Scherpe, Federal Republic of Germany.

Dr. P. C. Bansil, F.A.O. Agricultural Economist, Department of National Planning, Colombo.
Mr. A. Gromon, United Nations Resident Representative, Colombo.
Mr. H. A. A. Hasan, Director, Botanical Gardens, Aswan, Egypt, U.A.R.
Mr. Horst Runge, Trade Representative of the German Democratic Republic (in New Delhi).
Mr. F. W. Weissbach, Trade Representative of the German Democratic Republic in Ceylon.
Mr. A. D. McLeod, Managing Director of the Grand Central (Ceylon) Rubber Estates.
Mr. R. Shepherd, Resident Scientist, Prang Besar Rubber Co. of Malaya.
Mr. McMichen, Messrs. James Finlay & Co., Ltd.
Mr. C. R. Warren, Messrs. Carson Cumberbatch & Co., Ltd.
Mr. J. T. Videm, C.I.S.I.R., Colombo.
Mr. T. Mohanny, U.A.R. Embassy, Colombo.
Mr. P. W. Shearlaw, Messrs. Harrisons & Crosfield, London.
Prof. A. I. Orthaber, University, Ljubljana, Yugoslavia.
Lt. Col. J. R. P. Williams, M.B.E., Director, Associated Tea Estates of Ceylon Ltd., C/o. Colombo Commercial Co., Colombo.
Dr. K. F. Heinisch, Natural Rubber Bureau, Frankfurt/M, Germany.
Mr. W. G. Vennells, Natural Rubber Producers' Research Association, Welwyn Garden City, Herts, England.
Mr. H. S. Hopf, Department of Technical Co-operation, London, S.W. 1.
Mr. Ho-Kang and Delegates from the People's Republic of China.
Dr. Bill Möller, Ovre Husarg 21/A, Goteborg, Sweden.
Dr. J. E. O'Connell, 401, Mejirodai Apapto, 55, Sekiguchidaimachi, Bonkyo-Ku, Tokyo, Japan. (National Science Foundation, American Embassy, APO 503, St. Francisco).
Mr. Bruce Kinsey, C/o. American Embassy, Colombo.

Publications

The following reports and articles were prepared by the Director :—

(1) For information of the Rubber Research Board :
  (*a*) Director's Review for 1962.
  (*b*) Director's Report for the First Half Year 1963.
  (*c*) Report on the visit to Malaya by the Director and the Acting Head of the Rubber Chemistry Division in April 1963.
  (*d*) Research Programmes for 1964.

(2) Contribution to 1962 Annual Reports of the Planters' Association of Ceylon and of the Low-Country Products Association :
  " Progress Report of the Rubber Research Institute for 1962 "

(3) Contribution to the 1962 Annual Report of the Kalutara District Planters' Association :
  "RUBBER "

(4) Contribution to a publication by Major Raven-Hart :
  " RUBBER "

(5) Contribution to the Ceylon Year Book 1963 :
  " Progress Report of the Rubber Research Institute for 1962 "
  (in English and Sinhala).

(6) Contribution to the Times of Ceylon, Agriculture & Industry Supplement, October 1963—"Natural Rubber Research & Economics of Production".

(7) For publication in the R.R.I.C. Quarterly Journal, Vol. 39, Parts 1 & 2, March/June 1963 :

"History and Description of Promising RRIC Clones. IV—Clones Nab 15 and RRIC 87"

(8) For publication in the R.R.I.C. Quarterly Journal, Vol. 39, Parts 3 & 4, September/December 1963 :

"Clone PB (Prang Besar) 86"—Planting Topics.

The following publications were issued :—

1st and 2nd Combined Quarterly Journals, Vol. 39, Parts 1 & 2 (March/June 1963).

3rd and 4th Combined Quarterly Journals, Vol. 39, Parts 3 & 4 (September/December 1963).

Annual Report for 1962.

Advisory Circular Nos. 41, 57, 61, 69, and 73 were revised and reprinted.

Smallholdings Folder No. 9—Conserve your soil.

Rubber Research Institute Bulletin No. 57—"The Control of Abnormal Leaf-Fall Disease (*Phytophthora palmivora* Butler) of *Hevea* in Ceylon by J. H. Lloyd (in the press).

The following roneo-ed leaflets were issued :—

(*a*) (i) *Oidium* Questionnaire 1963 dated 23.3.63.
(ii) *Oidium* Questionnaire 1964 dated 7.12.63.

(*b*) (i) *Phytophthora* Questionnaire 1963 dated 30.4.63.
(ii) *Phytophthora* Questionnaire 1963 dated 11.5.63.

Correspondence

	Inward			*Outward*		
	1961	*1962*	*1963*	*1961*	*1962*	*1963*
Director { General	2218	2726	1291*	1198	1644	1647
Director { Technical	128	105	74	171	208	172
Administrative Department	4543	4897	4918	4081	4415	4722
Botany Division	341	378	351	274	312	233
Plant Pathology Division	547	856	784	572	630	629
Soils Division	604	521	519	498	374	400
Rubber Chemistry Division	488	545	474	413	446	386
Smallholdings Department { General	7963	7781	7899	11703	12971	12790
Smallholdings Department { (With Rubber Controller)	1125	1191	2018†	6244	6193	5052‡
Estate Department	500	766	711	1260	1309	1225
	18457	19766	19039	26414	28493	27256

* Includes 356 applications for various posts.

† Includes New Planting Applications etc.

‡ Includes 1799 Preliminary Reports, 1599 Final Inspection Reports and 1654 Special Reports.

Botany

The advisory work has been confined to recommendations on planting material, tapping problems, and the correct use of yield stimulants for obtaining increased economic yields.

The local clones RRIC 7, 41, 45, 52 and 86, which have been declared 'free' clones, have given promising yields during the year under review. The recommendations for planting these clones on a moderately large scale on commercial estates are favourably supported by the yield results as well as by secondary characters, especially with regard to disease susceptibility.

Clone RRIC 7 was planted in two clone trials in 1945 and 1953. In the latter trial approximately 800 trees of the clone yielded 9·5 lb per tree per year in the 4th year of tapping. Reliable methods of correcting the enzymatic discolouration of the latex of this clone have been recommended.

In the 1955 large-scale clone trial at Hedigalla Station clone RRIC 41 has yielded 9·5 lb per tree per year in 1963. The trees were first tapped in April 1962.

Clone RRIC 45 was budded in the field in 1955 in a clone trial at the Nivitigalakele Station. 572 trees yielded 10·1 lb per tree per year in the 2nd year of tapping. It is a vigorous grower and a promising high-yielding clone.

Clone RRIC 52 was planted in a large-scale clone trial in 1949 with a spacing of 6′ × 45′. This clone with 107 trees in tapping has given a yield of 14·9 lb per tree per year in 1963. The control clone PB 86 yielded 15·7 lb per tree per year with an equivalent number of trees. In the same trial 77 trees of clone RRIC 86 yielded 19·3 lb per tree per year. Clone RRIC 52 is specially recommended for planting in smallholdings, with a spacing of 15′ × 18′ which is more suited to its spreading foliage canopy.

Other local clones RRIC 5, 9, 13, 34, 35, 36, 37, 40, 50, 51, 59, 60, 74, 75, 88, 89 and clone Nab 15 have given promising yields in various clone trials. A number of these clones has not been recommended for commercial planting pending a final assessment of their secondary characters.

Among the foreign clones PB 28/59 planted in 1954 has given a yield of 14·2 lb per tree per year with 143 trees in tapping. Clones RRIM 623 and 607, planted in large-scale clone trials on two commercial estates in 1957 and 1958 respectively, are above average in girth. In the 1958 trial clone RRIC 52 is the best grower with a girth of 20·8 inches in 1963. Clones RRIC 41 and 45 are above average girth in this same clone trial.

The results of the early evaluations of planting material at the testing stations, located in Kepitigalla Group and Clodagh Estate in the Matale District for *Oidium* resistance and on Peenkande Group for *Phytophthora* resistance, will be reported in a Quarterly Journal.

A site has been selected on Nakiadeniya Group in the Galle district for testing clones for resistance to *Gloeosporium*, which is now of economic importance to the industry.

The general breeding stations, established on Nakkala and Moneragala Estates will help to extend the hand-pollination season to May and June each year, when trees in the Moneragala District are in flower. A better preservation of fruits which are set can be expected in the absence of *Phytophthora* in this district.

Yield stimulation experiments were continued in the experimental stations. The increased yields obtained from budded rubber with good bark reserves, normally yielding 600 to 800 lb per acre per year, have been encouraging. In the 4th stimulation experiment at Kuruwita the 'RRIC' mixture formulated with 2, 4, 5–T has given better results than "Stimulex" and "Dilatex" formulated with the same plant hormone. The Institute hopes to make arrangements for the production of the "RRIC" mixture on a commercial scale in 1964.

A tapping experiment initiated in 1954 at Dartonfield for comparing tapping at heights of 42″ and 50″ in budded rubber does not show any significant differences in yield at the two heights of tapping. Some caution is required for good tapping at 50″ in the first year of tapping.

Plant Pathology

Dr. O. S. Peries, Head of the Division, was appointed to co-ordinate research work carried on leaf and bark diseases in *Hevea* rubber between member countries of the International Rubber Research and Development Board in the United Kingdom.

The advisory services of this Division have considerably increased in connection with the methods of disease control on estates. A number of field experiments have been initiated by the Division on commercial estates, which require the personal supervision of the Head of the Division and his technical staff. A total of 788 estate visits have been made during the year under review.

The wintering season in 1963 was abnormally long and certain clones defoliated up to the first week in May. The late wintering clones suffered heavy attacks of *Oidium*, causing considerable leaf-fall. The foliage in general was not up to the standards of luxuriance observed in 1962.

Prolonged rainfall causing wetness on leaves for a long period, (2-3 days) militates against the rapid spread of the *Oidium* fungus.

The incidence of *Phytophthora* leaf disease was comparatively mild in spite of the heavy rainfall recorded in 1963.

Six *Phytophthora*-control field experiments were carried out during the year; five of these for comparing dusting and spraying methods and one for demonstrating relationship between pod-set and the incidence of *Phytophthora* leaf disease. In general, the incidence of the disease was too mild for results of any practical value.

Studies on the biology of *Phytophthora* spp. have been completed and papers on sexuality and perennation of the fungus have been prepared for publication. The time taken by the parasite to infect pods, petioles and leaf blades has been clearly established.

It has been found that the petiole of the leaf is much more susceptible to *Phytophthora* infection than the lamina; in fact, it is very rarely that the lamina is infected under field conditions in Ceylon. The time taken for lesion production on petioles of rubber leaves at various temperatures is summarized in Table I of the Divisional review.

It has been established quite definitely that the *Phytophthora* spp. grow and sporulate best on pods and that the major part of the inoculum of this fungus for leaf-fall epidemics is produced on these fruit bodies. The *Phytophthora* fungus can penetrate the pod and produce a lesion within 2 hours of inoculation and incubation under optimum conditions.

The incidence of Bark Rot was low for a major part of the year, but severe infection was recorded on certain estates in the last three months of the year. Field experiments have shown that the routine application of fungicides is best done after tapping.

A considerable amount of work has been done on the biology of spore germination in *Gloeosporium alborubrum*. The fungus is now of economic importance in this country as indicated by our experience of the incidence of this disease in 1963.

Preliminary studies on the susceptibility of different clones to *Gloeosporium* leaf disease have been completed.

Studies on the mode of penetration of *Fomes lignosus* into *Hevea* roots indicate that the fungus can enter more readily through surface injuries than by the penetration of the undamaged surface.

It was found that sulphur or copper sulphate added to the soil increased the acidity and caused a fundamental alteration in the composition of the microflora of the soil. These studies could lead to a method of biological control of White Root Disease.

The incidence of " Physiological Yellows " was very high in May/June and again in October-November 1963. This phenomenon could have been caused by abnormal and protracted wet-weather conditions. Excessive shady conditions during this year contributed to an abnormal leaf-fall, which was not associated with a pathogen.

Rubber Chemistry

Advisory work of the Division has been concentrated on the improvement of the quality of lower grade sheet and crepe and concentrated latex, manufactured in Ceylon. A total of 168 visits have been made by the Acting Head of the Division and his technical staff to commercial estates during the year under review.

An attempt has been made to determine the mercury content of bark and latex resulting from treatment of tapping panels with organo-mercurial fungicides.

With increased acreages of young budded rubber coming into tapping, estates are finding it increasingly difficult to determine the dry rubber content accurately with the use of the metrolac. The work of calibrating the metrolac has been undertaken on several estates.

The analysis of latex of 23 clones grown under local conditions has been continued. The results for 1962 have been summarized in Table I of the review of the Division.

The cause of brittleness, sometimes found in sheet, manufactured from young trees, is not fully understood. Sheet may be down-graded on this account. Under these circumstances visual grading could be quite inadequate in terms of ultimate properties. It was found that latex from trees up to 10 years of age produced sheets which lacked elasticity and showed a tendency to break on stretching.

Satisfactory oil-extended sheet rubber has been manufactured at the Institute. Arrangements have been made with the Ceylon Institute of Scientific and Industrial Research to test this rubber for use in the manufacture of retreaded tyres.

The calcium content of latex shows an increase with the time of the flow of latex, while in the case of magnesium content there is generally a decrease with the time of the flow of latex. The potassium content of panel scrap is appreciably less than that of the corresponding latex.

Discolouration in scrap rubber is also caused by non-enzymatic browning. Methods of improving the colour of scrap crepe with the use of sodium bisulphite has been recommended for improving the quality of this grade of crepe.

Experiments were continued to find ways and means of decreasing the rather high manganese content of scrap crepe in Ceylon, especially that manufactured from panel scrap.

A clonal assay of the quantity of phenols in clone RRIC 7, which causes a marked enzymatic discolouration of its latex, indicated the presence of phenolic bodies in the latex. Methods of minimizing such discolouration have been recommended.

The Rubber Chemist collaborates with the Natural Rubber Producers Research Association in the United Kingdom by sending prepared fresh samples of *Hevea brasiliensis*, *H. benthamiana*, and *H. spruceana* latices for carrying out fundamental research on the biosynthesis of latex with the aid of the electron microscope.

Soils

The satisfactory position of the Staff enabled the Division to intensify the research programme on the manurial requirements of *Hevea* rubber. The field work includes a number of experiments to make accurate determinations of the optimum doses of fertilizers for mature trees in production.

The general fertilizer recommendations were revised to include increased rates of fertilizer applications in the early years of immaturity.

The results of experiments on the effect of fertilizers on the growth of immature rubber indicate clearly the importance of applying potassium and magnesium at the correct levels for obtaining good growth. These nutrients when applied above certain levels can depress the growth of young rubber plants in some areas.

The application of magnesium as 'Dolomite' or as magnesium sulphate has shown no differential response in growth during the first two years of development of young plants in the field.

An organic fertilizer such as Animal Meal showed no advantage over inorganic fertilizer mixtures in applications made to nursery seedlings or planting holes.

The results obtained during the period under review from a limited number of experiments, did not indicate the necessity for any revision of the reduced rates of application recommended in 1962 for mature clonal rubber. It has, however, been found necessary to qualify the recommendation with the stipulation that the reduced rate of 2 lb per tree per year of the NPK mixture should be introduced after the third or fourth year of tapping.

Areas under intensified treatment by stimulation or tapping for increased yields, during the 6-year period prior to uprooting, should preferably be supported by manuring at 2 lb per tree per year with an NPK mixture up to three years before uprooting.

Observations on wind-damage losses on two estates in the Kalutara District in 1962 have shown that the major percentage of trees were damaged by uprooting rather than by trunk-snap. These observations indicate that wind-damage losses are connected more with the necessity for sound agronomic measures that favour a stable root system for anchorage and prevent large gaps in a planting, than with a modification of the composition or levels of fertilizer mixtures. Investigations on the possibility of preventing wind-damage by special manure mixtures will be feasible only in the case of clones which are known to be susceptible to wind-damage.

Tentative recommendations on changes of fertilizer policy on one estate have been made for any possible effect of the nutrition of *Hevea* on the incidence of leaf-fall caused by *Gloeosporium alborubrum*. The results of this investigation will be of observational value only. The Soils Division does not recommend a general adoption of a revised fertilizer policy as a means of minimizing the incidence of *Gloeosporium*.

Satisfactory progress has been made on the soil survey of rubber growing areas. A reconnaissance survey will be completed by the end of 1964.

Special attention has been given to soil conservation methods in rubber in view of the Government's intention to introduce regulations for the country as a whole.

Observations on weed control have shown the necessity for making a distinction between weed control and weed eradication, which is of fundamental importance in weed control procedure. Weed control procedure should, therefore, be adjusted to meet the conditions that prevail at different stages in the life of a rubber plantation. A weed is correctly defined as " a plant out of place ".

Statistics

The Assistant Statistician has collated the information obtained from the meteorological observations made in 1963. A summary is attached. The figures are of considerable importance to the Scientific Divisions which are carrying out research work on the agricultural and meteorological conditions that influence directly or indirectly the growth and yield of the rubber crop.

RUBBER RESEARCH INSTITUTE OF CEYLON, DARTONFIELD, AGALAWATTA.

Summary of Meteorological Observations

January-December 1963

Longitude 80° 09′ E

Latitude 6° 32′ N

Height above sea level 215 ft.

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
1. Mean maximum temperature	86·7	88·0	89·8	90·5	89·6	87·0	85·7	86·8	86·4	86·4	87·9	87·5
2. Mean minimum temperature	70·7	70·2	71·2	73·1	74·1	73·2	72·1	72·9	72·5	71·2	71·8	71·0
3. Average of max. and min. means	78·7	79·1	80·5	81·8	81·9	80·1	77·0	79·9	79·5	78·8	79·9	79·3
4. Highest max. temperature	89·8	91·8	92·3	93·8	92·8	89·8	88·0	91·5	89·0	90·0	95·0	91·5
5. Lowest min. temperature	63·7	67·2	67·7	69·7	71·7	69·7	70·0	70·0	70·0	67·0	68·0	68·5
6. Lowest max. temperature	80·8	77·8	86·8	83·8	83·8	83·8	81·0	82·0	81·5	80·0	82·0	80·5
7. Highest min. temperature	75·7	72·7	73·7	72·2	75·7	74·2	74·5	74·0	74·0	73·0	79·0	74·0
8. Mean relative humidity (8.30 a.m.)	78·1%	77·7%	80·2%	76·3%	78·8%	79·3%	89·2%	89·0%	88·4%	81·9%	70·8%	87·0%
9. Monthly rainfall in inches	11·16	10·05	13·35	19·50	37·65	15·82	27·33	16·81	35·00	25·81	39·70	17·10
10. 30-year average rainfall in inches	(6·43)	(6·39)	(10·56)	(14·18)	(23·86)	(16·61)	(11·50)	(11·56)	(13·15)	(21·51)	(17·24)	(16·03)
11. No. of rainy days	18	18	20	23	23	24	27	27	28	22	30	22
12. Most rain in one day	2·30	2·00	2·28	1·92	8·95	2·46	4·18	3·62	7·12	3·36	5·60	6·48
13. Total hours of bright Sunshine	152·1	173·9	171·6	118·6	79·3	127·2	83·1	102·3	92·5	114·2	88·3	111·2
14. Daily mean hours of Sunshine	4·90	6·21	5·54	3·95	2·56	4·24	2·68	3·20	3·08	3·81	2·94	3·59
15. Mean earth temperature at 8″	82·5	82·6	83·5	84·0	84·4	83·7	83·5	83·0	82·5	81·8	82·1	81·9
16. Mean earth temperature at 4′	84·0	83·9	84·6	85·4	85·5	84·1	84·1	84·0	83·8	82·7	83·0	82·5

The total rainfall of 269·28″ for this year is the highest on record since 1933. The previous highest rainfall record of 212·15″ was in 1941.

The Assistant Statistician has given a considerable amount of his time to studies in experimental design in connection with the use of non-additive models. Suggestions have been made for the adoption of specific experimental designs in collaboration with the Botanist, Soils Chemist, and the Plant Pathologist.

The analyses of field experiments laid down in commercial estates were carried out during the year under review.

Study visits have been made to estates in connection with the adoption of suitable designs for the layout of field experiments for the Soils and Plant Pathology Divisions.

Investigations have also been made on a special type of analysis for experimentation with weedicides in collaboration with the Soils Chemist.

We have in the past encountered considerable difficulties in analysing yield data of field experiments laid down in hilly land with marked fertility gradients, and with losses of trees in plots and blocks due to uncontrollable extraneous factors. It is essential that we initially select the correct locations for field experiments for satisfactory statistical analysis to obtain the fundamental knowledge on various aspects of rubber cultivation, which will enable us to make reliable recommendations on a practical basis.

Smallholdings

There has been an increase in the volume of work in the year under review, especially in connection with advisory services and inspections of smallholdings.

The Publicity Unit held 65 meetings. Films on rubber topics were shown for the first time in the Kegalle Division. Cine-film and slide shows will also be given in the future. The Department also participated in three exhibitions.

Four new ranges were carved out of some of the larger existing ranges; one range was closed down and a new range was created in its place.

A new booklet on tapping was published both in Sinhala and in English and was sold at -/25 cents per copy. The Annual Review of the Department was published in Sinhala and distributed among the smallholders.

33,894 visits were made during the year to replantings and replanted smallholdings, inclusive of 25,776 visits to permit-areas of previous years.

1,894, subsidy holdings were lined for soil conservation works and 2,305 subsidy holdings were lined for holing by the Rubber Instructors and Assistants. A total of 29,343 trees were marked for tapping in 580 subsidy holdings by Rubber Instructors.

234 special reports on subsidy areas have been submitted to the Rubber Control Department.

The field staff paid 11,220 visits to new-planting and new-planted permit-areas for lining and advisory work.

The Department successfully organized 101 co-operative dusting groups for the State-Aided Sulphur Dusting Scheme, 1963. A total of 10,228 acres (3,197 holdings) were dusted with good control of *Oidium*.

The Divisional Agricultural Officers delivered a series of lectures in Sinhala on various aspects of rubber cultivation and production to students of Farm Schools. They were also responsible for training the Rubber Instructors in the correct methods of tapping, with the help of the Assistant Advisory Officers.

A replanting smallholder under the subsidy scheme who had completed the requirements to qualify for the first two instalments will get only Rs. 400/-. However, the data collected in a survey reveal that his total effort for the items of work exceeds R. 700/-. If a change in the payment of subsidy is envisaged in the near future, this data could be used to work out a new scheme. The present system of payment, though slightly lagging behind the effort incurred, helps to keep the smallholder interested in his work for a longer period.

Estate

The total acreage of Dartonfield Group is 1,491. The planted acreage of 1,002 is made up of experimental plantations and commercial areas. The latter consist of blocks in which the Research Staff has no further interest for scientific investigations. There are 134½ acres of immature rubber, 849¾ in tapping, and 17¾ acres under budwood and stock nurseries. A 57-acre block at Hedigalla makes up the nursery of clonal seedlings for the requirements of the Government Replanting Subsidy Scheme.

The Estate Superintendent is responsible for the distribution of authenticated budwood of local and foreign clones to commercial estates and for the correspondence in connection with this work. He also supervises the nurseries of the Subsidy Scheme at Hedigalla.

The incidence of *Oidium* was again mild, except for a few locations where late wintering seedling trees and clones showed a heavy leaf-fall. With close rounds of sulphur dusting a satisfactory control was achieved.

A reduced crop was harvested in an year unfavourable for normal tapping. *Gloeosporium* was more noticeable than in previous years due to the high rainfall in 1963. Copper dusting was carried out as a control measure.

Bark Rot was negligible among the better known clones. The organo-mercurial fungicides were quite effective for controlling the disease in the more susceptible clones on trial in the experimental areas.

A few scattered cases of *Fomes lignosus* and *Ustulina zonata* were found in mature areas and routine control measures were adopted.

In a 1963 South-West replanting of 14 acres, in Nivitigalakele, clones RRIC 59, 60, 64, 75, 86, were planted in 300-tree plots, while clones RRIC 6, 39, 41, 98 and clone PB 86 were planted in 150-tree plots. The growth of the plants in this area is satisfactory. Special attention was given to root disease treatment.

The rainfall figures at Dartonfield Group were as follows :—

	Dartonfield	*Nivitigalakele*	*Hedigalla*
1963	269·8″	286·8″	245·3″
1962	163·4″	143·0″	182·9″

The Kuruwita Sub-station of the Institute in the Ratnapura District is overlooked by a Visiting Superintendent. It has a total acreage of 248¾ acres of which approximately 145 acres have been replanted from 1961 to 1963.

A small-scale clone trial was planted in 1963 consisting of 10-tree clones established from selected seedling progeny from the hand pollination programmes carried out in 1956, 1957, 1959, 1960, and 1961 together with selections from the 1955 clearing at Hedigalla. The clones on trial will be tested for high-yielding and disease-resistant qualities.

Other selected material planted in 1962 in 150-tree or 300-tree plots is made up of clones AVROS 529 and 2037, Harbel 1, IAN 45-717 and 6497, IRCI 7 and 9, PB 86 (control), PR 228, 251 and 259, RRIC 7, 14, 36, 37, 45, 51, 52 and RRIM 623, 628, 701.

Four manurial experiments have been laid down in 1961 and 1963 at the Kuruwita Sub-station by the Soils Division; about 35 acres have been used for these experiments.

REVIEW OF THE BOTANY DIVISION

By

Ronald T. Wijewantha

Summary

Plant Breeding

More selection was exercised this season in breeding for *Dothidella* resistance. The latest *Dothidella*-resistant material consisting of some of the IAN 6000 series was successfully incorporated into the breeding programme. Some hybrids with *H. spruceana* were obtained.

A total of 23,904 artificial hand pollinations were carried out in 1963, which gave 957 seedlings. This could be considered as a successful programme in view of the difficult conditions of fruit preservation from various diseases.

A single clone was discovered with very precocious flowering, and budgrafts of this clone were made on to nursery material in order to evolve a more satisfactory method of flower inducement.

The crown-budded area at Moneragala Group and the test-planting at Kumarawatte Group were given routine attention.

The *Oidium* Test Area at Kepitigalla Group was screened again for resistance. A second test area was established in Clodagh Group in the Matale District.

Disease ratings were carried out by two independent observers at the *Phytophthora* Testing Station at Peenkande Group, Nivitigala. A few clones have shown consistent tolerance to *Phytophthora* during 1961, 1962 and 1963. They will be preferentially used in our later breeding programme.

A site has been selected in the Galle District for the establishment of a *Gloeosporium* Testing Station. The first planting at this station is scheduled for the 1964 S.W. planting season.

Girth measurements were commenced in the small and medium-scale clone trials established at Kuruwita Sub-station. In the large-scale clone trial at Kuruwita, routine labelling and maintenance works were carried out.

Botanical

Advisory Work : 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. Much advice was also sought in regard to methods of obtaining increased yields with the use of yield stimulants and intensive tapping systems.

It has been decided to discourage the further planting of clone PB 86 in the wet low-country district in view of its inherent susceptibility to the 3 major leaf diseases, *Oidium*, *Phytophthora* and *Gloeosporium*.

Yield Stimulation Experiments : Yield stimulation experiment No. 3 was terminated at the end of July 1963 as this area was required for replanting. Over the period 1960-63, an average yield increase of 45 per cent over the control was obtained by the use of RRIC Mixture I. Dilatex on the other hand, gave an average yield increase of 55% over the control. The two results are not strictly comparable as the two stimulant mixtures were not tested against a common control.

Preliminary results from the 4th yield stimulation experiment, also set down at Kuruwita, in an old seedling area indicate the superiority of RRIC Mixture I over Stimulex and Dilatex.

In the large-scale yield stimulation experiment No. 5, initiated in November 1962 in a polyclone block, Stimulex outyielded the control by 10 per cent and RRIC Mixture II outyielded the control by 7-8 per cent. These results are only preliminary and the yield figures over the next few years will provide more reliable data from which to draw conclusions.

Tapping Experiments : In a tapping experiment set down in 1954 to evaluate the adaptability of the Michie Golledge tapping knife to a tapping height of 50" from the union as opposed to the standard height of 42" from the union, no marked differences were found in average yield or growth during the year under review in the 27 local and foreign clones that were tested.

A tapping experiment initiated in 1961 in a 3-acre block of PB 86, planted in 1938 at Dartonfield, continues to give consistent and useful results. Conclusions will have to be deferred till results over a few more years are available.

Clone Evaluation : Test-tapping in the legitimate hand-pollinated seedling experimental area was discontinued after the selection of the highest yielding clones for final assessment of their secondary morphological characters as well as a confirmation of their high-yielding qualities in large-scale clone trials.

The RRIC clones 90, 91 and 93 derived from a selection of the 1945 hand-pollinated seedlings, show promising yields of 22-26 lb dry rubber per tree per year in a small-scale clone trial at Hedigalla. These clones possess good external morphological characters and have already been planted in a large-scale clone trial at Nivitigalakele for final evaluation.

PB 28/59 in the 1954 clone trial at Nivitigalakele continued to be the outstanding clone in this trial, with 14·2 lb dry rubber per tree per year. The next best was RRIM 501 with 12·6 lb dry rubber per tree per year, which outyielded IRCI 7 which gave a yield of 8·8 lb per tree per year.

The Chemara clone Ch 3 gave a satisfactory yield of 26·7 lb dry rubber per tree per year as opposed to 20 lb dry rubber per tree per year in the control PB 86, in a clone trial at Hedigalla. Ch 3 is comparatively free of stem and branch damage.

Clone RRIC 52 was planted in a large-scale clone trial in 1949 with a spacing of 6′ × 45′. This clone with 107 trees in tapping has given a yield of 14·9 lb per tree per year in 1963. The control clone PB 86 yielded 15·7 lb per tree per year with an equivalent number of trees. In the same trial 77 trees of clone RRIC 86 yielded 19·3 lb per tree per year. Clone RRIC 52 is specially recommended for planting in smallholdings, with a spacing of 15′ × 18′ which is more suited to its spreading foliage canopy.

RRIC 33, 34, 35 36, PR 107, RRIM 501 and PB 86 were the highest yielders in the 1954 large-scale clone trial at Hedigalla during the year under review. Of the above, RRIC 36 with an average yield of 41·1 grams per tree per tapping is outstanding. A check is being kept on secondary morphological characters as well as the susceptibility of these clones to bark and leaf diseases.

Clone RRIC 46 with approximately 550 trees in test-tapping from April 1962, in the large-scale clone trial of 1955 at Hedigalla, has given a yield of 36 grams per tree per tapping in 1963. This early yield is promising. RRIC 46 was the highest yielder in this trial in 1962 as well.

Clones RRIC 45 and 46 gave reassuring yield results in 1963 in the 1953 large-scale clone trial at Nivitigalakele.

Girth Measurements in Immature Areas : The growth figures from the more important immature clone trial areas have been summarized in this report.

Crown-budding Experiment : The crown-budding experiments with clone LCB 870 continue to show an adverse effect of the LCB crown on the yields of the centre sections of a number of clones. These experiments have now been terminated and the results will be reported in the Quarterly Journal of this Institute shortly.

Laboratory and Field Investigations : Only limited laboratory investigations were possible during the year under review as the new Botany Laboratory building was completed only in December 1963.

Small-scale preliminary experiments on green budding, effect of continuous tapping without winter rest, and the long term effects of continuous yield stimulation on comparatively young clearings will be initiated in 1964.

DETAILED REVIEW

General

Staff

Mr. C. A. de Silva, Acting Director and Head of the Botany Division was on duty until his appointment as Director in March, 1963. He, however, continued to oversee the work of this Division till mid-June.

Dr. Ronald T. Wijewantha, who was appointed Head of the Botany Division with effect from March 1963, returned to Ceylon on 31. 5. '63, after successfully completing his post-graduate studies leading to a Ph.D. degree in Plant Breeding and Genetics, at the University of California, U.S.A. On the completion of his Ph.D. programme he had the distinction of being awarded a post-doctoral fellowship at the same University which he held till the beginning of May, 1963. He was also awarded Membership of the Sigma Xi, Scientific Society of America. Dr. Wijewantha assumed duties at Dartonfield on 6 June, 1963.

Mr. D. M. Fernando, Assistant Plant Breeder was appointed Plant Breeder as from 1 January 1963. He was on duty throughout the year.

Mr. L. B. Chandrasekera, Assistant Botanist was appointed Botanist with effect from 1 January 1963, and was on duty during the year.

Mr. R. Satchuthananthavale, Assistant Botanist was on duty till 25. 9. '63, when he left for post-graduate studies at the University of Sheffield, on a C-plan Scholarship.

Advisory Work

Advisory work, as in previous years, was confined to recommendations of planting material for replanting, tapping problems and the use of yield stimulants.

A number of advisory visits were paid to commercial estates by the Staff of the Botany Division during the period under review.

Correspondence

	Inward	*Outward*
General	22	82
Technical	829	202

Meetings

The Head of the Botany Division addressed the members of the Smallholdings Department at their Annual Field-day, held at Ratnapura Town Hall on 9 November, 1963. His topic was " Genetics and Plant Breeding with Special reference to *Hevea* Rubber."

He also addressed the Southern Province Planters' Association on 11 December, 1963, on the same subject.

Papers

The following papers were presented at International Scientific Association Meetings :—

1. Biochemical and development studies on the agropyroides mutation in barley—by G. L. Stebbins and R. T. Wijewantha, at the 1963 Meeting of the Genetics Society of America.

2. Histological studies on the bark cracking disorder of *Hevea brasiliensis* Muell. Arg.—by O. S. Peries and R. Satchuthananthavale, at the 19th Session of the Ceylon Association for the Advancement of Science.

Publications

1. History and description of promising RRIC clones. IV—Clones Nab 15 and RRIC 87. by C. A. de Silva and R. Satchuthananthavale. *Rubb. Res. Inst. Ceylon Quart. J.* (1963) **39**, Parts 1 and 2, 1-8.

2. A survey on the incidence of *Fomes* in replantings—By R. T. Wijewantha—*Trop. Agriculture, Trin.* (1964) **41**, No. 1.

PLANT BREEDING EXPERIMENTS

Breeding for Oidium resistance

a. Oidium Testing Station—Kepitigalla Group—Matale. The *Oidium* trial area of approximately $2\frac{3}{4}$ acres was planted in two instalments in 1959 and 1960. Test clones were planted in 5-tree plots. Tjir 1, a highly susceptible clone, was used as a control which was interspersed between the 5-tree test plots.

Since the sole purpose of this planting was to determine the *Oidium* rating of the clones on trial, a close spacing of 3 ft within the rows was adopted. To accentuate this close spacing further, double rows, 3 ft apart, were established with each set of double rows approximately 10 ft away from the next double row. Planting was along contour terraces. The clones established in this testing station consist of the following :—

1959 Planting

15 clones with FX designation from primary crosses made on Ford Plantations, Brazil, in 1941-1942.

4 clones of IAN-45 designation from primary crosses made at Belterra, Brazil, in 1945.

46 clones with IAN designation from first backcrosses or outcrosses made at Belterra, Brazil, from 1949-1952.

116 clones made from LCB 870 primary crosses.

34 clones made from LCB 870 first backcrosses or outcrosses.

16 clones made from RRIC 52 primary crosses.

6 single clones, namely, F 4542, LCB 1320, RRIC 52, PB 86, Tjir 1 and Galapitamada 1.

1960 Planting

47 clones of *Dothidella*-resistant material with F, FB, FX and IAN numbers.

58 clones made from RRIC 52 crosses (1957 Hand Pollination Programme).

18 clonal selections from the 1958 Hand-Pollination Programme.

26 clonal selections from the 1959 Hand-Pollination Programme.

LCB 870, TR 1548 and Tjir 1.

The clones in the 1959 planting had been *Oidium* rated in 1961, and the clones in the 1960 planting in 1961. During the year under review, the entire area was *Oidium* rated once again, but in this case by two independent observers. A detailed analysis of the results obtained over the last 3 years will be reported elsewhere. The area was selectively thinned on the basis of the results of this *Oidium* evaluation.

b. Oidium Testing Station—Clodagh Group—Matale. A second *Oidium* testing station in the Matale district was established in a 4-acre block lent by Clodagh Group. In this area, some of the RRIC 52 progeny, which had shown in the preliminary ratings a resistance to *Oidium* leaf disease, while exhibiting at the same time a satisfactory vigour of growth at Kepitigalla, were planted on a larger scale. At the same time, more recently evolved clones were planted at 3 points per clone with more than 1 replication wherever possible.

Material bred in Ceylon using *Dothidella*-resistant imported parents were included for the first time in an *Oidium* test. Other RRIC 52 progeny which had been selected for the current Kuruwita planting were also included in this test. A fair number of plants of the clones Tjir 1 and PB 86 were also planted in this area to serve as controls. (Table I)

TABLE I

DETAILS OF MATERIAL PLANTED AT CLODAGH GROUP

Medium Scale Trial

Parentage	*Clone No.*
RRIC 52 × PB 86	431, 444, 566.
RRIC 52 × Tjir 1	759
PB 5/139 × RRIC 52	784, 815, 828, 860, 864, 877, 1103, 1108.
RRIC 52 × LCB 1320	2270
RRIC 52 × AVROS 157	2317

Small Scale Trial

RRIC 52 × FX 349	2402, 2403.
RRIC 52 × FX 4098	2405, 2407, 2408, 2409, 2410, 2411.
RRIC 45 × FX 4098	2412, 2413, 2414, 2415, 2417, 2418, 2420, 2421, 2422, 2425, 2427, 2428, 2429.
FX 349 × RRIC 52	2430.
FX 349 × RRIC 36	2437.
RRIC 88 × IAN 45-710	2442, 2443.
RRIC 88 × FX 4098	2447, 2449, 2451, 2453, 2455, 2457, 2458, 2460, 2462, 2463, 2464.
RRIC 45 × IAN 45-878	2467, 2468, 2469, 2470, 2471, 2472, 2473, 2475, 2476, 2478, 2480, 2481, 2482, 2483, 2485, 2486, 2487.
LCB 1320 × LCB 1320	3149, 3150.
RRIC 52 × RRIC 52	4009, 4012, 4013, 4014.
IAN 3434 × RRIC 52	5329, 5330, 5331, 5333, 5334, 5336, 5337.
RRIC 52 × IAN 2750	5994, 5995, 5996, 5997, 5998, 5999, 6002, 6004, 6005.

Clones also represented in the 1963 Kuruwita Trial

RRIC 52 × RRIC 7	2011, 2029, 2044, 2053.
RRIC 52 × Wagga 6278	2114, 2120, 2122, 2123, 2127.
RRIC 36 × RRIC 52	2133.
RRIC 52 × LCB 1320	2265, 2268.
RRIC 52 × RRIC 36	2273, 2275.
RRIC 52 × AVROS 157	2303, 2309.
RRIC 52 × RRIC 52	4008, 4010, 4011.
Recent introduction	IAN 6505.
Controls	PB 86, Tjir 1.

Breeding for Phytophthora resistance

a. *Phytophthora Testing Station—Peenkande Group—Nivitigala.* A *Phytophthora* testing station was established in a ¾-acre block, in the Wadagala Division of Peenkande Group. Although the area available for establishing this testing station was of limited size and consisted of rocky terrain, the compensatory factors were many, such as accessibility to Institute head-quarters and more particularly, favourable climatic conditions for an accentuation of *Phytophthora*

infection. The testing station is also adjacent to a block of AVROS 152, which being heavily infected the whole year round provides an abundance of *Phytophthora* inoculum. A close spacing of 2 ft × 8 ft has been adopted in order to include as many clones as possible within the available space.

Disease ratings were carried out in both 1961 and 1962. In the year under review, disease evaluations were made by two independent observers. The complete results will be reported shortly in our Quarterly Journal.

Breeding for Gloeosporium resistance

The high incidence of *Gloeosporium* in several low-country districts during the last few years has made it necessary for an evaluation to be made of the newer high-yielding test clones and other experimental materials against this disease. A site has already been selected by the Plant Breeder for the establishment of a *Gloeosporium* testing station at Nakiadeniya in the Galle District. The first planting at this station is scheduled for the 1964 S.W. planting season.

Hevea breeding stations—Moneragala District

A supplementary breeding station was established in 1960 on Nakkala Estate, Moneragala to take advantage of an extended breeding season for purposes of increasing the scope of our current hand pollination programme. Flowering of *Hevea* usually occurs in May and June and in the absence of *Phytophthora* infection in this District, a more successful fruit set is anticipated.

A further Clone Trial cum Plant Breeding Station was established on Kumarawatte Group in this same district in 1961.

The growth of the crown-budded plants on Nakkala Estate as well as the recently evolved clones which were established in the clonal trial on Kumarawatte Group continue to show satisfactory progress.

Clone Trials

1961 Small-scale clone trial—Kuruwita. (S.W. Planting)

Girth measurements were taken throughout this area and a favourable average girth of 5·2 inches was recorded.

1961 Medium and small-scale clone trial—Kuruwita. (N.E. Planting)

This area too with routine maintenance, continued to show satisfactory growth.

1962 Large-scale clone trial—Kuruwita. Routine labelling and maintenance of this experimental area was carried out. A complete list of the clones included in this trial, can be found in the Institute's Annual Review for 1962.

Hand Pollination Programme

An extensive hand pollination programme was successfully carried out by the Plant Breeder on all 3 estates of the Dartonfield Group. A fair number of *Dothidella*-resistant clones flowered in the crown-budded and ring-barked areas. This enabled a series of crosses to be made utilising clones containing *Dothidella* resistance of various origins. Flowers from the IAN 6000 series were also available, though only in limited quantities. As a result, only a small number of seed sets was obtained.

A clone of *Hevea spruceana* commenced flowering at Dartonfield. This enabled a few crosses to be made between it and some local *H. brasiliensis* clones. A few viable seeds were obtained. Since the plants of the IAN 6000 series failed to synchronise with *H. spruceana* at flowering, it was unfortunately not possible to attempt this cross.

A plant of the RRIM selection E.S. 8 also flowered prematurely as a result of an attack of *Fomes*. Pollen from this plant was used successfully to obtain 17 plants of the cross RRIC 36 × E.S. 8.

A total of 23,904 artificial pollinations was carried out and 957 seedlings were established in the nurseries. Appendix I summarises the data on the hand pollination programme, submitted by the Plant Breeder.

Flower Inducement

General care and maintenance of the pollarded areas at Nivitigalakele was continued. Clone IAN 6500 came into flower in one of these trees and many male flowers were utilised in the hand pollination programme. The female flowers could not be used owing to premature drop. The following clones were budded after a previous failure or for the first time.

Tree No.	Clone budded	Tree No.	Clone budded	Tree No.	Clone budded
1	F 4542	27	RRIC 45	164	431
2	FX 360	28	RRIC 7	171	451
8	FX 714	41	RRIC 7	172	451
6	FX 516	44	IAN 2960	179	811
7	IAN 45-710	50	RRIC 51	180	811
9	IAN 3793	51	GT 127	190	860
18	FX 614	52	GT 127	194	860
19	FX 3810	53	GT 127	197	877
20	IAN 6497	62	413	199	877
21	IAN 6755	63	413		
25	RRIC 14	77	IAN 2965		
		163	431		

A number of clones which were ringed for flowering in the nursery produced flowers but were again difficult to protect as female parents. Of the IAN 6000 series IAN 6167, 6640 and 6645 flowered in this manner and were used for pollination.

Very early and repeated flowering was observed at Kepitigalla in clone H 440 planted in the *Oidium* Testing Station. The mother tree of this clone was traced in Hedigalla and buddings were made on to selected legitimate seedling in order

to investigate the stimulation of these plants into flower. Later, budwood of this clone was brought from Kepitigalla and another series of similar budgrafts were made.

Acknowledgements

The co-operation and active assistance given by the various Agency Houses as well as the resident Managers and Estate Superintendents, for the establishment and maintenance of the various disease-testing stations has been most gratifying. The sincere thanks of the Plant Breeding Section is extended to all concerned.

BOTANICAL EXPERIMENTS

Yield Stimulation Experiments

Yield stimulation experiments were first initiated in 1958 and 1959 at Dartonfield. The results of the experiments which were discontinued in 1961 when the experimental areas became due for replanting, have been discussed in previous reviews.

The third experiment on the use of yield stimulants was started in 1960 in an area planted in 1935 at Nivitigalakele. The experiment was carried out on 25-tree plots of local clones and in two sections. In one section 3 tapping tasks were used for testing RRIC stimulant mixture against a control and in the other section, space permitted 4 tapping tasks to be used for testing the proprietary product 'Dilatex' against a control. This experiment was terminated at the end of July 1963 as the clearing had to be handed over to the Estate Department for replanting. The yield results to date are presented below. (Table I)

Table I

YIELD STIMULATION EXPERIMENT NO. 3. NIVITIGALAKELE

Tapped S/2, d/2, 100%. Yield as % of Control

Year	Section 1		Section 2	
	RRIC Mixture	Control	Dilatex	Control
1960	126	100	140	100
1961	152	100	145	100
1962	145	100	155	100
1963	157	100	180	100

* Results only up to end of July 1963 when the experiment was terminated.

The fourth experiment in this series, was initiated at Kuruwita in January 1962 in an old seedling rubber area tapped at an intensity of 2S/2, d/3, 133% with a view to comparing the efficacy of 3 proprietary products. In December 1962, one of these (Ready Rub) was replaced with the RRIC Mixture I, as the

former was not available in Ceylon at that time. Owing to the lower rate of bark consumption on 2S/2, d/3, 133% system as compared with the S/2, d/2, 100% system, stimulants were applied to a 1½ inch strip of scraped bark below the tapping cut, instead of the usual 2 inch strip. Although the plan was to make applications at 6 monthly intervals in both 1962 and 1963 only one application per year could be made owing to rainy weather during the latter part of each year. The experimental results are shown in Table II.

TABLE II

YIELD STIMULATION EXPERIMENT NO. 4—KURUWITA

Tapped 2S/2, d/3, 133%. Yield as % of Control

Year	Ready Rub	RRIC Mixture I	Dilatex	Stimulex	Control
1962	137	—	104	119	100
1963	—	127	108	124	100

A large-scale yield stimulation experiment was initiated in November 1962 at Kuruwita Sub-station in a 40-acre polyclone block over 30 years old. The treatments consisted of the following :—

1. Stimulex applied on 1½" width scraped bark below the tapping cut.
2. Dilatex ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,
3. RRIC Mixture I ,, ,, ,, ,, ,, ,, ,, ,, ,,
4. RRIC Mixture II on 1½" width bark below tapping cut groomed with a wire brush.
5. RRIC Mixture II on 1½" width bark below tapping cut on untreated bark.

Although applications of stimulants were to have been made twice a year at 6-monthly intervals, only 1 application could be made at the beginning of each year owing to heavy rains. The yield results are given below. (Table III)

TABLE III

YIELD STIMULATION EXPERIMENT NO. 5—KURUWITA

Tapped 2S/2, d/4, 100%. Yield as % of Control

Year	Stimulex	Dilatex	RRIC Mixture I	RRIC Mixture II on groomed bark	RRIC Mixture II on untreated bark	Control
1962*	160	146	170	142	130	100
1963	110	107	102	107	108	100

* Based on yield results for November and December only.

Tapping Experiments

1954 Tapping Experiment—Dartonfield

A tapping experiment was initiated in 1954 at Dartonfield. The purpose of the trial was to observe the adaptability of the Michie-Golledge tapping knife to a height of 50″. Two plots of 5 trees each of 27 clones were tested. The treatments consisted of :—

1. Tapping at 42″ from the union.
2. Tapping at 50″ from the union.

The results for 1963 are presented in Table IVA. There were no marked differences in the average yield figures at the two heights of tapping in 1963.

Table IVA

1954 tapping experiment—Dartonfield

Tapped S/2, d/2, 100%

Yield in grams per tree per tapping

Clone	Tapping height 42″			Tapping height 50″		
	Virgin bark thickness in mm.	Girth in inches at 5 ft	Yield in grams	Virgin bark thickness in mm.	Girth in inches at 5 ft	Yield in grams
RRIC 8	8·2	22·8	14·8	7·4	26·2	14·7
,, 16	7·4	26·5	18·2	8·2	28·5	18·8
,, 54	8·6	25·9	29·0	8·4	27·5	27·9
,, 17	8·0	25·1	18·1	8·2	27·3	25·2
,, 86	8·6	26·2	32·8	8·8	26·8	36·3
,, 18	8·6	23·6	24·8	8·4	27·5	25·4
,, 82	6·5	20·0	20·4	7·0	20·2	21·6
,, 57	6·6	22·1	22·9	7·6	24·3	35·0
,, 80	7·0	23·4	27·0	7·3	23·7	30·2
,, 20	6·6	23·5	19·3	7·0	24·5	20·3
,, 28	6·2	22·9	12·4	7·5	22·6	15·1
,, 21	6·0	24·2	19·2	6·0	25·7	16·4
,, 22	7·0	24·0	27·4	6·5	24·0	27·7
,, 25	7·6	22·4	10·0	5·4	22·5	8·7
,, 81	6·2	25·1	18·3	7·0	26·3	25·8
,, 27	7·5	20·1	11·9	7·0	21·2	13·5
,, 28	7·0	26·4	26·2	7·0	26·4	25·6
,, 83	6·0	20·2	17·9	6·2	24·2	23·7
,, 84	8·0	20·4	24·4	7·5	23·2	26·6
,, 85	7·6	23·0	26·6	8·0	22·0	25·0
,, 87	6·3	21·3	19·8	8·0	24·5	23·4
,, 26	7·6	23·0	16·3	7·0	24·5	15·8
PBT 207	12·6	26·0	24·4	10·0	27·5	30·0
PB 28/59	7·5	21·9	39·9	8·0	24·8	46·9
PB 24/51	7·6	22·0	19·5	7·0	21·1	17·3
PB 24/3	7·2	23·6	26·6	7·6	22·5	22·4
RRIC 24	7·6	27·9	19·7	7·4	28·5	19·3
Mean	7·5	23·5	21·8	7·5	24·7	23·6

1961 Tapping Experiment—Dartonfield

A pilot tapping experiment, initiated in November 1961, is in progress at Dartonfield in a 3-acre block of PB 86 planted in 1938. The experiment consists of 4 treatments in unreplicated blocks of 80 trees each. The entire area had a previous history of consistent tapping on the S/2, d/2, 100% system. The 4 treatments introduced in November 1961 were as follows :—

A ... S/2, d/2, 100% (control).

B ... 2S/2, d/4, 100%.

C ... 2S/2, d/3, 133% (2 normal half-spiral cuts downward).

D ... 2S/2, d/3, 133% (one high cut at 100″ from ground level tapped with a ladder downwards, with a normal half spiral cut tapped downwards on the opposite panel.)

In summarising the yearly yield data, standard adjustments were made for initial differences in yielding capacity in the different blocks. The results for 1962 and 1963 are presented below. (Table IVB)

TABLE IVB

TAPPING EXPERIMENT—DARTONFIELD—INITIATED NOVEMBER 1961

Yield as % of Control

Year	A S/2, d/2, 100%	B 2S/2, d/4, 100%	C* 2S/2, d/3, 133%	D* 2S/2, d/3, 133%
1962	100	98·6	117·8	150·5
1963	100	91·2	121·8	130·9

* See text for treatment details.

The object in laying down this experiment has been discussed in the Annual Review for 1961. Although, in an unreplicated experiment of this nature, specific conclusions may not be feasible it may yet be possible to obtain useful information in due course on the economics of production on the various tapping systems as well as the long term effects of increased intensities of tapping.

CLONE EVALUATION : TEST-TAPPING

H. P. Seedlings and derivatives :

The test tapping of seedlings derived from the 1939-41 and 1943-45 hand pollination programmes was discontinued in 1963.

The test-tapping results of clones established in a small-scale trial from such hand-pollinated seedlings are presented in Table V.

Table V

TEST TAPPING RESULTS OF CLONES ESTABLISHED FROM HAND-POLLINATED SEEDLINGS.

	Origin of Material	Year of planting	Clone	No. of trees tapped 1963	Yield in lb dry rubber per tree per year			No. of trees affected			Mean girth in inches at 60" 1963	Bark thickness in mm.	
					1961	1962	1963	Canker and Bark Rot	Brown Bast	Wind-damage		Virgin	Renewed.
Nivitigalakele	1939 H.P. Seedling	1941	RRIC 9	3	26·1	31·9	32·7	—	1	—	48·3	13·0	10·7
			,, 51	5	24·1	29·4	28·6	1	2	—	51·7	13·8	10·6
			,, 24	5	24·8	19·6	21·5	2	—	—	48·7	12·8	8·8
			,, 14	2—3	14·2	14·3	20·0	1	1	1	40·5	12·5	8·0
			Control Wagga 6278		11·1	—	10·6						
Nivitigalakele	1940 H.P. Seedling	1944	RRIC 45	1	45·4	47·1	53·8	1	—	2	49·6	14·0	13·0
			,, 59	3	39·8	39·6	40·6	—	—	—	47·5	12·3	11·0
			,, 41	2	28·3	41·0	39·0	—	2	—	42·4	20·0	9·5
			,, 60	3	32·0	34·0	38·3	—	2	—	48·2	13·3	12·0
			,, 39	1	34·1	46·3	35·2	1	—	1	48·1	14·0	11·0
			,, 40	2—1	38·3	31·7	29·8	1	—	1	49·6	15·0	13·5
			Control Wagga 6278		18·7	19·3	20·5						
Hedigalla	1941 H.P. Seedling	1943	RRIC 50	4	44·0	40·1	37·7				44·1	13·8	—
			,, 75	2	52·2	32·3	36·5				42·8	11·0	—
			,, 33	4	39·9	30·9	35·6		1		—	—	—
			,, 76	4	32·7	28·4	34·5				39·7	13·2	—
			,, 35	4	42·9	30·6	32·2				42·7	11·3	—
			,, 79	4	32·4	26·9	32·8	1			46·0	11·7	—
			,, 36	4	44·4	30·9	31·0		1 *ustulina.*		43·4	12·5	—
			,, 37	4	50·8	26·0	28·6				37·5	11·6	—
			,, 74	5	35·8	26·8	27·9				40·5	12·9	—
			,, 38	3	—	—	25·6		1	1	40·5	12·3	—
			,, 46	3	30·9	21·6	24·8				38·1	11·1	—
			PB 86×PR 107	4	—	—	22·0				—	—	—
			RRIC 47	4	31·0	21·0	21·9		1		40.3	12·6	—
			,, 32	5	—	—	21·6				35·9	11·1	—

TABLE V (*Contd.*)

	Origin of Material	Year of planting	Clone	No. of trees tapped	Yield in lb dry rubber per tree per year			No. of trees affected			Mean girth in inches at 60" 1963	Bark thickness in mm.	
					1961	1962	1963	Canker and Bark Rot	Brown Bast	Wind damage		Virgin	Renewed
Hedigalla	1941 H.P. Seedling	1943	RRIC 49	1			20·8				35·6	10·7	—
			,, 48	4			17·4				29·5	8·7	—
			,, 34	4			13·5				35·5	10·8	—
			Wagga 6278	5			21·5				—	—	—
Hedigalla	1943 H.P. Seedling	1946	RRIC 98	4	33·1	40·4	30·8				38·6	12·3	—
			,, 97	4	23·3	26·3	30·2				45·6	11·9	—
			,, 96	5	30·6	32·4	26·2	1	1		42·3	12·2	—
			,, 77	3	29·4	25·7	28·4	1	1		37·4	12·5	—
			,, 55	3	29·4	35·6	25·3				32·4	11·4	—
			,, 62	1			25·0	1	2		30·7	10·7	—
			RR 233	4			24·8				—	—	—
			RRIC 57	5			24·0				33·1	10·9	—
			,, 54	5			20·6		1		36·7	11·5	—
			RR 241	5	23·2	25·0	20·2				33·2	10·0	—
			RRIC 61	4	26·1	23·6	19·5				35·5	10·0	—
			Control Tjir 1	4	18·2	20·9	16·8				—	—	—
Hedigalla	1944 H.P. Seedling	1947	No. 134	1	—	—	34·3	1	1	1			
			RRIC 64	5	25·7	34·7	25·6	—	—	—	34·7	9·7	—
			,, 65	4	25·0	26·1	20·2	—	—	1	34·9	10·1	—
			,, 78	3	19·8	24·2	19·3	1	—	1	30·1	10·4	—
			,, 66	4	19·9	22·2	17·9	—	1	—	32·1	8·3	—
			,, 63	4			13 4	—	—	1	25·2	8·5	—

In this trial, 3 or 5-tree clones of the original budgrafts were test tapped. Some of the clones have been tapped on reduced numbers due to losses of trees from disease and wind damage. There are many promising clones in this trial, but the final assessments of these high-yielding clones for secondary characters as well as a confirmation of their high-yielding qualities must be made from observations in the large-scale clone trials which have been set down.

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

RRIC 88 and 89.

The two clones RRIC 88 and 89 selected from among high-yielding PBIG seedlings planted in 1946 at Nivitigalakele, have continued to show good morphological growth characteristics as well as high yields in the 11th year of tapping. (Table VI).

TABLE VI

1946 CLONE TRIAL—NIVITIGALAKELE—RRIC 88 AND 89

Tapped on S/2, d/2, 100%

Yield in lb dry rubber per tree per year

	RRIC 88	RRIC 89
Yield in 1963	20·3	20·0
Yield in 1962	23·1	22·4
Yield in 1961	25·2	21·7
Yield in 1960	22·3	21·2
No. of trees tapped, 1963	22—21	22
Total Brown Bast cases	2	2
Total wind damage cases	1	—
Girth in inches, 1963	37·1	35·6
Thickness of virgin bark (mm)	11·9	11·2
Thickness of renewed bark (mm)	10·1	8·8

Although this experiment is an unreplicated trial with no control, test-tapping will be continued as early information on yield in subsequent years of tapping will be useful. A 3-acre block of each of these clones has been planted in the 1961 large-scale clone trial at Dartonfield. Both clones have already been recommended for planting in commercial estates on a limited scale since 1962.

Clone trial of selections from among the 1945 Hand Pollinated Seedlings—Hedigalla.

625 five-tree clones were established in 1952 at Hedigalla from a selection of the 1945 H.P. Seedlings. With rigorous selection, 12 of the most vigorous growing and better yielding clones were first selected for commercial test-tapping. Only 6 clones now remain in this trial with further subsequent elimination. The yields of these selected clones are given in Table VII.

TABLE VII

CLONE TRIAL OF SELECTIONS FROM AMONG THE 1945 HAND POLLINATED SEEDLINGS—HEDIGALLA

Tapped S/2, d/2, 100% from July 1960

Yield in lb dry rubber per tree per year.

Clone	No. of trees tapped, 1963	Yield			Girth in inches 1963	Bark thickness in mm.	
		1961	1962	1963		Virgin bark	Renewed bark
RRIC 91	5	20·5	21·1	26·0	35·1	9·3	7·7
RRIC 93	4	15·8	18·2	23·9	26·4	8·4	6·7
RRIC 90	5	22·9	25·3	22·3	29·4	8·4	6·6
RRIC 92	5	16·7	15·5	15·8	30·7	7·8	6·2
RRIC 94	5	15·6	17·7	19·6	24·7	7·8	5·8
RRIC 95	4	14·5	15·6	13·3	33·7	9·6	6·9

The above 6 clones which possess good external vegetative characters have been planted in 1962 at Nivitigalakele in a large-scale clone trial in 150-tree plots.

Test-tapping of foreign and local clones.

1952 Large-scale clone trial—Dartonfield. In a trial set down in 1952, clones Nab 12, 15 and 20 and RRIM 501 were compared with PB 86, originally in four replications of 200-tree plots of each clone. Test-tapping however was carried out once a month on only 35-40 trees of each clone from 1958 onwards due to the encroachment of building sites and the installation of over-head electric mains in this area. The results of the test-tapping are presented below. (Table VIII)

TABLE VIII

1952 LARGE-SCALE CLONE TRIAL—DARTONFIELD.

Tapped on S/2, d/2, 100%

Yield in grams per tree per tapping.

Clone	Yield			Girth in inches 1963
	1961	1962	1963	
RRIM 501	44·0	45·5	40·2	26·6
Nab 15	41·8	37·4	34·2	29·4
Nab 12	30·0	33·9	28·6	28·3
Nab 20	27·6	32·6	31·0	27·8
PB 86	28·1	28·0	31·1	26·6
Mean	34·3	35·5	33·0	27·7

Nab 15 is now planted on a commercial scale. Test tapping in this clone trial will be discontinued in 1964.

1939 clone trial—Nivitigalakele. Two of the Nab clones (12 and 15) in the above trial have also been under trial in another experiment set down in 1939 at Nivitigalakele. The control clone PB 86 which has been free of *Phytophthora* in this particular location, out-yielded the Nab clones. (Table IX)

TABLE IX

1939 CLONE TRIAL—NIVITIGALAKELE.

Tapped on S/2, d/2, 100%

Yield in lb dry rubber per tree per year.

Clone	No. of trees tapped, 1963	Yield			No. of trees affected			Mean girth in 1963	Bark thickness in mm.	
		1961	1962	1963	Canker and Bark Rot	Brown Bast	Wind damage		Virgin	Renewed
Nab 12	16	18·4	17·1	16·2	2	5	3	36·7	11·0	8·5
Nab 15	14	14·8	14·6	14·2	4	5	2	35·0	12·5	9·2
Control PB 86	17—16	22·0	20·7	20·7	—	4	2	37·4	11·4	9·0

1940 Clone trial—Nivitigalakele. The 3rd clone trial in test-tapping in this series contained a number of foreign clones and was set down in 1940 at Nivitigalakele. The results are presented in Table X. Clone RRIM 513 retains the highest number of trees after 16 years of continuous tapping.

TABLE X

1940 CLONE TRIAL—NIVITIGALAKELE.

Tapped S/2, d/2, 100%

Yield in lb dry rubber per tree per year.

Clone	No. of trees tapped, 1963	Yield			No. of trees affected			Mean Girth in inches, 1963	Bark thickness in mm.	
		1961	1962	1963	Canker and Bark Rot	Brown Bast	Wind damage		Virgin	Renewed
RRIC 1	17—16	—	19·4	19·1	3	7	1	46·6	13·5	10·2
PR 107	20—19	13·9	15·1	14·8	12	4	2	32·7	11·6	9·0
RRIM 501	10— 9	13·1	15·1	15·7	2	7	11	28·7	11·5	8·7
RRIM 513	20—17	9·5	10·0	9·3	2	7	—	27·5	10·5	7·8
Control Wagga 6278	17	16·1	18·1	18·4	5	1	6	34·0	13·3	9·7
Tjir 1	14	15·4	13·6	12·5	1	9	6	32·4	11·6	8·7

1954 Clone trial—Nivitigalakele. Test-tapping in the 1954 clone trial at Nivitigalakele was commenced in 1960 for an early evaluation of the more important imported clones. The yield figures over the last 3 years are presented in Table XI. It will be noted that PB 28/59 continues to be the outstanding clone in this trial, which justifies the recommendation for planting on a limited commercial scale.

TABLE XI

1954 CLONE TRIAL—NIVITIGALAKELE.

Tapped S/2, d/2, 100% from March, 1960.

Yield in lb dry rubber per tree per year.

	IRCI 10	IRCI 7	PB T-207	PB 6/5	PB 24/3	PB 28/59	PB 24/51	RRIM 501
Yield in 1961	8·8	10·2	7·0	8·9	8.6	14·2	7·6	9·7
,, ,, 1962	10·5	9·2	9·5	10·2	9.9	15·3	8·3	11·9
,, ,, 1963	8·4	8·8	9·1	10·3	10.5	14·2	9·0	12·6
No. of trees tapped in 1963	109–89	159–151	118–94	152–145	143–136	152-143	156–148	159–152
Canker & Bark Rot	—	2	2	1	1	1	—	1
Brown Bast	4	3	4	6	5	8	5	5
Wind Damage	60	17	75	10	10	16	17	19
Total casualties todate	64	22	81	17	16	25	12	25
Mean Girth in inches, 1963	22·7	25·7	24·4	23·2	24·8	25·1	25·6	24·0
Virgin Bark thickness in mm.	6·1	6·7	7·8	7·0	7·3	7·8	6·9	7·4

1944 Small-scale clone trial—Hedigalla. Test-tapping in the 1944 small-scale clone trial of 2 selected clones RRIC 52 and PB 5/122 and a control was continued in 1963. The yield data are given below. (Table XII)

TABLE XII

1944 SMALL-SCALE CLONE TRIAL—HEDIGALLA.

Tapped S/2, d/2, 100%

Yield in lb dry rubber per tree per year.

Clone	No. of trees tapped, 1963	Yield				
		1959	1960	1961	1962	1963
PB 5/122	3	23·8	35·5	29·8	22·8	30·2
RRIC 52	8	25·1	31·2	35·6	33·0	41·4
Control Wagga 6278	5	20·1	26·7	25·9	21·7	23·2

The Chemara clones Ch 3, 26, and 31 were set down in a replicated trial with 25-tree individual plots at Hedigalla in 1950 using PB 86 as a control. Ch 3 is comparatively free of stem and branch damage and the yield is satisfactory compared with the control. (Table XIII)

TABLE XIII

CHEMARA CLONE TRIAL, 1950—HEDIGALLA.

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 dry rubber per tree per year.

Clone	Ch 26	Ch 3	Ch 31	PB 86 Control
Yield 1961	24·7	16·6	9·6	14·3
Yield 1962	27·0	19·4	13·1	18·1
Yield 1963	20·1	26·7	11·8	20·1
No. of trees tapped, 1963.	50	29	66	68
Bark Rot and Canker cases	—	—	1	—
Brown Bast cases	—	—	—	2
Wind Damage cases	1	—	—	—

Test-tapping of RRIC clones 2-7.

190 three-tree clones were established from Prang Besar Seedlings in 1937. Early selections from this trial were planted out at Hedigalla in 1945 in a slightly larger trial. The yield results of clones which were finally selected for test-tapping are given below. (Table XIV)

TABLE XIV

1945 CLONE TRIAL—HEDIGALLA.

Tapped S/2, d/2, 100% from 1956.

Yield in lb dry rubber per tree per year.

Clone	RRIC 4	RRIC 5	RRIC 7	Tjir 1 Control
Yield 1960	17·5	18·8	21·0	17·6
Yield 1961	14·2	18·9	18·4	16·6
Yield 1962	18·0	22·7	28·7	19·5
Yield 1963	14·4	20·2	19·5	15·5
No. of trees tapped in 1963	35—40	55—68	69—73	66—73
Brown Bast cases	11	—	4	5
Wind Damage cases	3	—	—	—

In a small-scale clone trial at Hedigalla several other clones were planted in 1950, in 25-tree plots and 3 replications each. The yield results over the last 3 years suggest the further testing of RR 134. (Table XV)

TABLE XV

1950/51 CLEARING—HEDIGALLA.

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 dry rubber 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
Yield 1962	19·4	15·9	16·3	10·8	10·8	11·0
Yield 1963	17·7	12·7	15·9	14·5	9·6	11·7
Trees tapped, 1963	65	61	63	64	69	59
Canker and Bark Rot cases	—	—	—	1	—	—
Brown Bast cases	2	2	—	3	—	1
Wind Damage cases	—	1	—	1	—	4

LARGE-SCALE CLONE TRIALS

Clones which have survived scrutiny in small-scale early tapping trials are subsequently tested in larger trials.

1949 Clone trial—Hedigalla. In the original experiment, 150 trees of each clone were planted out in six 25-tree plots. The spacing was 6′ × 45′. As could be seen from the data (Table XVI), storm and diseases have resulted in considerable losses. Consequently the number of trees under tapping at the present time is much less than originally anticipated.

TABLE XVI

1949 LARGE-SCALE CLONE TRIAL—HEDIGALLA.

Tapped S/2, d/2, 100%

Yield in lb dry rubber per tree per year.

Clone	No. of trees tapped, 1963	Yield			Canker and Bark Rot cases 1963	Brown Bast cases 1963	Wind Damage 1963	
		1961	1962	1963			Branch and Stem	Uprooted
RRIC 86	77–76	16·7	21·0	19·3	1	—	—	—
Nab 20	70–66	16·7	20·2	17·5	4	10	—	—
RR 29	111–110	15·8	16·9	16·7	1	2	3	—
PB 86	107–105	15·7	15·6	15·7	5	1	—	—
RRIC 52	107–104	13·9	15·6	14·9	1	1	—	—
RRIM 501	82–79	16·3	17·7	13·8	14	—	2	—
RRIC 87	123–119	12·7	13·6	12·6	5	—	2	—
Dar 88	106–101	11·1	11·6	12·5	4	2	2	—
RRIM 513	114–111	12·6	13·4	11·6	14	3	—	—
RR 44	115–98	—	—	8·9	4	—	—	—

1954 Clone trial—Hedigalla. The clones in this trial were planted in large monoclonal blocks of 800—1000 trees per clone on difficult, inhospitable soils at Hedigalla. Test-tapping is commenced in each clone as it reaches tappable girth. As a result, a few clones came into tapping in 1961, a number in 1962 and a few more in 1963. The results for the 3 years, 1961—63, are summarized in Table XVII.

TABLE XVII

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, 1963	Yield			Girth in inches 1963	Bark Rot Cases	Brown Bast Cases	Wind-Damage	
		1961	1962	1963				Branch and Stem	Uprooted
RRIC 36	641–635	29·8	33·0	41·1	24·2	4	1	1	4
RRIM 501	628–625	19·4	28·2	39·6	22·9	—	1	1	2
RRIC 34	545–444	—	36·3	32·3	23·2	—	—	1	—
,, 35	752–750	30·8	33·5	32·2	24·2	8	1	—	—
,, 28	508–493	—	32·0	29·5	24·0	—	—	14	1
,, 18	660–656	15·3	24·1	27·7	25·0	—	—	4	—
AVROS 255	864–856	—	21·3	23·6	22·6	3 dead	—	—	5
RRIC 37	542–335	—	28·8	23·0	22·6	13	3	2	3
,, 22	713–707	17·5	25·1	21·7	24·5	1	—	—	5
,, 19	568–565	—	16·0	18·5	22·9	11	2	1	—
,, 29	509–488	—	16·7	18·3	22·4	—	—	1	19
,, 31	697–693	—	21·0	14·7	23·5	4	3	—	1
,, 16	667–662	16·7	16·8	14·4	25·3	—	4	1	—
,, 26	570–567	17·9	14·6	13·3	23·5	2	—	—	3
,, 25	526	—	16·7	12·7	22·3	—	—	—	—
,, 24	664–642	—	10·7	10·9	24·9	—	21	—	1
,, 21	654	—	14·4	10·4	24·2	—	—	—	—
,, 33*	445–442	—	—	34·3	22·4	—	2	—	3
PB 86*	470–467	—	—	32·9	22·8	—	1	2	—
PR 107*	606–591	—	—	31·8	23·4	3	5	—	7
RRIC 17*	502–500	—	—	21·7	21·7	—	1	—	1
,, 32*	580–574	—	—	21·4	22.6	—	2	—	4
,, 23*	499–497	—	—	16·6	21·7	—	1	—	1
'H' Block Seedlings 1956—1943				27·9		5	4	1	
LCB 870 × Tjir 1(B) 186—184				19·3				2	
,, × ,, 177				16·2				2	
,, × PR 107 188				16·0					
,, × Mil 3/2 186				14·3					

*Tapping commenced on 17.5.63.

Clones yielding around 30 grams per tree per tapping in the 1st or 2nd year of production could be considered as promising. A careful check is being kept on secondary characters as well as susceptibility of these clones to bark and leaf diseases.

1955 Clone trial—Hedigalla. 12 RRIC clones were planted in monoclonal blocks of 750 trees of each clone in 1955 at Hedigalla. The results for 1968 are presented below. (Table XVIII)

TABLE XVIII

1955 LARGE-SCALE CLONE TRIAL—HEDIGALLA.

Yield in grams per tree per tapping.

Clone	No. of trees tapped, 1968	Yield		Girth in inches 1963	Bark Rot and Canker	Brown Bast	Wind Damage	
		1962	1963				Branch and Stem	Uprooted
RRIC 46	562–545	31·1	36·0	18·7	—	11	6	—
„ 50	551	17·7	33·2	20·2	—	—	—	—
„ 13	630–603	30·3	33·1	20·6	—	17	9	*1 Ustulina*
„ 40	541–507	28·5	32·4	22·1	6	16	13	—
„ 41	572–552	30·3	31·3	21·3	—	18	2	—
„ 47	620–594	20·3	27·0	20·1	20	5	1	—
„ 11	528–522	21·6	24·8	22·4	—	2	4	—
„ 43	617–591	25·4	23·7	20·2	—	7	19	—
„ 9	616–609	19·5	21·4	22·7	—	2	5	—
„ 49	588–575	23·1	20·0	22·1	—	9	2	—
„ 12	575–559	15·2	18·9	24·0	—	5	11	—
„ 14	660–657	21·3	17·2	22·2	—	—	2 (*1 Ustulina*)	
Mean		23·6	26·6	21·4	—	—	—	—

A large number of trees in various clones have been uprooted due to the particular location of this trial on Hedigalla Division which is generally exposed to heavy monsoon storms. It may be noted that the clones in this trial have no known previous history of inherent susceptibility to wind damage.

1953 Clone trial—Nivitigalakele. In this trial the yielding capacities of RRIC 45 and 44 were compared against each other. The clones were budded in the field in approximately 700-tree monoclonal plots in 1955. This area is surrounded by a boundary area planted with PB 86, in 1953. As this PB 86 is 2 years older than the trees of clones RRIC 44 and 45, yield results from PB 86 would not be strictly comparable with those of the other two clones. The yield figures and girth measurement data for RRIC 44 and 45 are given overleaf. (Table XIX)

TABLE XIX

1958 LARGE-SCALE CLONE TRIAL—NIVITIGALAKELE.

Tapped S/2, d/2, 100%.

Yield in lb dry rubber per tree per year.

Clone	RRIC 45	RRIC 44
No. of trees tapped in 1963	551–466	498–363
Yield 1962	8·9	10·8
Yield 1963	10·2	11·3
Brown Bast cases	5	—
Bark Rot and Canker cases	1	—
Wind-damage cases	17	3
Mean girth in inches, 1963	24·1	23·2
Thickness of virgin bark in mm.	6·7	6·4

The yield of clone RRIC 45 is reassuring. This clone was established from an F_1 hybrid between RRIC 8 and Tjir 1. RRIC 44 which is also of hybrid origin (RRIC 8 × Hil 28) outyields even RRIC 45.

1956 Clone trial—Hedigalla. Local and foreign clones were planted in 300-tree monoclonal blocks in this trial. As individual clones reached tappable girth, they were brought into tapping. The yield results as well as girth measurement data in respect of these clones are presented in Table XX.

TABLE XX

1956 LARGE-SCALE CLONE TRIAL—HEDIGALLA.

Yield in grams per tree per tapping.

July to November, 1963.

Clone	No. of trees tapped	* Average girth in inches	Yield in grams per tree per tapping
PR 257	129	21·5	46·0
RRIM 605	199	21·8	38·0
PR 228	187	20·6	35·3
RRIM 618	223	21·9	33·8
RRIC 55	130	20·3	33·0
IRCI 9	193	21·7	31·0
PR 252	175	21·3	30·9
AVROS 1191	169	19·7	30·3
PB 86	219	20·9	23·3
IRCI 5	226	20·6	23·2
RRIM 603	216	21·0	22·5
RRIM 613	231	23·2	16·5

* Average girth of trees in tapping.

1956 Clone trial—Dartonfield. A trial to compare the yielding capacities of clones GT 1, WR 101, AVROS 385 and 427, was set down in 300-tree monoclonal blocks at Dartonfield. The clone RRIC 52 of which 48 points were planted on the boundaries, came into tapping in March 1962, whereas the others in the trial proper came into tapping only 1 year later in March 1963.

The yield and girth measurement data for 1963 are presented in Table XXI.

TABLE XXI

1956 LARGE-SCALE CLONE TRIAL—DARTONFIELD.
Yield in grams per tree per tapping.
Tapped S/2, d/2, 100%.

Clone	No. of trees in tapping	Yield
WR 101	145	22·7
GT 1	102	15·6
AVROS 885	142	7·5
RRIC 52	44—42	22·8

AVROS 427 is the poorest grower in this trial. This trial has unfortunately been sited in a hilly area with rocky outcrops, and will not give a true picture of the yield potentials of these clones.

GROWTH MEASUREMENTS IN IMMATURE AREAS

Girth measurements, as an index of the comparative rate of growth of various clones, are taken in large and small-scale trials at a height of 3 ft from the union in the case of buddings in immature areas. The criterion of tappability is 60—70% of the trees within a clone being at least 20″ in girth. Once a clone comes into tapping, girth measurements are continued to be taken, but at a height of 5 ft above the union. In large-scale trials, every 5th or 10th tree in a clone is numbered permanently to facilitate yearly measurements.

An average increase of 3 to 3½ inches per year could be considered as normal, good growth. In exceptional cases, an increase of up to 4 inches can be observed in the more vigorous clones.

1956 Large-scale clone trial—Hedigalla. The girth data in respect of the clones which are already in tapping have been presented in Table XX, along with the yield figures. Girth measurements in the clones which have not yet reached tappable girth are presented in Table XXIA.

TABLE XXI A

1956 LARGE-SCALE CLONE TRIAL—HEDIGALLA.
Average girth in inches.

Clone	Girth		Increase 1962/63
	1962	1963	
RRIM 617	17·6	20·4	2·8
PR 247	16·1	18·4	2·3
RRIC 54	15·9	18·2	2·3
RRIC 59	14·8	17·6	2·8
PR 253	14·9	16·9	2·0
PR 258	14·4	16·7	2·3

TABLE XXI A—(*Contd.*)

Clone	Girth		Increase 1962/63
	1962	1963	
AVROS 1447*	15·9	19·2	8·3
RRIC 39*	16·1	18·1	2·0
RRIC 42*	15·8	18·0	2·2
AVROS 1851*	15·4	17·7	2·3
RRIC 48*	14·8	17·4	2·6
AVROS 1328*	13·2	15·7	2·5
TR 1406*	13·9	15·6	1·7
IRCI 3*	13·5	15·4	1·9
IRCI 1*	12·7	14·4	1·7
IRCI 6*	11·0	12·7	1·7
PR 256*	10·7	12·6	1·9

* Clones planted 4 months later.

1957 Clone trial—Hedigalla. This trial area contains a large number of clones which were planted in September/October, in the North-East monsoon season of 1957.

196 ten-tree clones, established from selected H.P. Seedlings of the 1945, 1954 and 1955 pollination programmes were planted alternating with 10-tree plots of control clone PB 86 at suitable intervals. 25 ten-tree clones selected from 833 H.P. Seedling crosses of clone LCB 870 as one parent, were also included in this clone trial.

While no useful purpose will be served in presenting the detailed information collected in respect of the individual clones, it may be mentioned that over the entire area, the annual girth increment averaged only 2·6″ per tree. This is quite unsatisfactory and indicates once again the poor growing conditions in this area as well as inherent soil infertility.

1961 Large-scale clone trial—Dartonfield. This trial contains the clones RRIC 88, 89, 45, 52 and 7, RRIM 513 and PB 28/59. The first set of growth measurements was taken in 1963. The results are given below. (Table XXII)

TABLE XXII

1961 LARGE-SCALE CLONE TRIAL—DARTONFIELD.

Average girth in inches.

Clone	RRIC 52	RRIC 7	RRIM 513	RRIC 45	PB 86	RRIC 88	PB 28/59	RRIC 89
Number of trees	494	441	493	555	542	518	514	483
Average girth, 1963	5·1	4·6	4·4	5·8	5·2	4·7	4·9	4·0

1962 Large-scale clone trial—Nivitigalakele. In this trial the yielding capacity of 16 local and foreign clones will be compared against the control PB 86. Each clone is planted in a single unreplicated 150-tree plot. The clones under test are :—

IAN 45-717	RRIC 92
RRIC 5	RRIC 93
RRIC 39	RRIC 94
RRIC 51	RRIC 95
RRIC 86	RRIC 96
RRIC 90	RRIC 97
RRIC 91	RRIM 623
Control—PB 86	RRIM 628
	RRIM 701

The first series of girth measurements will be due in 1964.

1962 Small-scale clone trial—Nivitigalakele. In a trial similar to the above, 17 local and foreign clones have been set down in single 10-tree plots (unreplicated) for information on growth and yield potentials. The clones in this trial are :—

IAN 6497	Clone No. 82
PB 28/59	,, 566
RRIC 7	,, 759
RRIC 86	,, 815
RRIC 45	,, 1009
RRIC 52	,, 1103
RRIM 607	,, 1317
RRIM 707	,, 1458
	Harbel 1

Here too the first series of girth measurements will be due in 1964.

Crown-Budding Experiments

1952 Large-scale crown-budding trial—Dartonfield. Ten-tree plots have been used for comparing five clones crown budded with LCB 870 against the same clones which were not crown budded. LCB 870 is an extremely low-yielding clone which has been used for crown budding because of its resistance to *Oidium*. However in recent years this clone has been affected with *Oidium* at higher elevations.

The depressing effects of low-yielding crown on the yield of high-yielding centre sections in 3-component trees is once again evident. (Table XXIII)

Table XXIII

1952 crown budding trial—Dartonfield.

Yield in grams per tree per tapping.

Clone	Trees not crown-budded	Trees crown-budded
PB 86	31·1	21·7
RRIM 501	40·2	25·3
Nab 12	25·6	20·8
Nab 15	34·2	24·8
Nab 20	31·0	20·6
Mean	33·0	22·6

This experiment will be discontinued in 1964. The results of crown budding investigations which have been carried out by this Division since 1945, will be reported in the Quarterly Journal of this Institute shortly.

Experiments on Commercial Estates

1957 Small-scale clone trial—Estate A—Kalutara District. 5 clones are tested against PB 86 in this trial. The clones have been planted in 300-tree monoclonal blocks for tapping as a task in later years. The data in respect of girth measurements taken in 1963 are presented below. (Table XXIV)

Table XXIV

1957 small-scale clone trial—Estate A—Kalutara District.
Average girth in inches.

Clone	TR 1406	AVROS 529	IRCI 2	IRCI 3	RRIM 607	PB 86 control	Mean
Girth 1963	21·1	19·3	20·6	19·0	19·6	17·6	19·5
,, 1962	17·5	15·6	16·8	15·5	16·2	14·4	16·0
,, 1961	13·5	12·0	12·5	11·5	11·3	11·0	12·0
Increase 1962/63	3·6	3·7	3·8	3·5	3·4	3·2	3·5

1957 clone trial—Estate B—Kalutara District. In a trial similar to the above, 5 other promising clones were set down for testing against PB 86 in a 10-acre block, and 11 others against PB 86 in a 20-acre block. A summary of the girth measurements taken in 1963 is presented in Table XXV A and B.

Table XXV A

1957 clone trial—Estate B—Kalutara District. (10-acre block).
Average girth in inches.

Clone	TR 1548	RRIM 612	AVROS 2037	AVROS 1734	PR 254	PB 86 control	Mean
Girth 1963	22·4	22·3	21·7	21·0	20·5	18·9	21·1
,, 1962	19·3	19·2	18·4	18·3	17·5	16·3	18·1
,, 1961 ...	15·5	15·5	15·0	15·0	14·3	13·3	14·8
Increase 1962/63	3·1	3·1	3·3	2·7	3·0	2·6	3·0

TABLE XXV B

1957 CLONE TRIAL—ESTATE B—KALUTARA DISTRICT (20-ACRE BLOCK).

Average girth in inches.

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 1963	22·0	20·0	20·3	19·9	20·6	19·9	19·8	19·2	19·1	19·8	18·9	18·3	19·8
„ 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
„ 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 1962/63	3·0	3·2	2·7	2·5	3·3	2·9	3·1	2·7	2·6	2·7	3·1	3·0	2·9

1958 clone trial—Estate B—Kalutara District. 18 foreign and local clones were planted in 300-tree monoclonal blocks in this experiment. A summary of the girth measurement data is presented in Table XXVI.

TABLE XXVI

1958 CLONE TRIAL—ESTATE B—KALUTARA DISTRICT.

Average girth in inches

Clone	RRIC 52	RRIC 54	RRIC 41	IRCI 2	RRIC 22	RRIC 28	GT 1	RRIC 45	AVROS 385	RRIM 605	RRIC 37	IRCI 6	RRIC 39	AVROS 27	RRIC 86	RRIM 607	RRIC 55	PB 86 control	Mean
Girth 1963	20·8	18·0	18·0	17·3	17·6	16·8	17·4	17·7	16·6	16·8	17·5	16·2	18·9	15·8	17·2	18·7	15·3	15·4	17·2
,, 1962	16·2	14·7	14·8	13·9	14·2	13·8	13·8	14·2	13·5	13·6	14·0	13·1	14·9	12·8	13·5	14·6	12·1	12·3	13·9
,, 1961	9·3	10·3	11·0	10·0	10·0	8·3	10·0	10·3	9·3	9·8	10·0	9·0	8·0	9·3	8·8	10·0	8·3	8·3	9·4
Increase 1962/63	4·6	3·3	3·2	3·4	3·4	3·0	3·6	3·5	3·1	3·2	3·5	3·1	4·0	3·2	3·7	4·1	3·2	3·1	3·4

(Waljapala WJ 1 1963 girth 15·4″)

Laboratory and Field Investigations

Only limited laboratory investigations were possible during the year under review as the new Botany Block was completed only in December 1963. This Division collaborated in one joint anatomical cum pathological investigation. The results of this investigation were presented at the 19th Annual Session of the Ceylon Association for the Advancement of Science.

Small-scale preliminary experiments will be initiated in 1964 to investigate the following :—

1. Anatomical and physiological studies on the action of yield stimulants on *Hevea* bark samples.
2. Studies of laticiferous tissues from different portions of 3-component trees.
3. Green buddings.
4. Effect of continuous tapping without winter rest.
5. The long term effects of continuous yield stimulation in comparatively young clearings.

APPENDIX I

HEVEA HAND-POLLINATION PROGRAMME—1968.

(SS) @ Selected Seedling Origin.

Station	Cross made	Parentage/Origin	No. of pollinations	1st Exam. success	% success	No. of seeds collected	No. of seeds germinated	% Germination
Nivitigalakele	FX 273 × RRIC 52	(F 351 × PB 186) × (SS)	20	1	5·0	3	2	66·6
,,	FX 617 × RRIC 52	(F 4542 × Tjir 1) × (SS)	161	12	7·5	29	13	44·8
,,	IAN 45–713 × RRIC 52	(PB 86 × F 409) × (SS)	5	1	20·0	3	1	33·3
,,	IAN 45–873 × RRIC 45	(PB 86 × FA 1717) × (RRIC 8 × Tjir 1)	27	8	29·6	9	1	11·1
,,	IAN 2668 × RRIC 51	(FX 4068 × PB 86) × (RRIC 8 × Mil 3/2)	17	2	11·8	3	3	100·0
,,	IAN 2668 × RRIC 52	(FX 4068 × PB 86) × (SS)	12	3	25·0	3	3	100·0
Hedigalla	LCB 1320 × RRIC 36	(SS) × (PB 86 × PR 107)	111	2	1·8	3	2	66·6
,,	,, × RRIC 52	(SS) × (SS)	640	58	9·1	52	48	92·3
,,	,, × T III	(SS) × *H.spruceana*	19	2	10·5	3	3	100·0
Nivitigalakele	RRIC 36 × E.S. 8	(PB 86 × PR 107) × (RRIM 501 × Tjir 1)	451	10	2·2	30	17	56·6
,,	RRIC 36 × F 4542	(PB 86 × PR 107) × *H.benthamiana*	670	35	5·2	96	40	41·6
,,	,, × IAN 6585	(PB 86 × PR 107) × (FX 43-651 × PB 86)	285	9	3·2	28	21	75·0
Hedigalla	RRIC 36 × LCB 1320	(PB 86 × PR 107) × (SS)	18	9	50·0	12	9	75·0
,,	,, × RRIC 52	(PB 86 × PR 107) × (SS)	1262	226	17·9	223	140	62·7
Nivitigalakele	RRIC 45 × IAN 6167	(RRIC 8 × Mil 3/2) × (FX 43-448 × Tjir 1)	89	4	4·5	13	12	92·3
,,	RRIC 52 × FX 25	(SS) × (F 351 × AV 49) (false)	108	11	10·2	6	3	50·0
,,	,, × FX 273	,, × (F 351 × PB 186)	62	19	30·6	27	13	48·1
Hedigalla	,, × FX 360	,, × (F 4542 × AV 363)	2084	84	4.0	102	87	85·2
Nivitigalakele	,, × FX 617	,, × (F 4542 × Tjir 1)	248	37	14·9	27	22	81·4
Dartonfield	,, × IAN 45-717	,, × (PB 86 × F 4542)	235	9	3·8	8	5	62·5
Nivitigalakele	,, × IAN 2878	,, × (FX 516 × PB 86)	68	4	5·9	6	3	50·0
,,	,, × IAN 6167	,, × (FX 43-448 × Tjir 1)	355	10	2·8	9	7	77·7
,,	,, × IAN 6500	,, × (IAN 2818 × PB 86)	553	5	9·0	12	10	83·3
Hedigalla	,, × IAN 6645	× (FX 43-665 × PB 86)	278	6	2·2	3	3	100·0
,,	,, × LCB 1320	,, × (SS)	3224	185	5·7	48	45	93·7

APPENDIX I (*Contd.*)

Station	Cross made	Parentage/Origin	No. of pollinations	1st Exam. success	% success	No. of seeds collected	No. of seeds germinated	% Germination
Hedigalla	RRIC 52 × PB 86	(SS) × (SS)	3953	217	5·5	242	219	90·4
,,	,, × RRIC 36	(SS) × (PB × 86 × PR 107)	2758	172	6·2	62	51	82·2
Dartonfield	,, × RRIC 52	(SS) × (SS)	156	8	5·1	15	6	40·0
,,	,, × T III	(SS) × *H.spruceana*	2622	81	3·1	93	74	79·5
Nivitigalakele	RRIC 54 × FX 516	(PB 86 × Wag. 6278) × (F 4542 × AV 363)	52	6	9·7	18	15	83·3
,,	,, × FX 617	(,, × ,,) × (F 4542 × Tjir 1)	105	20	19·0	33	22	66·6
,,	,, × Tjir 1	(,, × ,, SS)	4	1	25·0	3	3	100·0
Dartonfield	T III × RRIC 36	*H.spruceana* × (PB 86 × PR 107)	206	27	13·1	24	20	83·3
,,	,, × RRIC 51	,, × (RRIC 8 × Mil 3/2)	62	5	8·1	8	8	100·0
,,	,, × RRIC 52	,, × (SS)	864	42	4·9	38	26	68·4
		Unsuccessful Crosses	**2110**					
		Total	**23904**	**1331**	**5·5**	**1294**	**957**	**73·9**

REVIEW OF THE PLANT PATHOLOGY DIVISION

By

O. S. Peries

Summary

All members of the staff of the Plant Pathology Department, except Mrs. V. Satchuthananthavale, Assistant Plant Pathologist, who left the Island in September for Post-graduate studies overseas, were on duty throughout the year.

The Agricultural Engineer, Mr. J. H. Lloyd, completed his assignment and left the Island on 19 April, and his work too has been handled by the writer, who has also been appointed by the International Rubber Research and Development Board to co-ordinate research work on leaf and bark diseases of *Hevea*, carried out at all the Middle and Far Eastern Rubber Research Institutes.

Laboratory work carried out during the period under review included studies on the biology and host-parasite relationships of *Oidium heveae* and *Phytophthora* spp.

The cardinal temperatures for the germination of the conidia of *O.heveae* have been established, the importance of free water in suppressing the germination of conidia has been demonstrated, and the development of the fungus from the conidial stage to sporulation has been described.

The studies on the biology of *Phytophthora* spp. have been completed, a paper on the sexuality of the fungus has been published and another on the growth characteristics of the fungus has been prepared for publication. Further details on strain variation in the fungus and its mode of perennation have been obtained. Detailed studies have been carried out on host-parasite relationships, and the time taken by the parasite to infect pods, petioles and leaf blades has been clearly established.

A great deal of work has been done on the biology of spore germination in *Gloeosporium alborubrum*.

The studies on the mode of penetration of *Hevea* roots by *Fomes lignosus* have been completed and this process has been described in detail.

Several new fungicides were tested in the laboratory for bark and root disease control, but none of them came up to the standards required for further assessment under field conditions.

Tests carried out with waterproof materials for bark disease control have shown that, although some of these materials have slight fungicidal properties, none of them promote bark renewal.

Pure culture experiments are being carried out with *F.lignosus* to establish the minimum inoculum necessary for infection of *Hevea* roots under controlled conditions.

It has been demonstrated that the addition of sulphur or copper sulphate to the soil not only alters the pH and the pattern of distribution of soil microflora, but can completely suppress the growth of *F.lignosus*. The significance of this has been discussed.

The wintering season extended over a long period this year, with the result that the late winterers suffered a relatively severe attack of *Oidium*. Consequently, the rubber foliage in general in 1963 was not as good as it was in the previous year.

Nine field experiments were carried out on *Oidium* control during the 1963 refoliation season. These have shown that spraying with wettable sulphur is neither a feasible nor economical method of controlling *Oidium*, with the machinery now available for the application of the fungicide. These experiments have also indicated that the intensive methods of *Oidium* control now generally adopted in Ceylon, may not be essential in the wet low-country districts and that considerable economies may be effected by controlled dusting with reference to a simple method of disease forecasting.

The incidence of *Phytophthora* leaf disease was comparatively mild this year in spite of the abnormally heavy rains recorded throughout the year.

Six *Phytophthora* control field experiments were carried out during the year, five to compare dusting with spraying and various products of each type for controlling the disease, the sixth to find out whether there is a demonstrable relationship between pod set and *Phytophthora* leaf disease incidence. Only two of these experiments gave significant results, which showed that dusting at weekly intervals can give as effective and often better control of the disease than spraying, either once pre-monsoonally or monthly during the monsoon period. However, the incidence of the disease was so low that these results are not considered to be of any practical value.

All experimental areas have been test-tapped in order to assess the economic importance of *Phytophthora* leaf disease in Ceylon. However, because of the inherent variability of yields from tree to tree and the errors caused by different personal standards of tapping, the yields recorded this year are not considered valid for experimental purposes.

A survey carried out in the various rubber growing districts of Ceylon has shown that *Gloeosporium* is a disease of vital importance to the rubber growing industry in Ceylon, and that intensive research must be carried out to establish methods of controlling it, especially in young clearings. Field experiments have already been started for this purpose, and in conjunction with these experiments a survey is being carried out in all the rubber growing districts of the Island to establish the seasonal periodicity of production of new flushes and the susceptibility of the latter to *Gloeosporium* leaf disease.

The incidence of Bark Rot was low for a major part of the year, but severe disease was recorded on certain estates in the last three months of the year. The field experiments started during 1962 for the selection of fungicides for Bark Rot control were continued this year.

The results of field experiments have shown that the routine application of fungicides for the protection of the tapping panel from Bark Rot infection is best done after tapping.

None of the new water-miscible fungicides tested in the laboratory for Bark Rot control came up to the standards required for further testing under field conditions. The results of five experiments, carried out during the year, on White Root disease control have confirmed the results of the experiments carried out in 1962, which showed that the fungicides now in use for *Fomes* control do not play a significant role in the control of the disease.

The rhizobial culture work was handed over by the Soils Chemistry Division to the Plant Pathology Division in November 1962. Several estates received rhizobial cultures free of charge on request from the Institute. Studies have been initiated to test a number of new strains of *rhizobia*, obtained from various parts of the world, for efficiency of nitrogen fixation under the conditions prevailing in Ceylon.

In addition to the field experiments on *Oidium* and *Phytophthora* leaf disease control, the Agricultural Engineering Section carried out further studies on the rainfastness and application characteristics of spray and dust formulations of copper fungicides and assessed the application performance of two new spraying and dusting machines.

DETAILED REVIEW

General

Staff

Dr. O. S. Peries (Head of Division) and Messrs. D. L. S. Wimalajeewa (Assistant Pathologist), H. L. Munasinghe (Senior Technical Assistant), E. G. Mendis, T. M. Fernando, S. K. Samaraweera, D. M. Dantanarayana, W. C. Dayaratne, T. Shanmuganathan and Z. E. Irugalbandara (Technical Assistants) were on duty throughout the year.

Mrs. V. Satchuthananthavale (Assistant Plant Pathologist) left the Island on 25 September 1963, for post-graduate studies at the University of Nottingham, under the Technical Co-operation Scheme of the Colombo Plan, but was later transferred to the University of Sheffield.

Correspondence

	Inward	*Outward*
General	94	124
Technical	690	505

Visits

	Advisory	*Experimental*	*Others*
Head of Division	41	86	16
Assistant Plant Pathologists	16	85	8
Senior Technical Assistant	15	1	2
Technical Assistants	30	616	0
Total	102	788	21

Meetings

The Head of the Division attended the following meetings :—

1. Kalutara District Planters' Association meeting, held on 19 June 1963, at which an address was delivered on " Physiologic Yellowing " of leaves.

2. Committee for the discussion of the importation of fungicides and herbicides into the Island—17 April.

3. Ceylon Association for the Advancement of Science, sessions 20-23 November, at which a paper entitled " Incidence, Symptoms and Histology of Bark Cracking in *Hevea brasiliensis* Müll-Arg ", was read.

4. Kurunegala District Planters' Association meeting, held on 12 December 1963, at which an address was delivered on " White Root Disease Control in *Hevea.*"

Publications

The following papers were prepared for publication by the staff of the Plant Pathology Department during 1963 :—

(1) Annual Review of the Plant Pathology Department for 1962.

(2) Annual Review of the Agricultural Engineering Unit for 1962.

(3) Field evaluations of methods for the control of White Root disease (*Fomes lignosus*) of *Hevea*. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 1 and 2, 9-15.

(4) Pure culture inoculation of *Hevea* roots with *Fomes lignosus*. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 1 and 2, 16-17.

(5) Incidence and economic importance of the *Gloeosporium* leaf disease of *Hevea* in Ceylon. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 1 and 2, 18-24.

(6) A preliminary report of physical assessments of products for *Gloeosporium* control trials. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 1 and 2, 25-26.

(7) Contribution on " Physiologic Yellows " to " Planting Topics." *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 1 and 2, 52.

(8) Complementary strains of *Phytophthora palmivora* from Ceylon rubber. *Phytopathology.* **53,** 729.

(9) The control of abnormal leaf-fall disease (*Phytophthora palmivora*, Butler) of *Hevea* in Ceylon. Parts I-IV, *Rubb. Inst. Ceylon. Bull.* 57 (1963) (In the Press).

(10) Field experiments for the control of *Oidium* leaf disease of *Hevea*. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 3 and 4, 73-80.

(11) The incidence, control and economic importance of *Oidium* leaf disease on Ceylon rubber—Planters' assessments. *Rubb. Res. Inst. Ceylon. Quart. J.* **39,** Parts 3 and 4, 65-72.

(12) Avisory Circular No. 41 on Pink Disease, *Corticium salmonicolor*, was completely revised.

(13) Advisory Circular No. 57 on Rubber Seedling Nurseries was completely revised.

(14) Problems of applying sprays and dusts to mature *Hevea* rubber in Ceylon. *J. Agr. Eng. Res.* 8, 240-251 (1963).

(15) Incidence, symptoms and histology of bark cracking in *Hevea brasiliensis* Müll. Arg. *Trop. Agric.* Trinidad (In the Press).

(16) The incidence and economic importance of the *Gloeosporium* leaf disease of *Hevea* in Ceylon. Part II. Report of a survey on the incidence of *Gloeosporium*. *Rubb. Res. Inst. Ceylon. Quart. J.* **39**, Parts 3 and 4, 81-84.

Co-ordination of Research

Dr. O. S. Peries was appointed to co-ordinate research work carried out on leaf and bark diseases at all the Rubber Research Institutes affiliated to the International Rubber Research and Development Board. The work connected with this takes up a great deal of time, but there is no doubt that co-ordination of research carried out at the various Institutes would be of immense value to all the member countries of the I.R.R.D.B., and, therefore, a special effort is being made to organize this work on a sound footing.

The writer is compiling a bibliography of the literature published by the different Institutes, on the leaf and bark diseases of *Hevea*, to form a basis for the co-ordination of research work on these subjects. The Plant Pathologists attached to the sister Institutes in other parts of the world are collaborating in this work, and their help and encouragement are greatly appreciated.

Laboratory Work

Diseased Specimens

The following diseases and pests were identified on specimens sent to the Institute in connection with advisory work during 1963 :—

Identity of diseases, pests and other causes of damage.	*No. of cases*
(*a*) *Fungi and Bacteria*	
Fomes lignosus	1
Fomes noxius	1
Gloeosporium alborubrum	8
Helminthosporium heveae	2
Hypocrella reineckiana	1
Oidium heveae	16
Phytophthora palmivora	8
(*b*) *Pests and other causes*	
Brown Bast	1
Insect damage	1
Lightning damage	2
Physiological yellowing of leaves ...	20
Physiological disorders (others) ...	1
Sun-scorch	2
Water-logging	1
Weed-killer	1
Total	61

Biology of the Fungal Parasites of Hevea

These studies, begun last year, were continued during the period under review. Remarkable progress has been made in these studies, mainly because of the enthusiasm shown by the Technical Assistants of the Department, who have worked untiringly on the problems set to them.

Biology of Oidium heveae.—(O. S. Peries and S. K. Samaraweera). The cardinal temperatures for the germination of the conidia of *O.heveae* have been established (Max. *c* 35°C. Opt. 25-30°C Min. *c* 5°C). These studies have also indicated that conidia germinate most rapidly at the optimum temperature *i.e.* 25-30°C.

Free water is injurious to the conidia of this fungus, which are killed by prolonged immersion in water. However, contact with water for short periods, under 2 hours, does not appear to have any ill-effects on these spores. This is the probable explanation for the fact that *Oidium* leaf disease spreads rapidly during periods when there are short, sharp showers. It is only prolonged rainfall, which maintains leaf surface wetness for long periods, (2-3 days) that militates against the rapid spread of the fungus; it has been shown that conidia do not germinate on and cause an infection of a wet leaf.

Further studies on the host range of *O.heveae* by the transfer of conidia from one host to another have shown that the *Oidium* of *Euphorbia hirta* and that of *Hevea* are not cross-transferable. This, together with the results of studies carried out in 1962, indicate that *O.heveae* is host-specific.

The lack of greenhouse facilities was again a great drawback to the rapid progress of these studies, as the fungus cannot be satisfactorily maintained outdoors during a major part of the year.

Biology of Phytophthora palmivora. (*a*) *Growth.* (O. S. Peries and T. M. Fernando). Studies on the growth rate and pH requirements of *P.palmivora* have been completed, and this work has been written up for publication in an International Journal.

(*b*) *Sexuality in P.palmivora isolated from Hevea.* (Mrs. V. Satchuthananthavale). Very good progress was made in these studies and a paper has already been published in an International Journal on this subject (Refer section on Publications).

It has been clearly demonstrated that certain isolates of *Phytophthora*, obtained from rubber in Ceylon, are homothallic. This involves the nomenclature of the fungus too, and according to the most recent publication on this subject, there are two species of *Phytophthora* which can infect *Hevea* in Ceylon, *viz.* *P.palmivora* and *P.meadii*, the latter being the more common pathogen found on rubber in this country. *P.meadii* is homothallic but may also pair with the hetorothallic species *P.palmivora* to produce oospores.

These studies are being continued and as many different cultures of the fungus as possible are being isolated for critical study, to establish whether a third species of *Phytophthora*, *P.heveae*, which is now recognized as an authentic species, is also present on Ceylon *Hevea*.

The fact that there are at least two species of the fungus in Ceylon, one of which while being homothallic is also compatible with the other, increases the chances of physiologic specialization of the fungus by sexual reproduction. Thus *Hevea* breeding for *Phytophthora* resistance will be a very arduous task.

(*c*) ***Physiologic specialization.***—(O. S. Peries and D. M. Dantanarayana). Studies in physiologic specialization of the fungus are being continued. The laboratory studies on the growth characteristics, morphology, production of sporangia, their germination and the viability of zoospores are now complete. The next step in these studies is to establish the infection spectra of the isolates under observation, in order to find out whether there are any marked differences in clonal susceptibility of *Hevea* to the different isolates of the fungus.

Here again the lack of greenhouse facilities is a major obstacle to the rapid progress of these studies; as it has been found that outdoor conditions are too variable to carry out carefully controlled inoculation studies.

(*d*) ***Perennation of P.palmivora.***—(O. S. Peries, Mrs. V. Satchuthananthavale and S. K. Samaraweera). Studies on the methods by which the fungus tides over periods unsuitable for its growth are being continued. It has been found that the fungus can survive for considerable periods in the soil; however, there are indications that survival in this medium is dependent to a large extent on the reserves of fresh organic matter in the soil.

Biology of G.alborubrum.—(D. L. S. Wimalajeewa). A major part of the studies on the biology of spore germination on this fungus has been completed, and these results will be published shortly.

Host-Parasite Relationships

Phytophthora palmivora

(*a*) ***Phytophthora infection of the petiole and lamina of Hevea leaves.***—(O. S. Peries and Z. E. Irugalbandara). Inoculation studies on the petiole and lamina of rubber leaves are nearly complete now, and a wealth of evidence is now available on this subject. It has been established that the petiole of the leaf is very much more susceptible to *Phytophthora* infection than the lamina; in fact, it is very rarely that the lamina becomes infected under field conditions in Ceylon. Work carried out recently in these laboratories have indicated that the leaf blade is hypersensitive to infection by *Phytophthora* and produces a necrotic reaction immediately after penetration by the fungus. Histological studies are now being carried out to ascertain the reason for the greater susceptibility of the petiole, as compared to the lamina, to infection by this fungus.

The time taken for infection to occur on the petiole and lamina at various temperatures, after inoculation with a zoospore suspension, has been established. (Table I).

Table I

TIME TAKEN FOR LESION PRODUCTION BY PHYTOPHTHORA SPP. ON THE PETIOLES OF RUBBER LEAVES AT VARIOUS TEMPERATURES.

Temp. °C	Av. time (hours)	Min. time observed (hours)
20	16–17	16
25	16	14
28	12–16	9
30	16	12
33	16	12
36	16 (Very rare)	—

Phytophthora spp., being fungi which produce swimming spores (zoospores), require free water for propagation. Studies have been carried out to find out the duration of surface wetness of leaf blades and petioles required for infection by *Phytophthora*. This information is extremely important with reference to the forecasting of *Phytophthora* leaf-fall epidemics, and the available data on this subject are summarized in Table II.

TABLE II

NO. OF HOURS OF SURFACE WETNESS REQUIRED FOR INFECTION OF PETIOLES AT VARIOUS TEMPERATURES.

Temp. °C	Av. time (hours)	Min. time (hours)
20	4–6	4
25	3–4	2
28	3–4	2
30	3–4	2
33	4–5	4
36	No lesions	

Lesions appeared only on very young leaf blades, just after the copper-brown stage, and the results of these studies were not consistent.

(*b.*) *Phytophthora infection of Hevea pods.*—It has now been established quite definitely that, on the rubber tree, *Phytophthora* spp. grow and sporulate best on the pods, and that the major part of the inoculum for *Phytophthora* leaf-fall epidemics is produced on them. It is therefore extremely important to study the behaviour of the fungus on the pods.

It has been found that the pods are extremely susceptible to *Phytophthora* infection, the fungus being capable of penetrating the pod and producing a lesion within two hours of inoculation and incubation under optimum conditions. Further details available on this subject are tabulated below (Table III).

TABLE III

TIME TAKEN (HOURS) FOR PRODUCTION OF LESIONS, AND NUMBER OF HOURS OF SURFACE WETNESS REQUIRED FOR INFECTION OF PODS AT VARIOUS TEMPERATURES.

Temp. °C	Lesion Production		Surface Wetness	
	Av. time	Min. time	Av. time	Min. time
20	10–20	9	5–6	5
25	8–10	7	3–4	2
28	8–10	4	3–4	2
30	8–10	6	3–4	2
33	8–10	6	3–4	2
36	No lesions		No lesions	

Oidium heveae

Development of the disease on host leaves. (O. S. Peries).—Preliminary studies on host-parasite relationships of the *Oidium* leaf disease have shown that the spores of this fungus begin to germinate in less than two hours on the surface of the rubber leaf, penetration occurs in about 24-36 hours, and the sporulating fungus becomes visible to the naked eye on the sixth day after inoculation.

The fungus at first grows radially on the leaf surface, so that it is seen as discrete white spots on the leaf to begin with. Later these white spots coalesce producing a generalized infection of the leaf if it is very young. On the other hand when semi-mature leaves are infected, the fungus cannot spread easily over the leaf, due to the difficulty of penetrating the hardened cuticle, and the disease is confined to areas immediately surrounding the primary foci of infection. This is the reason for the discrete white or brown circular lesions seen on leaves in the case of secondary *Oidium* infections.

Gloeosporium alborubrum

Susceptibility of different clones to Gloeosporium leaf disease.—(D L. S. Wimalajeewa). Preliminary studies on this subject have been completed.

Fomes lignosus

Mode of penetration and disease establishment.—(O. S. Peries and Z. E. Irugalbandara). Histological studies on the mode of penetration of *Hevea* roots by *F.lignosus* have been completed. The fungus penetrates into healthy bark by means of wedge-shaped aggregations of hyphae, and never by means of single hyphal strands. After ramifying in the bark, the fungus spreads rapidly in the cambial area and then enters the woody tissue along the medullary rays, from which the fungal strands penetrate into the xylem, mainly through the pits on the walls of these vessels.

One of the most important factors that has come out of this investigation is that *F.lignosus* can penetrate into uninjured roots even in the absence of lenticels. However, it must be clearly understood that the fungus can enter through injuries on the root more readily than by penetration of the undamaged surface. This has an important bearing on collar examination for root disease identification and injuries to roots of young plants in the course of manuring. Field experiments are now being carried out to assess the importance of the former.

Fungicides

(*a*) *Fungicides for Bark Rot control.*—(O. S. Peries and D. M. Dantanarayana). The methods developed during 1962 are now being used for the routine testing of all fungicides, sent to the Institute, which are likely to be useful for Bark Rot control. None of the new fungicides tested during the period under review had the requisite properties for inclusion in field trials for final assessments.

The results of tests carried out during 1963 are summarized below :—

Fungicide	Active Ingredient (A.I.)	Fungitoxic Limit of A.I.		Phytotoxic Limit of A.I.
		Contact method	Diffusion method	
Crag Gliodin	2-heptadecyl glyoxalidine acetate	Non-effective at 10%	N.T.	N.T.
Fungicide 328*		1.5%	N.T.	N.T.
Panthersan	0.1% Phenyl Mercuric Chloride in furnace oil	Neat	N.T.	Non toxic neat

N.T. — Not tested.

*Bulk insoluble in water, hence not tested further.

(*b*) *Fungicides for Root Disease control.*—(O. S. Peries, D. M. Dantanarayana and M. T. Veerabangsa). Studies were carried out to find out the reasons for the apparent loss of fungitoxicity of Tillex, an organo-mercurial fungicide, towards *Fomes lignosus*, when the latter is grown over prolonged periods in the presence of Tillex in Petri dish cultures.

There were two possibilities to account for this phenomenon; either the fungus became adapted to the presence of the organo-mercurial in its growth medium, or the concentration of the fungicide in the medium was reduced below the threshold value toxic to the fungus, through diffusion and volatalization on prolonged incubation. Laboratory tests, where filter paper discs dipped in organo-mercurial solutions have been placed on agar in Petri dishes, have indicated that the latter is the more likely explanation; as the concentration of mercury in the agar medium on such plates decreases gradually over a period of time, finally reaching a value which is below the lethal level for the fungus. Repeated re-isolation of the parasite from such cultures have so far indicated that the fungus does not become adapted to the presence of high concentrations of the fungicide in its growth medium.

We are grateful to the Rubber Chemistry Division for co-operation in this experiment.

(*c*) *Waterproof fungicides for the protection of tapping panels.*—(O. S. Peries, D. M. Dantanarayana and E. G. Mendis). The laboratory and small-scale field experiments, which were started in 1962 to assess the relative efficacy of various waterproof materials to promote bark renewal, have been completed. It has been found that a few of these products show some fungicidal properties, but that none of them are significantly better than water, used as a control, in the promotion of bark renewal of tapped trees.

Large-scale field experiments have been started to assess the performance of these materials with reference to their effect on yields, the incidence of bark diseases, and the rate of bark renewal. The economics of the use of these materials will be worked out on the basis of the results of these experiments, and the most economical material for use under normal estate practice will be recommended for general use on *Hevea* in Ceylon.

Inoculation experiments with Fomes lignosus.—(O. S. Peries and S. K. Samaraweera). The technique for inoculation of *Hevea* roots with pure cultures of *F.lignosus* has been perfected (Refer section on Publications). Fundamental studies are now being carried out to establish the minimum amount of inoculum necessary to cause root infection under controlled conditions and to assess the action of certain fungicides on *F.lignosus*. The results of preliminary experiments indicate that at least ten pieces of rubber wood ($1 \times 1 \times 6$ cm) are necessary to cause infection by the method described.

Soil micro-flora and root disease incidence.—(O. S. Peries, H. L. Munasinghe and S. K. Samaraweera). The experiments carried out in 1962 showed that the addition of sulphur or copper sulphate to the soil not only increased the acidity of the soil but caused a fundamental alteration in the composition of the soil-

micro-flora as compared with an untreated soil. Sulphur reduced the numbers of all soil micro-flora significantly, but copper sulphate, whilst reducing the numbers of most soil fungi, appeared to encourage the propagation of certain *Penicillium* spp. in the soil.

The pot experiment started in 1962 to find out whether changes in the pH and the micro-flora, consequent on the addition of sulphur and copper sulphate to the soil, had any effect on the infection of *Hevea* roots by *F.lignosus* was concluded during the period under review. In this experiment there was 100% *Fomes* infection of budded stumps planted in untreated soil, whereas the fungus was completely suppressed in soil treated with either sulphur or copper sulphate. However, the dosages of these materials, used in this experiment, were apparently toxic to the host plant too, as only a few of the plants in the treated pots sprouted. Further experiments were carried out in 1963 to establish the minimum effective dosages of these materials, which would suppress the pathogen completely, but would still be non-toxic to the host plant. The results of these experiments will be available for analysis shortly.

Studies are also being carried out to ascertain whether there is any marked antagonism between the fungi surviving in the treated soil and the pathogen, to account for the suppression of the latter in such soil.

Soil micro-organisms.—(H. L. Munasinghe). Basic investigations are being carried out for the quantitative evaluation of the soil micro-organisms in the various rubber-growing districts of Ceylon and to find out whether there are any seasonal fluctuations in the numbers and/or varieties of fungi and bacteria in the soil, with a view to determining their role in the growth and development of the root system of *Hevea.*

Leaf Diseases

Oidium leaf disease

(*a*) *General.* The wintering season of 1963 was abnormally long and certain clones shed their leaves even in the first week of May. One of the reasons for the prolonged wintering was that January and February 1963 were both unusually wet, the rainfall recorded in these two months being about twice the average recorded for them over the years in most of the rubber-growing districts. The rainfall figures for the three Divisions of Dartonfield Group are given below for comparison :—

Table IV

RAINFALL FIGURES FOR DARTONFIELD GROUP. JAN./FEB. 1962/1963

Month	Dartonfield		Hedigalla		Nivitigalakele	
	1963	1962	1963	1962	1963	1962
January	11·16	6·8	21·18	9·78	7·64	6·18
February	10·05	3·66	16·69	8·98	8·20	2·25

Although wintering is a physiological activity of the rubber tree, the actual time of occurrence of this phenomenon is dependent to a large extent on the weather conditions and locations. In general, dry weather during the early months of the year helps to advance the date of commencement of wintering, whereas wet weather retards the process. The significance of a prolonged wintering season lies in the fact that it increases the intensity of *Oidium* infection on the later wintering clones, in correlation with the build-up of the disease inoculum as the season progresses. This was clearly borne out this year, as most of the late wintering clones were more severely affected by *Oidium* than the early winterers. This abnormal wintering and the intensity of the secondary *Oidium* infection had interesting repercussions later in the year, culminating in the unusually widespread yellowing of leaves and defoliation observed in many districts during late May and early June this year.

Phytophthora leaf disease

General. The first symptoms of *Phytophthora* infection in the Kalutara District were recorded on 12 June 1963, at an estate in Govinna. The first symptoms of pod infection at Dartonfield were observed on 27 June 1963, and this was followed six days later by leaf-fall. Some leaf-fall occurred in July, but *Phytophthora* infection was comparatively mild throughout the South West monsoon season in spite of the unusually heavy rains recorded throughout the year.

The weather conditions during the early part of the South West monsoon were rather unusual. The first two weeks of May were relatively dry, but heavy rains occurred in the last two weeks and the total rainfall recorded was well above the average for the month. In June, the first nine days were rather wet, but bright, sunny, warm weather prevailed from 9-17 June. The daily minimum temperature was distinctly lower during the last week of June, and the first symptoms of *Phytophthora* was recorded at Dartonfield on 27 June.

The rainfall figures for May-September on Dartonfield Group are given in Table V below.

TABLE V

RAINFALL RECORDED ON DARTONFIELD GROUP, MAY-SEPTEMBER 1963 AS COMPARED WITH THE AVERAGE FOR THESE MONTHS.

	Dartonfield			Hedigalla			Nivitigalakele		
	5 yr. av.	1959*	1963	5 yr. av.	1959*	1963	5 yr. av.	1959*	1963
May	18·66	16·08	37·65	20·22	18·22	26·73	19·10	18·53	32·90
June	15·94	28·30	15·82	19·11	34·40	14·31	16·80	32·71	14·33
July	12·61	12·79	27·33	12·13	14·90	19·79	11·72	15·52	24·06
August	9·93	14·59	16·81	13·66	16·75	18·67	10·16	16·93	14·83
September	12·07	19·16	35·00	13·22	22·07	32·08	12·22	18·10	32·30

* For comparison as heavy *Phytophthora* leaf-fall occurred in 1959.

Gloeosporium leaf disease

(*a*) *General.*—The incidence of *Gloeosporium* was high throughout the period under review, and there were numerous requests for advice on the methods of controlling this disease.

(*b*) *Survey of disease incidence.*—(D. L. S. Wimalajeewa). An assessment of the incidence and economic importance of *Gloeosporium* leaf disease, based on planters' views on the subject, was carried out in 1962. This was followed by an observational survey of the incidence of the disease in various parts of the country. This survey has confirmed the views previously expressed by the planters, thus indicating the necessity for detailed investigations on the biology of the causal fungus and the control of the disease, which have now been started.

(*c*) *Field experiments.*—(D. L. S. Wimalajeewa, O. S. Peries and T. Shanmuganathan). Preliminary field trials for screening materials for *Gloeosporium* control have been completed. The results of these experiments were statistically analysed but none of them gave significant results. A new series of field experiments were started in 1963 for the purpose of comparing various promising fungicides for *Gloeosporium* control.

Other field experiments are now being carried out to assess the over-all economic significance of this disease in Ceylon. These are long-term experiments, which have been designed to assess the growth of rubber, from the time of planting up to tappable age, in areas where the disease is controlled by the use of various fungicides in comparison with others, which are left as untreated controls.

Bark And Stem Diseases

Black stripe disease

(*a*) *General.*—The incidence of Bark Rot was generally low during a major part of the period under review, except in October and November, when heavy infection occurred in certain estates.

(*b*) *Field experiments.*—(O. S. Peries and T. M. Fernando). The two field experiments, which were started in 1962 in order to test various fungicides for Bark Rot control, were continued in 1963, but no conclusions can be drawn from the results of these experiments due to the low incidence of the disease in the experimental areas from the time these experiments were started.

The third field experiment, designed to test the optimum time for the routine application of fungicides to the tapping panel, has shown that significantly ($P < 0.01$) better results can be obtained by the application of fungicides at the time of latex collection as compared with application before the commencement of tapping.

Pink Disease (*Corticium salmonicolor*)

General.—There were no complaints regarding Pink Disease during the period under review.

Root Diseases

White Root Disease (Fomes lignosus)

(*a*) *General.*—The incidence of White Root disease, caused by the fungus *F.lignosus*, was relatively high in young replanted areas during the year.

(*b*) *Field experiments*

Evaluation of the efficacy of organo-mercurials.—(O. S. Peries, T. M. Fernando and S. K. Samaraweera). The experiments carried out during 1962 suggested that there was little justification for the use of organo-mercurial fungicides for the control of *Fomes*, as long as the surgical treatment of the infected tree was carried out carefully. As this is a controversial subject, five more experiments were carried out on commercial estates in 1963 to confirm the results obtained in 1962. The results of the 1963 experiments have clearly shown that Tillex does not play a significant role in the control of *Fomes* according to the methods now recommended.

Assessment of methods of identification and treatment of Fomes.—The three long-term experiments, started in 1962, to assess the relative merits of different methods of identifying and treating *Fomes*-infected trees in replanted areas were continued during the period under review.

Effect of different manurial treatments on incidence of Fomes.—This experiment, which is being carried out at Kuruwita Sub-station in close co-operation with the Soils Chemistry Division, was given routine attention by the latter.

Pests and Other Causes

General

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

"*Physiologic Yellows*"

A number of yellow leaf samples were sent to the Institute and there were numerous requests for visits to estates where an unusual yellowing of leaves was observed in late May and early June this year. After a critical examination of the problem it was concluded that the basis of this phenomenon was entirely physiological.

The factors that probably combined to produce this unusual type of defoliation in May/June and again in October/November were the prolonged wintering season of 1963, the consequent high incidence of secondary *Oidium* generally and the typical, continuous, heavy rains recorded in the period during which this phenomenon was most conspicuous. A majority of the leaves which were shed at the time showed severe symptoms of secondary *Oidium* infection, and it is quite possible that certain saprophytic micro-organisms thrived on the brown necrotic areas produced by the parasitic fungus, *O.heveae*, during the abnormally wet periods, referred to above, thus upsetting some fine physiological balance in the tree, which led to this unusual defoliation.

Cover Crops

Rhizobial Strains for Nitrogen Fixation in Leguminous Cover Crops.—(O. S. Peries and H. L. Munasinghe). The work involved in screening and maintaining cultures of rhizobia was transferred to this Division from the Soils Chemistry Division on 2 November 1962. Cultures of available strains of the bacteria were issued to estates that applied for them. Some estates reported favourably on the effects of seed inoculation on the growth and appearance of cover crops under field conditions. Laboratory studies have been initiated to assess the effect of inoculation of covers with selected strains of bacteria on fixation of nitrogen under field conditions in Ceylon.

A number of new strains of *Rhizobium* spp., obtained from Australia, Malaya and the U. K., are now being tested under laboratory conditions here for the selection of more effective strains of bacteria for seed inoculation.

Field Experiments

Dartonfield 1 acre, 1953 replanted area

This area is planted with mixed local and foreign clones for studies on resistance to leaf diseases and for small-scale field trials.

AGRICULTURAL ENGINEERING UNIT

General

Staff

The three Technical Assistants attached to this Unit, Messrs E. G. Mendis, W. C. Dayaratne and T. Shanmuganathan were on duty throughout the year and worked under the direct supervision of Dr. O. S. Peries, the Head of the Division.

All field trials on leaf disease control were carried out by the staff of this Unit with the help of Messrs. T. M. Fernando and S. K. Samaraweera, when necessary.

Field Trials

Leaf Disease Control

(*a*) *Oidium leaf disease control.*—(O. S. Peries, E. G. Mendis, T. M. Fernando, S. K. Samaraweera and W. C. Dayaratne). Nine *Oidium* control field experiments were carried out by the staff of the Plant Pathology Division, during the 1963 wintering season.

Five of the above were randomized block experiments, three being designed to compare the economics of dusting with that of spraying and the efficacy of each, the fourth to find out the degree of *Oidium* control obtainable by spraying as compared with weekly and twice a week dusting, and the fifth to establish the optimum swath width for dusting. The other four experiments were observational trials, carried out on PB 86 and Tjir 1 clonal areas on commercial estates, with

a view to comparing the efficacy of sulphur dusting as carried out under normal estate conditions with that of dusting under careful supervision, using what is now believed to be the best method of control with reference to dosage, swath width, dusting intervals, walking speed during the operation, and time of application.

The results of these experiments have already been published (Peries, *et al*, 1963). Briefly, the studies carried out this year have indicated that spraying with wettable sulphur is neither a feasible nor an economic method of controlling *Oidium* in Ceylon, with the machinery and materials available for application at present in this country.

The results of these experiments have clearly indicated that, since severe epidemics of the disease do not occur every year in the wet low-country districts, all *Oidium* control experiments should be designed as long term experiments, and that test-tapping should be carried out at regular intervals on all experimental plots over a number of years. This appears to be the only feasible method of assessing the economics of disease control and establishing the long-term effects of various treatments on the growth, bark renewal and yield of the rubber tree.

(*b*) *Phytophthora leaf disease control.*—(O. S. Peries, E. G. Mendis, W. C. Dayaratne and T. Shanmuganathan). Five field experiments were carried out on commercial estates mainly for comparing dusting with spraying as a method of controlling *Phytophthora* leaf disease. Another, the sixth field experiment was carried out at Hedigalla Division to assess the correlation between pod set and the incidence of the disease. Arrangements were also made to carry out test-tapping in the experimental areas with a view to making an objective assessment of the economic importance of this disease in Ceylon.

The incidence of *Phytophthora* was mild in 1963 too, and there was comparatively little leaf-fall in all the experimental areas. The details of all field experiments on *Phytophthora* control carried out during the year are given in Table I.

TABLE I

DETAILS OF FIELD TRIALS UNDERTAKEN TO INVESTIGATE THE CONTROL OF PHYTOPHTHORA LEAF-FALL.

Expt. No.	Estate	Clone & date of planting	Plot size (acres)	No. of treatments	No. of replicates	Result of Experiment	Av. % leaf-fall on untreated control plots
1	Ellakanda	PB 86 (1940)	2	4	4	Significant	< 1%
2	Yatadola	PB 86 (1946-47)	2	7	4	Significant	< 6%
3	Eladuwa	PB 86 (1951)	1½	4	4	Non-significant	< 1%
4	Malaboda	PB 86 (1951-57)	2	2	4	Non-significant	< 1%
5	Ellakanda	AVROS 352 (1946)	1	2	8	Non-significant	< 1%
6	Hedigalla Division	LCB 870 (1957)	25 trees	2	4	Non-significant	< 1%

Significant differences between treatments were obtained in two of the five experiments, and these results are summarized below :—

Experiment 1. This experiment, which was designed to compare weekly dusting with one pre-monsoonal spray and monthly spraying, was carried out on clone PB 86 at Ellakanda Estate, Horana, on a 35-acre area planted in 1940. This was a randomized block experiment consisting of 4 replications of 4 treatments, the plot size being 2 acres.

The results of this experiment are tabulated below and show that all three treatments were significantly ($P < 0.02$) better than the control. Monthly spraying was slightly better than the other two treatments, but this difference was not significant.

TABLE II

EFFECT OF DUSTING AND SPRAYING WITH COPPER FUNGICIDES ON CONTROL OF PHYTOPHTHORA LEAF DISEASE ON PB 86 AT ELLAKANDA ESTATE.

Treatments	Total leaf-fall	Mean	Diff.	Sig. Diff.
A. Control	8767	2192		
B. Monthly spraying (Lovo Copper)	1690	423	−1769	+ 1237 − (5%)
C. One pre-monsoon spray (Lovo Copper)	3048	762	−1430	+ 1588 − (2%)
D. Weekly dusting (Copper Sandoz)	2796	699	−1493	

Treatment B better than control at 2% level.

Treatments C & D better than control at 5% level.

No significant differences between treatments B, C & D.

Experiment 2. This was a randomized block experiment, carried out on 2-acre plots and consisted of 4 replications of 6 treatments and a control. In this product trial three copper based spraying materials and three types of copper dusts were compared with one another for *Phytophthora* leaf disease control. The experiment was carried out on Yatadola Estate on an area replanted in 1947 with clone PB 86. The results of this experiment are summarized in Table III where the significance of the results too are shown.

TABLE III

THE EFFICACY OF VARIOUS COPPER BASED DUSTING AND SPRAYING MATERIALS IN THE CONTROL OF PHYTOPHTHORA LEAF DISEASE. (YATADOLA ESTATE, 1947 REPLANTED AREA, CLONE PB 86).

Treatments	Total leaf-fall	Mean leaf-fall	L.S.D.
A. One pre-monsoon spray Lovo copper	916	229	$\pm$ 98(5%)
B. One pre-monsoon spray Fycol	713	178	$\pm$ 134(1%)
C. One pre-monsoon spray Brunokop	986	246	$\pm$ 182(0·1%)
D. Weekly dusting (Oxycar)	829	207	
E. Weekly dusting (Blendox)	368	92	
F. Weekly dusting (Copper Sandoz)	433	108	
G. Control	1257	314	

Treatments E & F are better than control (0.1%)
Treatment B is better than control (1%)
Treatment D is better than control (5%)
Treatment E better than A & C (1%), better than D (5%)
Treatment F better than C (1%), better than A & D (5%)

In view of the mild incidence of the disease (< 10% leaf-fall on all experimental areas) the results of these experiments are of little practical value, as the absolute efficacy of a fungicide will depend on its ability to control severe epidemics of the disease. These experiments will therefore have to be repeated over a number of years before conclusive results are obtained. All the experiments carried out this year were designed as long term trials to assess the economic significance of the disease by comparing yields and disease incidence on treated and untreated plots.

OTHER FIELD TRIALS

Defoliation experiment.—(D. L. S. Wimalajeewa and T. Shanmuganathan). This experiment, started in 1962, was continued over 1963 and the data will be available for analysis shortly.

Leaf-fall assessments in different districts.—(O. S. Peries and E. G. Mendis). As most of the leaf disease control experiments are carried out in the Kalutara District, there is little factual data available on the incidence of leaf diseases in the other rubber planting districts of the Island. Therefore, leaf count beds, for the assessment of the incidence and progress of leaf diseases, were prepared on selected estates in all planting districts with the co-operation of the Superintendents of those estates.

Formulation Appraisals

Rainfastness tests.—(O. S. Peries and W. C. Dayaratna). With the studies carried out by the former Agricultural Engineer, Mr. J. H. Lloyd, a wealth of information is available on the rainfastness of various copper fungicides on rubber leaves. However, no data are available on deposit characteristics or rainfastness of copper fungicides on rubber pods, which play a vital role in the spread of the disease. Therefore, studies were made on the retention of various copper based fungicides, both dusts and spray formulations, on rubber pods after washing with different amounts of simulated rain. These trials were carried out as a preliminary study in the assessment of the biological activity of copper retained by the pod on the causal fungus of *Phytophthora* leaf disease.

The results of these experiments are summarized in Table IV.

Table IV

THE RETENTION OF DIFFERENT COPPER FUNGICIDES ON WET AND DRY PODS AFTER EXPOSURE TO VARIOUS AMOUNTS OF SIMULATED RAINFALL. THE AMOUNTS ARE EXPRESSED IN MICROGRAMS OF COPPER PER SQ. CM. OF POD SURFACE.

Product	Wet					Dry				
	Before Washing	Simulated rain 1″	2″	3″	5″	Before Washing	Simulated rain 1″	2″	3″	5″
Coprantol (Spray)	4·66	3·00	2·12	–	–	15·30	2·33	1·09	–	1·09
Fycol (Spray)	11·80	1·80	1·50	–	–	13·70	6·20	7·50	–	6·80
Lovo-Copper (Spray)	8·04	3·12	2·07	–	–	9·02	9·02	8·49	–	6·50
Copper Sandoz (dust)	–	–	–	–	–	8·40	–	–	0·04	0·01
Blendox (dust)	2·25	0·11	0·20	–	–	3·50	–	–	0·60	0·43
Oxycar (dust)	–	–	–	–	–	2·70	–	–	0·60	0·72

These results show that dry pods retain more sprayed copper than pods that are wet at the time of application of the fungicide. Lovo-copper is the most rainfast material of the spray formulations tested, Fycol being second. In comparison with the spray materials, the retention of all dusts tested was poor on pods.

When these results and those obtained in 1962, on the retention of copper formulations on leaf surfaces, are compared with the 1963 field experiments on *Phytophthora* leaf disease control, it appears that the rainfastness of the formulation is not the main criterion for the efficacy of that material under field conditions. Clearly, the biological activity of the formulation requires further study, and this work has already been started.

Machinery and Application

Assessment of spraying machinery.—(O. S. Peries, E. G. Mendis and W. C. Dayaratne). The vertical range of two more types of spraying machines, *viz.* the Mistral IV AV and the Mistral II AV, details of which are given in Table V, was tested during the year, by methods similar to those used by Lloyd (1963).

Table V

DETAILS OF NEW SPRAYING MACHINES TESTED DURING THE YEAR.

Name of machine	Mistral IV AV	Mistral II AV	Mistral III AB
Type of application	Spray	Spray or dust	Spray or dust
Manufacturer	Birchmeier & Co. Ltd., Switzerland	Birchmeier & Co. Ltd., Switzerland	Birchmeier & Co. Ltd., Switzerland
Engine	Villiers, 4-stroke, 150 c.c. developing 3 h.p. at 3,300 r.p.m.	Villiers 4-stroke, 150 c.c. developing 3 h.p. at 3,300 r.p.m.	Briggs & Stratton 8 F.B. 4-stroke, 150 c.c. developing 3 h.p. at 3,200 r.p.m.
Unladen weight of machine (lb)	90	100	102
Spray liquid tank capacity (gal.)	4	6	6
Dust hopper capacity (lb)	–	45	45
Maximum output Spray (pints/min.)	1·9	2.5	2.1
Dust (lb/min)	–	8	8
Air outlet shape & diameter (inches)	Round 8·6	Round 8	Round 8
Air velocity at outlet (m.p.h.)	150	146	146
Air volume (cu. ft/min)	580	580	580
Mode of agitation Spray	None	None	None
Dust	–	Mechanical	Mechanical

The Mistral IV AV is a new model designed especially for spraying coconut and rubber trees of medium height. The Mistral II AV is similar in all respects to the Mistral III AB sprayer/duster, except that the former is fitted with a new nozzle and a new type of Villiers engine instead of the original Briggs and Stratton engine. The results of the tests are given in Table VI.

TABLE VI

DROP SPECTRUM ANALYSES OF THREE TYPES OF SPRAYING MACHINES. THE NUMBER OF DROPS PER CM^2 AND THE SPRAY VOLUMES RECOVERED HAVE BOTH BEEN EXPRESSED PER GALLON OF SPRAY EMITTED PER ACRE.

Height above ground (feet)	Mistral IV AV			Mistral II AV			Mistral III AB*		
	Mass** median diameter (microns)	Number of drops per cm^2	Recovery (Imp. gal./ acre)	Mass median diameter (microns)	Number of drops per cm^2	Recovery (Imp. gal./ acre)	Mass median diameter (microns)	Number of drops per cm^2	Recovery (Imp. gal./ acre)
0	159	62·5	0·446	188	17.3	0·48	239	21·6	0·610
10	173	18·3	0·460	171	41.5	0·48	211	28·9	0·540
20	134	202·5	0·835	264	68·0	0·51	184	17·7	0·177
30	144	285·4	1·270	136	29·0	0·05	124	25·6	0·056
40	128	206·2	0·715	121	54·0	0·04	125	18·1	0.026
50	110	286·5	0·560	117	43·0	0·09	160	16·3	0·052
60	91	283·8	1·060	107	44·4	0·07	182	17·0	0·078
70	113	312·5	0·586	131	27·9	0·07	152	24·6	0·075
80	110	185·1	0·438	183	24·3	0·05	152	32·3	0·045
85	9	2·9	0·001	71	62·3	0·06	66	26·1	0·008
Emission rate (pints/min)		1·9			1·96			2·1	
Area-dosage (gal./acre of ground)		8·3			5·9			5·7	
Walking speed (m p.h.)		1·0			1·3			1·1	
Wind speed (m.p.h.)		0·5			0·5			1·1	
Temp. °F		75			75			74	
Relative humidity		84			84			96	

* Results of assessments carried out by Lloyd in 1962 (Lloyd, 1963) given for comparison.

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

Both the Mistral IV AV and the Mistral II AV had good deposit distribution characteristics and both machines could deposit spray up to a height of 85 feet. The vertical range of the Mistral IV AV machine appears to tail off very sharply after the 80-foot mark, but later tests have shown that this machine can effectively deposit spray at all heights up to and including 85 feet. This machine appears to have distinct possibilities, and the manufacturers should pursue this matter further, as it would be interesting to assess its performance under field conditions.

The new nozzle and Villiers engine (150 c.c., horizontal shaft 4-stroke) fitted to the old Mistral III AB duster/sprayer appears to have improved the performance of this machine to a marked degree, as can be seen by comparison of the results obtained with the new and the old models (main columns 3 and 4 on Table V.) The results of the field performance of this machine should be interesting.

References

Lloyd, J.H. (1963). Review of the Agricultural Engineering Unit. *Rubb. Res. Inst. Ceylon Ann. Rev.* 1962. 71-93.

Peries, O. S., Mendis, E. G., Fernando, T. M., Samaraweera, S. K., Dayaratne, W. C. (1963). Field experiments for the control of *Oidium* leaf disease of *Hevea*. *Rubb. Res. Inst. Ceylon Quart. J.* 39, Parts 3 and 4, 73-80.

REVIEW OF THE SOILS CHEMISTRY DIVISION

By

A. J. Jeevaratnam

Summary

The satisfactory staff position during the year under review has enabled the Division to intensify its programme of research on the varied aspects of nutrition of *Hevea*. A note-worthy feature of this development has been the expanded programme of field experimentation which now includes several experiments that have been commenced on mature clonal areas to determine more accurately the optimum fertilizer dosages for mature rubber after it reaches the stage of production.

An important achievement of the Division during the period under review was the revision of the general fertilizer recommendations to include increased rates of fertilizer application in the early years of immaturity based on the results obtained from experiments conducted during the period 1958 to 1962.

Results obtained in 1963, from experiments in progress on the effect of fertilizers on growth of immature rubber, have shown more strikingly than ever before the importance of applying potassium and magnesium at the correct levels. It would appear that the rates of application are more critical than they were originally thought to be, since applications of these nutrients above certain levels have shown a depressing effect on the growth of young *Hevea* plants in some areas.

There has been no apparent difference in the growth of young plants of clone PB 86 due to application of magnesium as dolomite compared with application of magnesium as magnesium sulphate during the first two years of growth.

Application of an organic fertilizer, like Animal Meal, did not prove to have any advantage over the inorganic fertilizer mixtures in seedling nurseries, planting-hole applications or during the early stages of field planting.

The results obtained, from the few experiments that have been in progress to study the effect of fertilizers on the growth and yield of mature clonal rubber, did not indicate the necessity for any deviation from the tentative recommendations made in 1962 for reduced rates of application. It has, however, been found necessary to qualify the recommendation to read that the reduced levels of application for mature clonal rubber at the rate of 2 lb of the NPK mixture per tree per year should be introduced from about the third or fourth year of tapping and not from the time of commencement of tapping. Under normal circumstances manuring at the further reduced rates of 1½ lb to 1 lb per tree from the time of commencement of tapping on renewed bark should be continued without any break up to six years prior to uprooting. If an area is subject to any form of intensified treatment either by stimulation or tapping for increased yields six years prior to uprooting, it may be considered advisable to continue to manure such areas right throughout at the rate of 2 lb per tree per year without any break up to three years before uprooting.

Examination of data on the nature of wind-damage losses recorded on two estates in the Kalutara District in 1962 have shown that the percentage of trees lost by trunk snap or branch breakage is low compared to those lost by uprooting. This indicates that measures for the prevention of wind-damage losses should be based on the adoption of sound agronomic practices that favour good root development for anchorage and measures which minimize the occurrence of gaps in the canopy, rather than on the alteration of the composition or levels of fertilizer mixtures to be applied. The possibility of reducing wind-damage losses by modifying the nutrient composition and/or level of fertilizer mixtures applied would appear to be feasible only in respect of clones which are known to be particularly susceptible to wind-damage by trunk snap or branch breakage. An experiment to investigate this aspect of nutrition on clone LCB 1320 is already in progress.

There has been much interest shown by producers on the subject of nutrition and resistance or susceptibility to leaf diseases, perhaps due to the high incidence of leaf fall caused by *Gloeosporium*, particularly on PB 86 clearings in 1963. While there is a dearth of information on this aspect of nutrition of *Hevea* from any source, certain changes in the fertilizer policy were recommended after a careful investigation of the conditions prevailing on an estate where the problem was rather acute. For the present however, this Division does not advocate the adoption of any changes in the fertilizer policy on this account.

Laboratory investigations on the determination of potassium status of different soils encountered on the rubber growing areas indicate the possibility of working out a satisfactory laboratory method for evaluating the correct levels of potassium applications. This technique would be of immense value for making fertilizer recommendations in advisory work.

Satisfactory progress has been made on the soil survey of the rubber growing areas and it is hoped that a reconnaisance survey would be completed by the end of 1964.

The subject of soil conservation has been in the limelight during the period under review in view of the Government's intention to introduce regulations that are to be applied over the whole island. Studies on the recordings of rainfall intensities, maintained at ten different locations in the rubber growing areas of Ceylon since 1960, indicate that the early adoption of mechanical measures such as lateral silt-pitted drains along the contour on the scales recommended in the past should normally be adequate to cope with the run-off that occurs in rubber plantations at non-erosive velocities, provided sound agronomic practices are adopted at the time of replanting and right through the life cycle of a plantation. It has therefore, been found necessary to focus attention on the importance of several aspects of cover crop policies, cultivation practices, and weed control. In this connexion it has been found necessary to discourage the practice of clean weeding or poisoning natural vegetation followed by burning, prior to the establishment of cover crops.

Follow-up observations on weed control experiments undertaken by the Division have shown the necessity to emphasize certain aspects of fundamental importance on this subject such as the distinction between weed control and weed eradication. Complete eradication of naturally occurring vegetation by application of herbicides or otherwise should be resorted only for purposes of

exterminating noxious vegetation or when it is deemed necessary to maintain an area in a clean-weeded condition, as would be necessary along planting rows in the early stages of a replanting or when the intention is to replace existing natural vegetation with a more beneficial vegetative cover.

Under all other circumstances the policy should be one of judicious weed control undertaken only to the extent of checking the growth of natural vegetation, so as to minimise the chances of any competition between the natural vegetation and the cultivated crop.

It has also been found necessary to point out that a particular plant species which may be considered to be a weed at an early stage of the life of the plantation may have to be considered a useful cover plant at a later stage in the life of the same plantation, thus exemplifying the definition of a weed as "a plant out of place." Weed control policies should, therefore, be adjusted to meet the conditions that prevail at different stages in the life of a rubber plantation.

DETAILED REVIEW

General

Staff

The Staff of the Soils Chemistry Division during 1963 consisted of the Head of the Division, two graduate assistants, one Senior Technical Assistant, seven Technical and Field Assistants, and five Laboratory and Field Attendants.

One of the graduate assistants, Mr. C. G. Silva was appointed to the position of Soils Chemist with effect from 1st December 1963 on the satisfactory completion of a probationary period of one year.

Correspondence

	Inward	*Outward*
Technical	479	373
General	40	27

Visits

	Head of the Soils Chemistry Division	Graduate Assistants	Senior Technical Assistant	Technical Assistants
Advisory	35	5	4	—
Experiments on Institute's Experimental Stations	21	8	14	3
Experiments on outside Estates	25	6	3	14
Miscellaneous	21	8	—	2

Meetings

Kalutara District Planters' Association—19/6*

Kelani Valley District Planters' Association—30/7*

Soil Conservation Regulations Committee Meeting—19/1

Soil Conservation Society—31/1, 28/7, 14/11**, 13/12

In-Service Training Course, Soil Conservation Aides—27/4*

Ceylon Association for the Advancement of Science—27/7, 16/9, 20th to 23rd/11**

* Meetings addressed by the Head of the Soils Chemistry Division.
** Papers read by the Head of the Soils Chemistry Division.

Publications

(*a*) Annual Review of the Soil Chemistry Division for 1962.

(*b*) Revised Recommendations on Manuring. *Rubb. Res. Inst. Ceylon Quart. J.* Vol. 39, Parts 1 and 2, 53-54.

Advisory Work

An unusually high proportion of the time of the Head of the Division was devoted to advisory work. This is mainly ascribed to the increased number and the varied nature of the calls for advice that devolved on the Division consequent on the appointment of the Deputy Director and Head of the Botany Division, who handled most of the advisory work of a general nature in the past, as Director early in 1963.

Establishment of an Advisory Service.—The feasibility of improving the advisory services of the Division in making fertilizer recommendations to the producers has been under review for quite some time, as the varied nature of the results obtained from different field experiments did not justify the policy of making general recommendations. In fact, the five-year programme that ended in 1962 envisaged the establishment of an advisory service based on the laboratory examination of soil and leaf samples from individual estates. The advisory work rendered to estates that complained of backward or uneven growth in immature areas and poor yields in areas in production gave indications that had an important bearing on the subject. Apart from nutrition, a combination of several other factors, such as, improper disease control at the time of replanting, the use of poor quality planting material, inadequacy of the soil conservation measures adopted, unorthodox procedures adopted in the establishment of cover crops, too high or too low planting densities, were invariably responsible for limiting growth and production. With a perennial crop like *Hevea* the rectification of some of the limiting factors is not a practical proposition until the area is replanted again. The extent to which the potential for high yields per acre per year can be exploited by improved fertilizer practices, therefore, becomes restricted.

Maximum benefits would accrue only when the highest standards of efficiency are maintained in every operation from the time of replanting right through the life cycle of the plantation.

Since the establishment of an advisory service would involve considerable expense of time and money, it appeared that this will not be warranted unless maximum benefits could be realised. If an advisory service is established, its scope should be extended to assist producers in maintaining a high order of efficiency in every field right from the time of replanting. The establishment of an advisory service of this nature is of such a scope that the Division will not be able to undertake it fully with the present staff facilities. It was also realised that the prospect of delegating such a service, when it was established, to a separate division would not provide the solution as in any case it would entail a field and laboratory survey of soil and foliage by the Soils Division. Hence it was decided to make a start at least on a limited scale by establishing an advisory unit only for producers who wish to avail of the services of this unit, and undertake to abide by the recommendations given by it.

Since only a limited number of producers would be able to avail of the services of this unit, it was decided that the policy of making general fertilizer recommendations should continue for the benefit of the others. In accordance with this decision certain revisions in the fertilizer policy for immature areas were made, and were issued to the industry.

Replanting Policy. Arising from the finding that instances of backward growth and poor yields reported by producers were the result of one or more limiting factors that had been introduced in the replanting procedure, further investigations revealed that such occurrences were the result of strain on available resources brought about by the unsystematic replanting programmes adopted by producers, and in part due to a lack of appreciation of the limiting factors which could have a depressing effect on growth and yield.

It was, therefore, necessary to focus attention on the advantages of adopting a systematic replanting programme by each individual producer, and the lines on which it should be prepared and implemented.

A paper entitled, "A Planned Programme for Improved Efficiency in the Cultivation and Production of Natural Rubber" was therefore prepared in consultation with the Department of National Planning and was presented to an audience of scientists under Section B at the annual sessions of the Ceylon Association for the Advancement of Science. It is proposed to prepare a suitable article on this subject for publication in due course.

Research Investigations

The research investigations carried out by the Division are reported under the subject headings of Nutrition, Cover Crops, Cultivation Practices, Weed Control and Soil Survey.

Nutrition

During 1963, greater emphasis has been given to the study of fertilizer responses of *Hevea* at the two distinctly different phases of growth, namely the immature and productive phases, to applications of different nutrients at various levels and from different fertilizer sources. The variations in response due to differences in planting material, time of application, cover crops and cultivation practices will also be assessed. A total of thirty field experiments were in progress at the end of 1963 of which ten were initiated during the period under review.

Some of the experiments laid down to study responses of *Hevea* in growth and yield to fertilizer application as determined by foliar diagnosis as against fertilizer applications according to recommended practices were continued in their original form, others were continued in a modified form while a few were terminated altogether.

Nutrition and Wind-Damage

The effect of different levels of nutrients on growth and susceptibility to wind-damage of clone LCB 1320 has been investigated at Mirishena Estate. Girth measurements taken at the end of one year from the time of commencement of the experiment and wind-damage losses recorded during the period did not show any significant differences due to treatments.

Laboratory Investigations

Laboratory investigations have been carried out on a restricted scale. One investigation on which satisfactory progress has been made was connected with the evaluation of potassium status of different soils encountered in the rubber growing areas of Ceylon.

Determination of different fractions of potassium such as water soluable, exchangeable, difficultly exchangeable, and the total potassium have been completed in a limited number of variable soils encountered in rubber areas.

Results obtained so far indicate that a satisfactory method of evaluating the potassium status of different soils in the laboratory may be worked out.

Since *Hevea* plants have shown wide variations in their response to applications of potassium fertilizers, varying from a depressing effect in some areas to that of enhanced growth with a linear trend in others, a method of assessing critically the need for and the level at which potassium fertilizers should be applied could be expected to be of far-reaching practical significance.

Field Experiments

Results from the different experiments that were in progress are grouped as manurial trials, manurial/clone trials and manurial/cultivation treatment trials according to the phase of growth.

Seedling Nursery Phase

The results from earlier trials indicated the necessity for continuing the established manurial practice except that manuring with Animal Meal had no particular advantage over inorganic fertilizer mixtures. The next task was to determine the optimum levels of different nutrients for manuring nurseries.

The optimum quantities of nutrients required would vary depending on the period within which the required standard of growth should be obtained and the vigour of growth of seedlings from different parentage. In view of the fact that it would become increasingly difficult to obtain the required quantity of Tjir 1 clonal seeds for use as stocks in years to come, an attempt was made to compare the growth of seedlings raised from seeds of two clones that are likely to be planted at an increased rate in the future and which produce large sized seeds—namely RRIC 52 and RRIC 45—with that of seedlings raised from Tjir 1 clonal seed.

Seeds collected during the 1963 season were germinated and planted in beds in August/September 1963.

Estimation of shoot and root growth made after about four months growth, has indicated that the vigour of growth of RRIC 52 and RRIC 45 seedlings is very much superior to that of Tijr 1.

Immature phase

Manurial trials

(*a*) *NPK Experiment with basic application of magnesium as Commercial Epsom Salts and as Dolomite in split plots. 8 acres. 1961 Replanting R.R.I.C. Sub-station, Kuruwita.*

Girth measurements recorded at the end of the second year of growth have been statistically analysed. The analysis was done on adjusted girths due to the uneven number of trees on which girth measurements were recorded in each plot. The difference in the number of trees per plot was due to the high incidence of *Fomes* that was experienced in this experimental area in 1962.

Plants that received applications of potassium alone or in combination with N, P and NP showed significantly better growth than the control.

Application of magnesium as Dolomite showed no difference in the growth of plants compared with plants that received magnesium as magnesium sulphate (Commercial Epsom Salts).

The opinion held by some planting circles in Ceylon that Dolomite has a depressing effect on the growth of rubber plants was not borne out by the results of this experiment.

(*b*) 2^3 *NPK Factorial Experiment* (*without nil level*) ***Kumarawatte Group, Moneragala District.***

Girth measurements recorded at the end of 1963—the fifth year of growth—have continued to show no significant improvement in girth by doubling the recommended level of application of any of the nutrients—nitrogen, phosphorus or potassium. The only nutrient that showed a beneficial trend was nitrogen.

(*c*) *Experiment to test the effect of four levels of potassium application on Eladuwa Estate. Planted in 1958.*

Girth measurements recorded in January 1964 gave the following results :

Mean girth in inches of plants receiving different treatments.

Treatment	Mean girth in inches	Difference over R. 4 : 6 : 2	L. S. D.
R. 4 : 6 : 2	16·88		± 0.42
R. 4 : 6 : 3	16·99	+ 0·11	
R. 4 : 6 : 5	17·08	+ 0·20	
R. 4 : 6 : 8	16·83	— 0·05	

It will be noted that while there is no significant difference in girth due to the different levels of potassium applied, the tendency for growth to be reduced at the higher levels of potassium applications was less pronounced in 1963 than in previous years.

Since the above experiment has been laid down in an area planted with different clones, the mean girth in inches of the different clones are reported below. Due to the fact that the clone differences have been confounded with that of the blocks, the differences in growth between clones or the clone/manurial interaction cannot be statistically evaluated.

Mean girth in inches of different clones

Clone	Mean girth in inches	Difference over PB 86
PB 86	14·84	
GT 1	17·78	+ 2·94
RRIC 28	17·12	+ 2·28
RRIC 45	17·23	+ 2·39
IRCI 2	17·53	+ 2·69
RRIM 605	17·16	+ 2·32

Manurial/Cultivation Treatments Trials

(*a*) *3×3×3—K×Mg×Cultivation treatments—experiment with basic application of N and P. 1959 Replanting, Parambe Group.*

Of the two replicates in this trial, one was changed to 3×3×3—N×P×Cultivation treatments experiment with basic application of K and Mg during the course of 1963. Girth measurements were taken at the end of 1963, but no attempt is made to interpret the results in view of the change that has been instituted.

(*b*) *3×3×3—N×P×Cultivation treatments—experiment with basic application of K and Mg, 1961 Replanting, R.R.I.C. Sub-station, Kuruwita.*

Girth measurements recorded in July 1963 at the end of the second year of growth have been analysed and the treatment effects were not found to be significant.

(*c*) *3×3×3—K×Mg×Cultivation treatments—experiment with basic application of N×P, 1961 Replanting, R.R.I.C. Sub-station, Kuruwita.*

The girth measurements recorded at the end of the second year of growth showed that the quadratic effect of K and a negative linear effect of Mg assumed significance at the accepted levels.

Treatments		Mean girth in inches	Difference over control
K	0	4·07	
	1	4·47	+ 0·40*
	2	4·25	+ 0·18
Mg	0	4·44	
	1	4·24	— 0·20
	2	4·10	— 0·34*
Cultivation	0	4·18	
	1	4·39	+ 0·21
	2	4·22	+ 0·04

N.B. C_0 No mulching.

C_1 Cultivation of *Pueraria* and mulching with *Pueraria.*

C_2 Cultivation of *Pueraria* and *Tripsacum* and mulching with *Tripsacum.*

Points of note are :

(1) While the application of potassium at the first level has given a significant positive response, application at higher levels does not continue to give added response.

(2) Application of magnesium shows a significant negative linear effect.

(3) Though mulching has shown no significant effect on growth, there are indications that mulching with *Pueraria* is better than no mulching.

Mature Phase

Manurial Trials

(*a*) *Effect of different levels of application of nitrogen, phosphorus, potassium and magnesium on growth and yield in mature areas.*

Experiments have been laid down on two fields of mature PB 86, one that has not been manured during the past ten years and another that has been systematically manured from the time of planting up to the time of a commencement of the experiment to study the response in growth and yield to applications of different nutrients at different levels.

Preliminary recording of yield on individual trees prior to the introduction of the treatments has been carried out in 1963.

(*b*) *Time of fertilizer application trial—Dewalakande Estate.*

Yield records maintained in 1963 are reported below

Treatments	Adjusted mean yields per tapping block in lb	Difference	Sig : diff : 5%
1. After refoliation	2181·0		+ 212·05
2. Prior to wintering	2126·9	— 54·1	
3. After wintering and prior to refoliation	2187·9	+ 6·9	
4. P,K, and Mg prior to wintering and N after refoliation	2073·3	—107·7	
5. No fertilizer application	2140·5	— 49·5	

There has been no significant difference in yield as a result of applying fertilizers at different times of the annual refoliation cycle. In fact there was no difference even due to non-application of fertilizers.

Cover Crops

Investigations on cover crops have been restricted to examination of problems that were encountered in the course of advisory work.

Pueraria phaseoloides has proved satisfactory in many aspects and is the popular choice on most estates in Ceylon. It is now realised that no single cover crop species can satisfy all the requirements expected of a cover crop in rubber plantations.

Observations made on cover crop practices followed by estates in different areas seem to indicate that certain species may suit particular conditions better than others. In areas of marginal rainfall with long, dry spells a cover like *Mimosa invisa (var inermis)* could be an ideal choice. It has the habit of dying out during the dry spell to form its own mulch and rejuvenates on its own with the onset of wet weather. In general, and on a long term policy, it is considered that a mixture of different creeping and erect covers could prove to be superior to a single species.

The practice of clean weeding for purposes of establishing a cover crop seems to be very much in vogue in spite of the undesirable effects of such a procedure. It would appear that certain stipulations will have to be laid down in the near future if the beneficial effects of an introduced cover are to be exploited to the fullest advantage without having to lose most of the top soil that has been accumulated over a period of years.

The recommendation, that Guatemala grass be cultivated between rows of rubber plants in association with the leguminous cover for obtaining sufficient mulching material to thatch the planting rows, appears to have presented certain difficulties in practice. The main difficulties appear to be those of maintaining the grass economically in the manner suggested and the failure to prevent competition between the grass and the rubber plants.

Investigations have revealed that though lopping of the grass is an operation that involves additional expenditure, the savings that accrue by way of reduced costs of weeding and mode of application of fertilizers do not appear to have been taken into consideration.

Mulching

The results from field experiments, designed to test the effects of mulching with two cover crop materials in relation to manuring with different levels of nutrients, have continued to indicate that mulching has a beneficial effect on the growth of young *Hevea* plants compared to no mulching.

Of the two types of cultivation practices tested *viz.* cultivation of *Pueraria* and mulching with loppings of *Pueraria* compared with the cultivation of *Pueraria* and Guatemala grass and mulching with loppings of Guatemala grass — the former practice had a beneficial effect on the growth of young *Hevea* plants than the latter.

Weed Control

It has been found that the use of herbicides for judicious weed control in rubber plantations is an effective as well as an economic proposition compared to manual weeding in areas with little or no recognised ground cover. Sodium arsenite is by far the cheapest herbicide that can be used for this purpose provided adequate precautions are taken.

Alternate herbicides that can be used which are non-poisonous, but more expensive are a mixture of herbicides containing Dalapon and 2, 4-D ("Veedkil") and Paraquat ("Gramoxone").

Residual herbicides such as Diuron, or Simazine can be used only on areas where eradication of weeds is desired, such as along planting rows or in patches or strips prior to establishment of cover crops.

Follow-up observations on areas where weed control experiments were conducted indicate that natural vegetation should be controlled to the point of eradication only when and where such vegetation could be replaced with a recognised ground cover. Under all other circumstances the growth of natural vegetation should only be checked at periodic intervals.

Since Paraquat is claimed to become inactivated when it comes in contact with the soil, this herbicide would appear to be ideally suited for use in agricultural areas.

In view of the high cost of this herbicide investigations have been undertaken to determine the minimum rates at which Paraquat should be applied in order to achieve the degree of weed control desired in the different situations and to assess the extent to which the efficacy of this herbicide can be enhanced, when applied in combination with residual herbicides, in situations where clean weeded conditions have to be maintained.

Experiments to determine the possibilities of this herbicide for selective control of weeds, when applied at low concentrations, are also in progress.

Soil Survey

The immediate objective of the Soil Survey project initiated by the Division was to carry out a reconnaisance survey of the soils in the rubber growing areas in Ceylon and to prepare a map on this basis. With this end in view, the soil survey unit comprising one graduate assistant and two technical assistants commenced work early in 1963.

The rubber growing areas were first divided into different climatic zones on the basis of rainfall. Since it was deemed necessary to subdivide each of the climatic zones on the basis of parent material and land forms in order to determine the criteria on which the reconnaisance survey should be carried out, a detailed survey of selected areas in the different climatic zones where detailed geological and land forms surveys had previously been carried out was considered necessary.

Areas covered by the one inch survey sheets for Ratnapura and Alutgama were therefore selected and soil surveys of a detailed nature have been carried out at different locations.

Soil samples were collected wherever it was considered that laboratory characterization by physical, chemical or mineralogical analysis would be of help in the survey. These analyses have been undertaken by members of the soil survey unit whenever they were not engaged on field work.

REVIEW OF THE RUBBER CHEMISTRY DIVISION

By

M. Nadarajah

Summary

Besides the usual advisory activities, the routine analyses and experiments connected with them, investigations on improving the quality of lower grade rubbers and on the oil-extension of natural rubber at the latex stage have been continued.

The analysis of latex and rubber from 23 clones has been continued. Investigations on discolouration of latex and the nature and amount of phenols and enzymes present in them were in progress.

An attempt was made to determine the mercury content of bark and of latex resulting from treating tapping panels with mercurial fungicides.

The relation between visual grading and the results of laboratory determiminations of cleanliness has been studied and results obtained have been included with the values obtained in previous years.

With more replanted areas coming into tapping, several estates have requested our services to calibrate their metrolacs by trial coagulation. This is due to the rather low dry rubber content and the larger amount of non-rubber constituents present in latex from young trees.

The work on the copper and manganese content of Ceylon rubber has been continued and a report on the results obtained was submitted to the I.R.R.D.B. meeting held in London in December, 1963.

Panel scrap has been found to contain a much higher calcium content than was found in latex and investigations have been carried out to ascertain the cause for this occurrence.

DETAILED REVIEW

General

Staff

The Department consists of the Acting Head of the Rubber Chemistry Division, Mr. M. Nadarajah, the Assistant Rubber Chemist, 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.

Mr. O. M. R. Sirisena was on no-pay study leave as from 1-9-63 to follow a course leading to the L.I.R.I. at the National College of Rubber Technology, England.

Advisory Services, Correspondence, visits

	1963
Correspondence incoming	474
Correspondence outgoing	386
Unsolicited samples for report or analyses ...	80
Visitors to the Division	70
Visits by the Staff of the Division (details below) ...	282

	R.R.I.C. Estates	*Commercial Estates*	*Other Visits*	*Total*
Actg. Head of the Rubber Chemistry Division ...	5	43	20	68
Asst. Rubber Chemist ...	21	22	14	57
Senior Technical Assistant ...	—	87	7	94
Technical Assistants ...	20	16	27	63
Total ...	46	168	68	282

Publications

The publications during 1963 to which members of the Division have contributed include the following :—

1. Review of the Rubber Chemistry Division for 1962. *Rev. Rubb. Res. Inst. Ceylon*, (1963).

2. Some Observations on the Non-Rubber Constituents of *Hevea* Latex. Part I. *Rubb. Res. Inst. Ceylon Quart. J.* 39 (1963) Parts 1 and 2, 27-31.

3. Disposal of Factory Effluents from Crepe and Sheet Producing Factories. *Rubb. Res. Inst. Ceylon Quart. J.* 39 (1963) Parts 1 and 2, 32-37.

4. The Determination of the Dry Rubber Content of Natural Rubber Latex. *Rubb. Res. Inst. Ceylon. Quart. J.* 39 (1963) Parts 3 and 4, 85-94.

5. A report on "Copper and Manganese Content of Ceylon Rubbers" was submitted to the I.R.R.D.B. meeting held in London in December, 1963.

6. Short Notes have been submitted on the following subjects for inclusion in the "Question Corner" of the Institute's Quarterly Journal :

   Fractional Coagulation of Latex.

   Grading of Smoked Sheet, Blanket Crepe and Scrap Crepe.

   Discolouration of Scrap and Latex from Clone RRIC 7.

   Preparation of Ammoniated Latex for concentration.

7. Work was commenced on revising our Handbook "Guide to the Preparation of Plantation Rubber in Ceylon." The first two chapters, *i.e.* "General Considerations" and "Latex in the Field," have been rewritten.

8. The Advisory Circular No. 61 on "Prevention of Coagulation in the Field," has been revised and was published as Advisory Circular No. 73.

Meetings, Lectures, Visits.

1. A demonstration of SP Crepe manufacture was given to several visitors including Estate Superintendents and Visiting Agents on 25-1-63.

2. The Actg. Head of the Rubber Chemistry Division visited Malaya from 1st to 3rd April, 1963, to attend a seminar organised by the R.R.I.M. He also visited estates and took part in discussions with officers of the R.R.I.M. and N.R.P.R.A. from 4th to the 12th April, 1963.

3. The Actg. Head of the Rubber Chemistry Division assisted by the Senior Technical Assistant gave a talk to the Officers of the Smallholdings Department on "Latex Coagulation and Dry Rubber Content" on 9-11-63 at their Annual Field Day.

4. The Actg. Head of the Rubber Chemistry Division gave a talk on "Rubber Manufacturing Techniques" at a meeting of the Kelani-Valley Planters' Association at Avissawella on 26-11-63. He also read a paper on "The Phenols of Latex of *Hevea brasiliensis* and their Oxidation to Produce Discolourations," at the sessions of the Ceylon Association for the Advancement of Science on 22-11-63.

LATEX

Determination of d.r.c. of latex

With more young budded trees coming into tapping, estates are finding it increasingly difficult to determine the dry rubber content of latex accurately with the use of the metrolac. Several estates have been visited to perform trial coagulations to calibrate their metrolacs.

As a result of these trial coagulations a tentative ready reckoner was obtained on the basis of the values given in Table 1.

TABLE 1

THE RELATIONSHIP BETWEEN O'BRIEN METROLAC READING AND D. R. C.

Metrolac reading in ounces at 1 : 2 dilution	d. r. c. in ounces per pint of latex
14	5½
16	6
18	6½
20	7
22	7½
24	8

Control of Coagulation

Bromo Cresol Green indicator papers prepared at the Institute are regularly supplied to estates for the control of latex coagulation.

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.

Samples of latex from trees of clone PB 186, with and without Antimucin treatment to the panel before tapping, were also sent to them for comparison of biosynthetic activity.

Analysis of Clonal Latex.

The analysis of latex and rubber from 23 different clones grown in Ceylon has been continued. The results expressed as mean values are summarized in Table II for 1962 and in Table III for 1-1-63 to 31-4-63. Sampling has been stopped as from the end of April 1963.

TABLE II

ANALYSIS OF CLONAL LATEX — MEAN VALUES 1962

Clones	Viscosity 30°C cp	Volumino-sity	Ash %	Manganese (ppm)	Potassium (ppm)	Mooney Viscosity
PB 186	9·3	1·24	1·21	1·5	4382	77·2
PB 86 (old)	9·8	1.36	1·57	1·8	5252	98·6
PB 86 (young)	8·5	1.45	1·80	1·4	6094	95·1
PR 107	8·7	1.29	1·62	0·9	5286	87·7
Nab 12	8·3	1·34	1·59	0·9	5280	82·5
Nab 15	10·4	1·27	1·32	0·9	4921	101·9
Nab 20	10·5	1·33	1·49	1·2	5093	97·6
RRIM 500	11·4	1·49	1·77	1·1	5514	88·0
RRIM 501	9·5	1·40	1·88	1·1	6115	59·7
RRIC 5	9·7	1·45	1·75	1·2	5893	89·9
RRIC 7	12·4	1·39	1·54	1·2	4988	103·5
RRIC 41	5·7	1·45	1·44	1·2	4424	94·7
RRIC 45	4·5	1·39	1·70	1·5	5717	84·8
RRIC 52	9·2	1·29	1·43	1·5	5367	94·2
RRIC 86	10·0	1·41	1·70	1·0	5339	89·7
Tjir 1	10·3	1·37	1·60	0·9	5534	102·1
Mil 3/2	10·6	1·30	1·51	1·1	5257	94·2
AVROS 255	7·8	1·40	1·67	0·9	5847	85·1
AVROS 352	9·5	1·38	1·79	1·1	6245	87·5
LCB 1320	7·8	1·38	1·82	1·0	5745	95·2
Wagga 6278	10·2	1·36	1·46	1·4	4617	98·3
Glen 1	11·8	1·45	2·13	1·7	5939	78·9
H benthamiana (F 4537)	4·5	1·22	1·35	1·2	4802	78·1
Mean	9·1	1·37	1·62	1·2	5376	89·7

Table III

ANALYSES OF CLONAL LATEX — MEAN VALUES (1-1-63—31-4-63)

Clone	D.R.C. %	T. S. %	Yellow Fraction %	Viscosity 30°C cp	Volumi-nosity	Ash %	Water Extract %	Acetone Extract %	Cop-per (ppm)	Iron (ppm)	Manga-nese (ppm)	Magne-sium (ppm)	Calcium (ppm)	Potas-sium (ppm)	Mooney Viscosity
PB 186	40·8	43·2	10·0	9·1	1·22	1·38	0·6	4·23	8·5	16·0	2·4	331	48	4500	82·0
PB 86 (old)	35·3	38·4	17·3	9·7	1·33	1·74	2·6	3·90	7·1	16·0	1·6	11177	59	5617	98·3
PB 86 (young)	34·6	36·1	17·5	8·1	1·48	1·81	3·4	3·66	5·1	15·8	1·9	1154	52	6295	97·8
PR 107	37·2	40·2	17·0	8·5	1·30	1.56	1·5	3·75	5·5	15·0	0·9	650	56	4100	78·3
Nab 12	40·7	43·7	12·0	11·4	1·29	1·73	1·2	4·33	7·8	10·1	0·6	779	51	6150	72·0
Nab 15	45·7	49·2	14·3	12·7	1·24	1·32	2·2	3·94	3·3	15·3	0·7	493	49	5095	94·5
Nab 20	39.9	43·2	18·5	14·6	1·34	1·42	1·3	4·98	5·3	11·5	1·0	1044	30	5940	93·0
RRIM 500	35·5	38·7	24·0	—	—	1·85	1·2	5·82	8·3	5·0	0·8	1375	28	5250	86·0
RRIM 501	39·8	43·0	23·5	10·1	1·38	1·88	0·9	3·41	8·3	12·3	1·3	550	43	6300	49·5
RRIC 5	35·3	38·5	26·0	10·9	1·46	1·69	0·9	3·94	5·5	16·0	1·3	1094	30	6973	84·5
RRIC 7	39·7	42·8	20·3	13·4	1·38	1·36	1·5	3·94	3·3	21·7	1·4	994	50	5583	96·0
RRIC 41	35·3	38·1	10·3	7·3	1·23	1·19	2·1	4·10	3·8	13·0	1·6	831	45	4690	98·3
RRIC 45	31·7	34·9	15·5	6.4	1·40	1·60	2·5	5·16	5·1	19·0	1·0	1110	49	5143	70·0
RRIC 52	35·2	38·5	17·0	8·9	1·39	1·35	1·2	4·49	4·8	17·8	1·2	674	46	6520	82·0
RRIC 86	38·9	41·2	24·5	10·8	1·38	1·75	1·5	4·70	4·8	17·3	1·2	1350	50	6460	80·5
Tjir 1	36·2	39·5	18·5	8·4	1·34	1·49	1·6	3·50	5·2	17·3	0·8	1235	40	5065	93·5
Mil 3/2	40·1	43·7	15·5	11·9	1·32	1·36	1·5	4·25	4·4	18·5	0·9	616	54	5870	90·5
AVROS 255	37·5	40·1	17·0	9·5	1·33	1·50	0·7	4·20	4·9	16·5	1·0	607	48	6010	80·5
AVROS 352	39·0	42·0	21·5	11·9	1·35	1·56	1·4	6·60	6·1	9·8	1·2	660	40	5870	81·5
LCB 1320	36·1	39·1	30·5	8·5	1·34	1·64	3·1	4·57	3·9	14·7	1·5	1148	45	6767	92·0
Wagga 6278	37·4	40·4	18·3	12·2	1·41	1·47	2·0	3·56	2·7	14·0	0·9	1334	40	5157	99·2
Glen 1	39·6	43·1	18·0	12·3	1·35	2·14	3·5	4·16	5·0	18·1	1·4	997	56	5607	81·2
H. benthamiana (F. 4537)	29·4	32·6	15·7	4·6	1·29	1·47	1·8	4·27	6·2	11·7	1·2	228	60	5305	80·5
Mean	37·4	40·4	18·4	10·1	1.34	1·58	1·7	4·32	5·4	14·1	1·2	886	46	5664	85·7

The following comments can be made from the results given in Table II.

(*a*) *Ash Content.*—The latex from clone Glen 1 has a very high ash content and latex from clones LCB 1320, RRIM 501, RRIM 500, PB 86 (young), RRIC 5, AVROS 352 have an ash content well above average (> 1.70%).

(*b*) *Mooney Viscosity.*—The hardness of crepe rubber manufactured from clonal latices may be graded as given in Table IV.

TABLE IV

HARDNESS OF CREPE FROM CLONAL LATICES

Mooney viscosity	Hardness	Clone
< 70	Very soft	RRIM 501
70 — 80	Soft	Glen 1, PB 186, H. benthamiana
80 — 90	Medium	AVROS 352, AVROS 255, RRIC 86, RRIC 45, RRIM 500, Nab 12, PR 107, RRIC 5.
90 — 100	Hard	Wagga 6278, RRIC 41, RRIC 52, PB 86, Nab 20, Mil 3/2.
> 100	Very hard	Tjir 1, RRIC 7, Nab 15.

The following comments can also be made from the results given in Table III. These values were obtained during the first 4 months of 1963 which may be considered an abnormal period in that this includes the period before, during, and after wintering.

(*a*) *Ash Content.*—The latex from clone Glen 1 has a very high ash content and latex from clones RRIM 501, RRIM 500, PB 86, RRIC 86 and Nab 12 have an ash content well above average (> 1.70%).

(*b*) *Mooney viscosity.*—The rubber was softer during this period when compared with the average for the year. This was especially noticeable in the crepe made from the latex of the clones RRIM 501, RRIC 45, PR 107, Nab 12, RRIC 7, RRIC 52, RRIC 86, Tjir 1 and Nab 15.

(*c*) *Percentage yellow fraction.*—The percentage yellow fraction which is of importance in the fractional coagulation of latex can be classified as given in Table V.

TABLE V

PERCENTAGE YELLOW FRACTION

Volume of Yellow fraction	Percentage	Clone
Very large	> 25%	LCB 1320, RRIC 5
Large	20 — 25%	RRIM 500, RRIM 501, RRIC 7, RRIC 86 AVROS 352.
Medium	15 — 20%	H. benthamiana, Glen 1, Wagga 6278, AVROS 255, RRIC 52, RRIC 45, PB 86, Tjir 1, Mil 3/2, PR 107, Nab 20.
Low	< 15%	PB 186, Nab 12, Nab 15, RRIC 41.

Defects in Smoked Sheet

Frequent enquiries regarding various defects in smoked sheet have been received and several estates have been visited for detailed investigations of the cause.

Weak Sheet

The cause of weak or brittle sheet is not fully understood. This defect causes sheet, which would normally be graded as No. 1 to be down-graded to No. 4 or No. 5, even though there is no adverse influence on technical properties after vulcanisation. This is an instance of the inadequacy of the system of selling rubber on visual grading, which may be quite meaningless in terms of ultimate properties.

Latex from young trees contain more non-rubber constituents than latex from older trees. Nevertheless, not all latex from young trees gave brittle sheets. Results of the analyses of samples of rubber collected from young trees are given in Table VI.

TABLE VI

ANALYSES OF RUBBER FROM YOUNG TREES

Cure at 140°C	Unaged						Aged 14/70°C				*MR 100	Strain	VR	VC	Scorch 120°C
Mins.	T.S.	E.B.	300	500	700	Hard	T.S.	E.B.	300	500					
20	118	770	17	37	93	37	240	670	24	81	6.6	61	51	27	85
40	144	720	16	44	131	38	206	630	26	86	7.3	53			

* corrected to compound mooney viscosity of 40.

Weak sheets have a low mooney viscosity. The properties of vulcanisates made from this rubber are similar to those obtained from normal RSS 1, milled to the same mooney viscosity. The defects shown in weak sheet rubber have no effect on the vulcanisates made from it but the low viscosity of the rubber could be serious to a manufacturer whose processes are based on rubber of normal viscosity. Weak sheets could be of advantage to manufacturers who require low-viscosity rubber if it could be supplied consistently at the low-viscosity.

A sample of weak sheet rubber manufactured from latex of Glen 1, evaluated in the A.C.S. 1 compound, gave the following results (Table VII). The rubber has a high modulus falling within the blue circle limits for T.C. rubber.

TABLE VII

ANALYSES OF SHEET RUBBER FROM YOUNG TREES

Sample	Acetone Extract in p.p.m.	Calcium in p.p.m.	Magnesium in p.p.m.	Comments on samples
(1) RSS made from Glen 1 latex (without Antimucin treatment of panel)	3·5	37	278	brittle
(2) RSS made from PB 86 latex	3·2	39	205	normal
(3) RSS made from Glen 1 latex	4·2	35	165	brittle
(4) RSS made from Glen 1 latex	3·3	10	120	brittle
(5) Panel Scrap from Glen 1 trees	2·3	1722	0	brittle
(6) Latex film from Glen 1 latex (from 10-year-old trees)	2·4	0	2715	brittle
(7) Latex film from Glen 1 latex (from 8-year-old-trees)	3·4	11	1560	brittle

Sheets made from undiluted latex of Glen 1 gave faster curing and softer sheets than those made from normal dilution *i.e.* diluted at 1½ lb per gallon. The addition of formalin gave still softer but slower curing sheets. The results are given in Table VIII.

TABLE VIII

PROPERTIES OF SHEET MADE FROM LATEX OF YOUNG TREES

Treatment	Sheets weakness	Strain	Mooney viscosity ML4 at 100°C
Diluted at 1½ lb/gallon	Weak	54·4	29·0
No dilution	Weak	56·9	22·5
No dilution and formalin added at 2 fl oz/100 lb rubber	Very Weak	66·0	23·0

Oil-Extended Sheets

Dutrex R, which is a highly aromatic oil was further tested for the manufacture of oil-extended sheets. Dutrex R was emulsified in the following manner to give a 20% emulsion. 1 part of Duponol OS was dissolved in 20 parts of Dutrex R at 60-70°C. This was added to 100 parts by weight of water also at 60-70°C and emulsified at this temperature. A satisfactory emulsion was obtained.

The emulsified Dutrex R was added to undiluted field latex so that the weight of oil added was 35% on the dry rubber content and the latex masterbatch was coagulated with formic acid. The volumes of latex and oil were such that the final weight of the sheet was 1 lb. A satisfactory sheet was obtained on rolling and smoking the coagulum.

Colour of Crepe, Enzymatic Discolouration.

When latex is centrifuged a bottom fraction separates out and it is well known that this bottom fraction is susceptible to enzymatic activity. Several workers have shown the presence of the enzyme polyphenol oxidase accompanied by natural substances in the bottom fraction. Since copper is an essential constituent of the enzyme polyphenol oxidase and iron a constituent of cytochrome oxidase, investigations were carried out to find whether there is any correlation between the copper or the iron content of bottom fraction latex and enzymatic discolouration.

Field latex was collected in vessels surrounded by ice and centrifuged in a M.S.E. centrifuge at 2,500 r.p.m. for 30 minutes. The top fraction and the bottom fraction were separated and dried by spreading on glass plates to give latex films. On analysis of the latex films, it was found that there is no clear relationship between the copper or iron content of the bottom fraction and discolouration.

Untreated Panel Scrap.

Untreated panel scrap has a higher calcium content than the corresponding latex film, the increase being of the order of 5 to 100 fold (Table IX).

TABLE IX

CALCIUM CONTENT IN P.P.M. (SAMPLED IN 1963)

Clone	Before Wintering		After Wintering		August	
	Latex Film	Panel Scrap	Latex Film	Panel Scrap	Latex Film	Panel Scrap
PB 186	48·0	800·0	—	—	66·0	580·0
PB 86 (old)	36·0	3400·0	—	—	70·0	600·0
PB 86 (young)	20·0	1946·8	50·0	4000·0	56·0	855·2
PR 107	64·0	640·0	—	—	42·0	789·6
Nab 12	48·0	4700·0	54·0	2700·0	42·0	600·0
Nab 15	60·0	888·0	46·0	860·0	46·0	980·0
Nab 20	20·0	1100·0	—	—	50·0	960·0
RRIM 500	28·0	880·0	—	—	60·0	720·0
RRIM 501	40·0	—	—	—	80·0	—
RRIC 5	20·0	660·0	44·0	780·0	42·0	700·0
RRIC 7	52·0	1040·0	46·0	980·0	44·0	1820·0
RRIC 41	44·0	—	—	1860·0	46·0	752·9
RRIC 45	40·0	1400·0	50·0	—	64·0	1105·5
RRIC 52	50·0	—	—	—	55·0	860·0
RRIC 86	30·0	—	—	—	40·0	740·0
Tjir 1	44·0	1000·0	—	—	62·0	440·0
Mil 3/2	60·0	2020·0	—	—	42·0	427·0
AVROS 255	44·0	880·0	—	—	58·0	700·0
AVROS 352	36·0	1040·0	—	—	56·0	708·1
LCB 1320	40·0	700·0	—	—	48·0	853·1
Wagga 6278	32·0	2240·0	34·0	1400·0	46·0	780·0
Glen 1	36·0	660·0	60·0	2300·0	68·0	720·0
H. benthamiana (F 4537)	—	—	86·0	3360·0	98·0	892·9

It is known that factors which activate the liberation of the water soluble base choline from the insoluble phosphatide, lecithin, also have a pronounced effect upon the rate of coagulation. Calcium ions behave as powerful activators of the enzyme which degrades the natural phosphatide present in latex.

The abnormally high calcium content of scraps is probably due to the calcium ions accumulating in the latex towards the end of the latex flow, activating the enzyme which degrades the phosphatide lecithin and causing the coagulation of the latex on the tapping panel.

The calcium content of latex collected at 15-minute intervals shows an increase of calcium content with time of latex flow (Table X). The increase is marked for latex from young trees, slaughter tapped trees and poor yielding trees e.g. *Hevea benthamiana* and LCB 870.

TABLE X

VARIATION OF CALCIUM CONTENT IN P.P.M. WITH LATEX FLOW

Clone	Samples collected every 15 minutes							
	1st 15 mins	2nd 15 mins	3rd 15 mins	4th 15 mins	5th 15 mins	6th 15 mins	7th 15 mins	Panel Scrap
Glen 1	61	43	45	68	77	135	179	590
PB 86 (young)	127	57	45	47	100	133	217	1898
PB 86 (old)	56	83	79	57	81	83	103	390
H. benthamiana	26	68	74	74	374	—	—	2641
LCB 870	113	71	60	81	129	99	162	357
LCB 870 (slaughter tapped)	77	46	92	118	102	149	—	1062
Average	77	61	66	74	144	120	165	1156

In the case of magnesium it was found that the magnesium content of latex generally decreases with time of latex flow (Table XI).

TABLE XI

VARIATION OF MAGNESIUM CONTENT IN P.P.M. WITH LATEX FLOW

Clone	Samples collected every 15 minutes							
	1st 15 mins	2nd 15 mins	3rd 15 mins	4th 15 mins	5th 15 mins	6th 15 mins	7th 15 mins	Panel Scrap
Glen 1	2544	2244	1872	1596	1176	557	1151	1374
PB 86 (young)	276	1152	909	872	1005	973	919	794
PB 86 (old)	1418	1366	1309	1322	1295	1330	1292	757
H. benthamiana	1412	307	272	418	434	354	—	810
LCB 870	868	833	804	659	551	607	576	1053
LCB 870 (slaughter tapped)	866	872	874	915	1042	1697	—	896
Average	1231	1129	1007	964	917	920	985	947

We have also found the potassium content of panel scrap to be very much less than that of the corresponding latex.

Scrap Crepe Manufacture

It is known that crepe manufactured from estate cup lump is of good quality *i.e.*, it is clean and has good dynamic properties. Hence it should fetch a good price if the colour of the scrap crepe manufactured from it could be improved.

The principal discolouration in scrap rubber is also caused by non-enzymatic browning. It is known that sulphites retard non-enzymatic browning and this retardation is more effective at an acid pH. The following procedures were adopted for treating scrap and were found to improve the colour of the scrap crepe :

(*a*) Cup lump on arrival at the factory is washed in water, and then soaked in a freshly prepared solution of sodium bisulphite to which formic acid is added. (8 oz sodium bisulphite and 1 oz formic acid per 100 gals of water). The cup lump should be milled the following day and the macerated crepe soaked for ½ an hour in a freshly prepared solution containing sodium bisulphite and formic acid (8 oz sodium bisulphite and 1 oz formic acid per 100 gals of water). The macerated crepe is milled into lace.

(*b*) Scrap on arrival at the factory is sorted, washed in a scrap washer, and then soaked overnight in fresh rubber serum containing sodium bisulphite (0.1%). The scrap is then milled and the macerated crepe soaked again for ½ an hour in fresh rubber serum containing sodium bisulphite (0.1%) and milled into lace.

Miscellaneous

Dirt Content of Rubber

The relation between visual grading and the results of laboratory determinations of cleanliness are given in Table XII and XIII. These results include the values given in the Annual Review for 1960.

Table XII

DIRT CONTENT OF CEYLON RUBBER

Grade	No. of Samples	Variability	Arith. Mean	Std. Deviation
RSS 1	69	26·8	·046	.0123
RSS 2	50	32·2	·045	.0145
RSS 3	44	33·2	·057	.0190
RSS 4	32	37·7	·065	.0246
RSS 5	8	25.1	·075	·0188
Latex Crepe 1X	138	52.2	·025	·0129
,, ,, 1	560	59.7	·028	·0170
,, ,, 2	299	51.6	·029	·0150
,, ,, 3	363	66.0	·057	·0376
,, ,, 4	100	61.6	·076	·0468
,, ,, 5	28	62·2	·091	·0565
Scrap Crepe 1	473	66·6	·361	·2405
,, ,, 2	444	67·7	·375	·2597
,, ,, 3	323	73·5	·679	·4989
,, ,, 4	18	67·7	·534	·3611
,, ,, 5	8	75·7	·562	·4255

TABLE XIII

CLASSIFICATION OF CEYLON RUBBER ON DIRT CONTENT

Grade	Super Clean 0-0.049%	Clean 0.05 - 0.149%	General Purpose 0.150 - 0.300%	Dirt above 0.300%
RSS 1	71·0	29·0	—	—
RSS 2	68·0	32·0	—	—
RSS 3	36·4	63·6	—	—
RSS 4	25·0	75·0	—	—
RSS 5	—	100·0	—	—
Latex Crepe 1X	92·8	7·2	—	—
" " 1	90·5	9·3	0.2	—
" " 2	90·0	10.0	—	—
" " 3	50·7	46·0	2·8	0.5
" " 4	31·0	65·0	3·0	1.0
" " 5	17·9	67.8	14·3	—
Scrap Crepe 1	1·5	28·5	19·2	50·8
" " 2	0·5	12·8	29·1	57·6
" " 3	1.2	3·7	17·0	78·1
" " 4	—	7·7	30·8	61·5
" " 5	—	12·5	12·5	75·0

Phenols in Latex

Investigations were undertaken to determine quantitatively the amount of polyphenols present in the bottom fraction of latex by a colorimetric method.

10 ml of latex were collected directly from the tapping cut into 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 contents were stirred during the collection. As the pH of the latex at the moment of its exudation from the tree is approximately 7.0, the buffer solution was used to maintain the pH at this value. Further, the use of the 0.6M buffer, produced a good separation of the bottom fraction particles, on centrifugation. The diluted latex was centrifuged at 14,000 r.p.m. for 20 minutes. The supernatant was decanted off and 10 ml of distilled water was added to the jelly. The contents were transferred into small centrifuge tubes and centrifuged at low speed for about 3 minutes. The supernatant liquid was transferred into a 25 ml volumetric flask. The precipitates in the small centrifuge tubes were washed twice with distilled water, centrifuged and the supernatants added to the liquid in the 25 ml flask and made up with distilled water to the 25 ml mark.

This solution was passed through a filter paper, and 1 ml of the filtrate was pipetted into a 10 ml volumetric flask. To this was added 5 ml of distilled water and 0.5 ml of Folin Denis reagent. The Folin Denis reagent was prepared as follows : " To 750 ml of water, 100 grm of sodium tungstate (Na_2 $W0_4$ $2H_20$) 20 grm of phosphomolybdic acid and 50 ml of phosphoric acid were added. The mixture was refluxed for 3 hours, cooled and diluted to 1 litre." The contents were mixed well and exactly 3 minutes after the addition of the Folin Denis reagent, 1 ml of a saturated solution of sodium carbonate was added, mixed well, made up to the mark with distilled water, and left for one hour. The contents were centrifuged and absorbance readings were taken on the supernatant on using a Beckmann Spectrophotometer, at a wave length of 725 mu and using 1 cm cells and a 0.6 slit width.

The results obtained are given in Table XIV and they indicate that the amount of natural phenols vary considerably from clone to clone. Thus the latex of clone RRIC 7 is very prone to enzymatic discolouration and is found to have a very high phenolic content. However, on the whole, there is no clear relationship between phenolic content and enzymatic discolouration.

TABLE XIV

PHENOLS IN THE BOTTOM FRACTION OF LATEX EXPRESSED AS P.P.M. OF TYROSINE

Clone	Phenolic content as p.p.m. of Tyrosine	Enzymatic discolouration in crepe
PB 86 (old)	14·1	No discolouration
Glen 1	13·9	
AVROS 255	13·2	
RRIM 500	9·0	
Nab 20	16·2	
PB 86 (young)	13.1	
Nab 15	10·0	Slightly discoloured
Tjir 1	10·0	
PB 186	3·7	
RRIM 501	21·4	
RRIC 52	14·4	
RRIC 86	12·7	
LCB 1320	9·0	
AVROS 352	20·4	
RRIC 5	9·0	Discoloured
PR 107	17·3	
Nab 12	10·4	
Wagga 6278	11·2	
RRIC 45	17·9	
RRIC 7	48·7	Very discoloured

Enzymes in Latex

A sufficient quantity of latex was collected directly from the tree into five volumes of Tris-Mannitol buffer (T = 0.6, pH = 7) cooled in crushed ice. The temperature was kept low throughout the process of extraction to prevent deactivation of the enzymes. The enzymes were first separated in the bottom fraction, free from most of the rubber particles by centrifuging at low speed. This was subsequently washed with buffer solution and freezed to cause disruption of cells and cellular components. The cellular components were brought into solution in distilled water and the proteins were precipitated with ammonium sulphate leaving the phenolic bodies in solution.

The enzyme activity was followed both chronometrically and colorimetrically. In the colorimetric method the enzymatic reaction is followed side by side with a chemical reaction resulting in the formation of a coloured complex the intensity of which is directly related to the rate of enzymatic activity.

Ethylene diamine reacts with quinones to give a coloured complex having an absorbance maximum at 572 mμ and this reaction was made use of to follow the enzymatic oxidation of catechol. The increase in intensity of the coloured complex which is directly related to the degree of oxidation was determined using the Beckmann model Spectrophotometer. Absorbance measurements indicated that cyanides, azides and diethyl dithiocarbamates inhibited the enzymatic reaction.

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 Chief Advisory Officer, Senior Assistant Advisory Officer, Assistant Advisory Officer (North) and Assistant Advisory Officer (South) were on duty throughout the year.

Messrs. D. G. Dhanapala, temporary clerk and H. M. Punchi Banda, Clerk-Translator left the Department this year. Mr. P. G. Somadasa, temporary daily-paid Watcher was absorbed into the permanent service and Mr. T. T. Francis, temporary casual labourer was appointed temporary daily-paid watcher. Mr. S. D. Athukorale, Replanting Attendant, and Mr. W. A. S. Wijesekera were appointed as temporary Rubber Instructors. Mr. A. Wijesinghe was appointed as temporary Typist-Clerk while Mr. I. L. Sirisena, temporary Clerk was appointed as Clerk-Translator.

One Rubber Instructor died unexpectedly this year.

Two Conferences of Supervisory Staff were held during this year.

The Chief Advisory Officer, Smallholdings attended three meetings of the Rubber Replanting Advisory Board, an Administrative Committee Meeting of the Rubber Research Board and a meeting convened by a Member of Parliament in regard to advisory work of the Department in some Government land to be alienated to peasants.

Four new ranges were carved out of some of the larger existing ones. One range was closed down and a new one was created instead.

An F.A.O. Scholar was shown rubber smallholdings in Kosgama and Padukka ranges. A delegation of Chinese Scientists and Agriculturists were taken on a tour of inspection by the Chief Advisory Officer, Smallholdings in Padukka and Galagedera ranges at the request of the Rubber Controller. The Smallholders' Representative inspected smallholdings with the C.A.O.S. in the Northern and Southern sectors.

The Department participated in three exhibitions and our folders and posters were sent to a Science Exhibition.

Three officers were given loans to purchase motor cycles and two others were given loans to repair their motor cycles.

The new booklet on tapping was published both in English and Sinhala and was sold at /-25 cts. a copy. The Annual Review of the Department was published in Sinhala and distributed among smallholders.

Lining for soil conservation works and planting points was carried out by the field staff. They also advised smallholders on all aspects of rubber work. 493 aluminium pans were sold. Future sales are bound to increase as a local firm has started manufacturing these pans.

The Annual Field Day of the Department was held at Ratnapura. The Chairman and the Director were unable to attend the Field Day. Two guest speakers addressed the field staff. The Smallholder's representative distributed certificates to some successful trainees.

33,984 visits were made during the year to replantings and replanted smallholdings inclusive of 25,776 visits to permit areas of previous years. 8208 visits were made to 1963 replanting permit-areas. 1894 subsidy holdings of 1963 totalling 2503 acres 3 roods 08 perches were lined for soil conservation works by Rubber Instructors and Assistants. Similarly 2305 subsidy holdings of 1963 totalling 3079 acres 3 roods 26 perches were lined for planting holes by Rubber Instructors and Assistants. In addition to above, in 625 subsidy holdings of previous year's issues, Rubber Instructors have lined an extent of 984 acres 0 roods 16 perches for soil conservation works and in 665 similar holdings Rubber Instructors have lined an extent of 1066 acres 3 roods 20 perches for planting holes. 234 special reports on subsidy areas have been submitted to the Rubber Controller. Rubber Instructors have marked for tapping a total of 29,343 tappable trees in 580 subsidy holdings.

Field officers of this Department carried out random checks on planting material issued by the Rubber Controller at Commodity Purchase Depots to subsidy replanters and a total of 25,397 plants were checked at 308 visits to various Depots.

Each smallholding for which new planting rights were desired was visited by a Rubber Instructor before a permit was issued and 1799 such preliminary inspections were made and reports submitted to the Rubber Controller. 11,220 visits were made by the field staff to new-planting and new-planted permit areas of this and previous years for advice and lining. A new record sheet was entered up for each of the year's new-planting permit areas visited. 1599 final inspection reports and 1654 special reports were made by Rubber Instructors during the year. Instructors and Assistants lined 308 new-planting areas of 424 acres 1 rood 11 perches for soil conservation works and 362 permit areas of 489 acres 2 roods 02 perches for planting holes in 1963 permit areas. Similarly 78 permit areas of 115 acres 0 roods 30 perches in extent were lined for soil conservation works by Rubber Instructors and Assistants and 86 permit areas of 134 acres 2 roods 04 perches for planting holes in 1962 new-planting areas. Divisional Advisory Officers have checked lining in 151 new-planting permit areas. Rubber Instructors have marked 7631 tappable trees in 105 new-planted smallholdings. Rs. 3,488·37 were paid to 65 peasant-class permit holders as soil conservation grants.

Special inspections were undertaken at the request of the Rubber Controller in addition to the normal advisory visits.

This Department successfully organised 101 co-operative dusting groups for the State-aided Sulphur Dusting Scheme, 1963. In all a total of 10,228 acres (3197 holdings) were successfully dusted. Dusting operations were commenced on 10.1.63 in Udagoda sulphur dusting group in the Undugoda range. The dusting operations for the season were concluded on 15.4.63 when the last holding of the Mudunkotuwa sulphur dusting group were given the last round of dusting.

It as been observed that whilst undusted holdings were infected with *Oidium* thed usted holdings generally escaped attack. However, due to partial wintering, high humidity and frequent showers, a number of holdings in Pitigala, Migahatenne and Baduraliya were observed to be infected fairly heavily. Arrangements have been completed to dust approximately 10,348 acres of rubber in 3100 holdings in 1964. A total of 104 sulphur dusting groups were organised but 4 groups dropped out of the scheme due to difficulties of collecting money for sulphur dust and other expenses. The sulphur dust of the required quality has been purchased but as a result of the strike and unsettled conditions in the Port in December the sulphur had not been unloaded. Representations have however been made to get priority for unloading the sulphur. 20 new sulphur dusting machines have been purchased for use in the scheme while all old machines have been repaired or serviced.

The Publicity Unit held 65 publicity meetings and exhibitions. Two films on rubber were obtained on loan from the Rubber Research Institute of Malaya and they were shown for the first time at the distribution of the tapping certificates to the Kegalla Division trainees. These films were projected on the sound projector which was bought for the Department.

Divisional Advisory Officers delivered a series of lectures in Sinhala on various aspects of rubber to students of Farm Schools.

Rubber Instructors have conducted 2208 demonstrations on various aspects of rubber cultivation and manufacture. 49 demonstration smokehouses and 72 ordinary smokehouses were started and 44 demonstration and 46 ordinary smokehouses were completed and a grant of Rs. 75/- was paid per demonstration smokehouse.

All Rubber Instructors were trained in tapping at two training classes (each lasting three days) by Assistant Advisory Officers and Divisional Advisory Officers. 45 training classes were organised by Rubber Instructors and 1004 trainees were accepted, 817 participated and 501 successful trainees were awarded certificates. Every Rubber Instructor will organise a training class in 1964 too. This scheme is expected to improve the standard of tapping of smallholders and the conditions of their smallholdings.

All Rubber Instructors continue to send daily rainfall returns and this survey will be continued for a further period. It has been noted that rainfall at Ibbagamuwa (Polgahawela Range) was 76·55 inches while at Pitipana (Homagama Range) it was 199·22 inches.

Data collected in the Survey of the Economics of a Rubber Smallholding reveal that a smallholder normally spends an average of Rs. 710/70 for 9 items of work which qualify him to earn 2 instalments of subsidy amounting to Rs. 400/-.

A *Phytophthora* Survey was carried out at the request of the Head of the Plant Pathology Division.

DETAILED REVIEW

Introduction.—The work of the Smallholdings Department both in the field and in office increased during the year under review. A fairly large number of subsidy re-planting and new-planting permits were issued. The consolidation of the old sulphur dusting groups, the organisation of new groups and the supervision of all groups were undertaken. The Publicity Unit functioned in the field during the year. Assistance to smallholders was given in the form of advisory visits, lining for planting holes, soil conservation works, and the usual advisory services.

Staff

Mr. A. B. Dissanayake, the Chief Advisory Officer, Smallholdings, was on duty throughout the year. Mr. H. H. Peiris, the Senior Assistant Advisory Officer, Mr. K. Wilson de Silva, the Assistant Advisory Officer (North) and Mr. D. E. A. Abeywickrema, Assistant Advisory Officer (South) were on duty throughout the year under review.

Mr. D. G. Dhanapala, the Temporary Clerk who was appointed on 1. 6. 62 to assist the Sulphur Dusting Clerk resigned on 1. 2. 63.

Mr. H. M. Punchi Banda, Clerk-Translator, who was in charge of sulphur dusting work resigned on 3. 7. 63.

Mr. P. G. Somadasa, the temporary daily paid watcher was absorbed into the permanent service with effect from 2. 1. 63.

Mr. T. T. Francis, the temporary casual office labourer was appointed temporary daily paid watcher from 1. 2. 63.

Mr. S. D. Athukorale, Replanting Attendant, who was assisting the Rubber Instructor, Publicity Unit and Mr. W. A. S. Wijesekera were appointed as Temporary Rubber Instructors with effect from 2. 9. 63 and 16. 10. 63 respectively.

Mr. A. Wijesinghe was appointed as a temporary Typist-Clerk to assist sulphur dusting work and he reported for duty on 4. 9. 63.

Mr. I. L. Sirisena, Temporary Clerk was appointed to the permanent post of Clerk-Translator with effect from 2. 12. 63 to fill the vacancy created by the resignation of Mr. Punchi Banda.

The unexpected death of Mr. M. D. M. Goonewardana, Rubber Instructor, on 19. 4. 63 is regretfully recorded. He joined the Department in 1952 and counted 11 years service at the time of his death.

Two conferences of the Supervisory Staff of the Department, convened by the Chief Advisory Officer, were held at the Smallholdings Department headquarters on 26th March and 16th September, 1963.

The Chief Advisory Officer attended on invitation three meetings of the Rubber Replanting Advisory Board and a meeting at Halpe School convened by the Member of Parliament for the area, with regard to advisory work in some Government land which was to be alienated to peasants.

The Chief Advisory Officer attended, on invitation, an Administrative Committee Meeting of the Rubber Research Board where the Departmental Estimates and Programme for the year 1964 were considered and approved.

Reorganisation of Ranges

It had been found that some ranges were far too unwieldy in size and the concentration of permit areas very heavy. It was therefore decided to break up these large ranges into smaller ones to bring down the concentration of work in those ranges to more manageable proportions. This was mainly done to facilitate field work of Rubber Instructors.

The following new ranges were therefore carved out of some of the larger ones :

1. Yatiyantota range in Avissawella Division
2. Weliveriya range in Colombo Division
3. Dodampe range in Ratnapura Division
4. Galpatha range in Matugama Division.

The former Pitabeddara range, where little rubber planting is now done was closed down and the villages redistributed to the neighbouring ranges. Instead a new range around Imaduwa was carved out of the existing ranges and a Rubber Instructor was stationed at Imaduwa.

Visits

An F.A.O. Scholar, Mr. Abdul Khan of Pakistan was shown rubber smallholdings in the Kosgama and Padukka ranges. At the request of the Rubber Controller the Chief Advisory Officer showed a delegation of Chinese Scientists and Agriculturists a comprehensive selection of rubber-replanting smallholdings, smoke houses, smoked sheet etc., in Padukka and Galagedera ranges, on 16th and 17th December. Mr. W. P. H. Dias, J.P., the Smallholders' Representative on the Rubber Research Board inspected smallholdings with the Chief Advisory Officer, in the Northern and Southern sectors.

Exhibitions

This Department participated in the Tawalama Maha Vidyalaya Exhibition from 29th to 31st March, the Telijjawila Agricultural Exhibition at the Central College from 23rd to 25th April and the Dippitiya Exhibition on 30th November 1963. Our Departmental Folders and Posters were posted to the Principal of the Badulla Maha Vidyalaya for their Science Exhibition.

Loans

Two loans of Rs. 500/- and Rs. 690/- were given to Mr. D. J. Ratnayake, Rubber Instructor, Pugoda and Mr. G. Weeratunga, Rubber Instructor, Kesbewa respectively for effecting repairs to their motor cycles, which had been bought on loan from this Institute. Further, three other loans totalling Rs. 6,570/- were given to three Rubber Instructors for purchasing of motor cycles.

Correspondence

The following figures in regard to correspondence are an indication of the volume of work done during this period both in the field a.. [1] at the Smallholdings Headquarters :

General :

Inward	7,899	
Outward	12,790	

With the Rubber Controller :

Inward	2,018	(from the Rubber Controller with New Planting Applications etc.).
Outward	5,052	(including 1,799 Preliminary Reports, 1,599 Final Inspection Reports and 1,654 Special Reports).

From field officers to permit holders :

5,149 (not included in the above figures)

Publications

The new Smallholdings Department booklet on Tapping was published in both Sinhala and English. This booklet, illustrated with photographs taken in the field, was available for sale to smallholders at a nominal rate of /-25 cts. to cover part cost of printing.

The Annual Review of the Smallholdings Department published in Sinhala, was distributed among smallholders in order to acquaint them with the work done by this Department.

Assistance to Smallholders

Lining for soil conservation works and for planting points was carried out by Rubber Instructors and Replanting Attendants. Rubber Instructors also advised smallholders on the correct tapping procedure, disease control, manuring and sheet making.

As a result of the ban on the import of foreign manufactured aluminium pans for latex coagulation only 493 pans were sold, mostly during the latter part of the year. A local firm began manufacturing these pans during the last quarter of the year and future sales are bound to increase considerably. These pans, from the local source, will be sold at concession rates.

Annual Field Day

The Annual Field Day of the Department was held at the Ratnapura Town Hall on 9th November, 1963. The programme was as follows :

8-00— 9-15 a.m.	...	Talk on Latex Coagulation and Dry Rubber Content by Mr. M. Nadarajah and Mr. D. S. Muthukuda.
9-15— 9-30 a.m.	...	Question Time.
9-30— 9-45 a.m.	...	Tea Interval.
9-45— 9-50 a.m.	...	Welcome of Guests, *i.e.*, Chairman, Rubber Research Board, Director, Rubber Research Institute. Smallholders' Representative on the Rubber Research, Board etc.
9-50—10-15 a.m.	...	Short talks by the Guests.
10-15—11-00 a.m.	...	Talk by Dr. R. T. Wijewantha on "Genetics and Plant Breeding with special reference to Hevea."
11-00—11-15 a.m.	...	Question Time.
11-15—11-40 a.m.	...	Assembling Smallholders.
11-40—11-50 a.m.	...	A talk by the Chief Advisory Officer, Smallholdings, in Sinhala explaining the Training Scheme in Tapping for Smallholders.
11-50— 1-00 p.m.	...	Distribution of Certificates by the Chairman, Rubber Research Board.
1-00— 1-10 p.m.	...	Talk by a Smallholder. Conclusion of Programme.

The Chairman of the Rubber Research Board and the Director of the Rubber Research Institute of Ceylon were unable to attend the Field Day this year due to unavoidable circumstances. The field work of the day comprised a lecture on Latex Coagulation and the Dry Rubber Content. With the use of a number of metrolacs Mr. Nadarajah showed the necessity to have a correction for metrolacs and explained in detail the theoretical and practical considerations of latex coagulation.

Dr. R. T. Wijewantha, while tracing the development of Genetics showed the scientific methods that can be adopted to breed a high-yielding, disease-resistant clone.

Questions were asked from the lecturers and the subjects were discussed at length.

After assembling the smallholders, the Chief Advisory Officer explained in Sinhala the necessity for and the details of the Training Scheme in tapping for smallholders and invited Mr. W. P. H. Dias, J.P., the Smallholders' Representative, to distribute the certificates to the successful trainees.

After a short talk by the Smallholders' Representative a smallholder made a speech thanking the Department, thus ending the field day proceedings.

Replanting

Considerable attention was paid by the field staff in assisting smallholders as well as small estate owners (on request) in replanting their permit areas according to the requirements of the Rubber Replanting Subsidy Scheme. The following replanting permits issued in respect of smallholdings were in force at the end of the year under review :

Number of Permits	*Acres*	*Roods*	*Perches*
5563	7467	2	25

Every one of the above 5563 smallholdings was visited by a Rubber Instructor. 33,984 visits were made during the year to replanting and replanted smallhodings inclusive of 25,776 visits to permit areas of previous years. 8208 visits were made to 1963 replanting permit areas during the year.

Rubber Instructors and Assistants lined 1894 permit areas totalling 2503 acres 3 roods 08 perches for soil conservation works and 2305 permit areas of 3079 acres 3 roods 26 perches for planting holes in the 1963 permit areas.

Similarly, the field staff lined a further 625 permit areas of 984 acres 0 roods 16 perches in extent for soil conservation works and 665 permits areas of 1066 acres 3 roods 20 perches in extent for planting holes in permit areas of the previous year. 234 special reports on subsidy replanting permit areas were submitted to the Rubber Controller.

A total of 29,343 tappable trees in 580 subsidy replanted smallholdings have been marked for tapping by Rubber Instructors by way of demonstrations.

A total of 308 visits were made by the field staff for the purpose of random checking of the planting material issued at the various Commodity Purchase Depots to smallholders. In all 25,397 plants were examined at these visits. Whenever smallholder's sheets were examined by Rubber Instructors at such visits to Depots, all defects seen in the sheet rubber were pointed out to smallholders and advice given on methods of avoiding the defects in smoked sheet.

New Planting

Apart from replanting work Rubber Instructors devoted part of their time in visiting, advising and assisting 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. 1799 such preliminary inspections were made and reports sent to the Rubber Controller throughout the year. 1596 new-planting permits covering approximately 2188 acres 0 roods 10 perches were issued during the year.

3404 visits were made by the field staff to new-planting and new-planted permit areas of 1963 and 1962 for advice and 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 1963. 1599 Final Inspection Reports and 1654 Special Reports were made by Rubber Instructors during the year. Further, a total of 7816 subsequent visits were made by the field staff to new-planted permit areas of previous years.

Rubber Instructors and Assistants lined 308 permit areas of 424 acres 1 rood 11 perches in extent for soil conservation works and 362 permit areas of 489 acres 2 roods 02 perches in extent for planting holes in this year's permit areas.

Similarly, 78 permit areas of 115 acres 0 roods 30 perches in extent were lined by Rubber Instructors and Assistants for soil conservation works and also 86 permit areas of 134 acres 2 roods 04 perches in extent for planting holes in last year's (1962) new-planting permit areas. Divisional Advisory Officers have checked such lining in the field in 151 new-planting permit areas.

Rubber Instructors marked 7631 tappable trees in 105 new-planted smallholdings.

Soil Conservation

Rs. 3,488·37 were paid as soil conservation grants to 65 peasant class permitholders during the year. 104 holdings were measured by Rubber Instructors, vouchers prepared and submitted. Of these, the Divisional Advisory Officers checked the measurement reports in the field in 79 cases.

Special Inspections for the 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	1,799
Visits for Final Inspection Reports	1,599
Visits for Special Reports (New Planting)	1,654
Visits for Special Reports (Subsidy Replanting) ...	234
Visits for random checking of Planting Material ...	308

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 1963.

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 1963. 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 by means of notices, leaflets, publicity meetings and the efforts of the Rubber Instructors it was possible to reach a figure, a little in excess of the target of 10,000 acres fixed for the year 1963.

Necessary instructions, regarding correct procedure of dusting, were given to all staff prior to the 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 sulphur 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 available for repairs in the field during dusting. Minor repairs were however attended to by local mechanics. Major repairs were effected by the Agents of the machines.

Applications were accepted from 101 sulphur dusting groups comprising 3197 holdings giving a total acreage of 10,228 distributed all over the rubber growing areas of the island (Annexure 1).

As in previous years Kalutara continued to be the single District with the largest acreage dusted *i.e.* 2740½ acres (2530 last year). The smallest acreage dusted in a single district was Kandy with 73 acres (60 last year). (Table I).

TABLE I

TOTAL ACREAGE ACCEPTED FOR SULPHUR DUSTING IN 1963

District	No. of Groups in 1963	No. of Holdings in 1963	Acreage in 1963
Kalutara	26	877	2740½
Colombo	22	817	2307½
Kegalla	26	842	2318
Ratnapura	18	346	1454½
Galle	9	226	901
Matara	4	75	438½
Kandy	1	14	73
Total	101	3197	10,228

This year it has been observed that 17 co-operative sulphur dusting groups functioned on their own with almost no help from this Department. In these groups, under the guidance of their energetic Group Organisers, collection of money, transport and distribution of sulphur dust, transport of machines and dusting were done by the group members themselves.

A total of 18 sulphur dusting demonstrations were given in order to train those group organisers and machine operators who had no previous experience in dusting.

Dusting operations commenced on 10. 1. 63 in Udagoda sulphur dusting group in the Undugoda range (Kegalla District). The first to complete dusting was the same group, having given the final round of dusting on 16. 2. 63. The dusting operations for the season were concluded on 15. 4. 63 when the last holdings of the Mudunkotuwa sulphur dusting group (Ratnapura District) were given the last round of dusting.

It has been observed that whilst undusted holdings were infected with *Oidium* the dusted holdings generally escaped attack. However, due to partial wintering, (the foliage on the crowns of most of the trees defoliated whereas that of the lower branches remained green) high humidity and frequent showers, a number of holdings in Pitigala, Migahatenne and Baduraliya were observed to be infected fairly heavily.

Summary

Acreage dusted	10,228	acres
Number of holdings dusted ...	3,197	
Number of groups which functioned ...	101	
Number of machines used	125	
Acreage per machine	81·8	acres
Average size of a holding	3·2	acres
Size of the smallest holding	¼	acre
Size of the largest holding	30	acres
Average number of holdings in a group ...	32	
Average cost of dusting an acre (including sulphur)	Rs. 12·21	

The total extent of 10,228 acres dusted in 1963 constitutes the largest extent of smallholdings dusted against *Oidium* in a single season.

The total acreage dusted consisted of 8,226¾ acres of Budded Rubber, 1,712½ acres of Clonal Seedling Rubber and 288¾ acres of Ordinary Unselected Seedling Rubber. (Table II).

TABLE II

ACREAGE CLASSIFIED ACCORDING TO TYPE OF RUBBER

Kind of Rubber	Acreage Dusted
Budded	8226¾
Clonal	1712½
Unselected Seedling	288¾

Of the total acreage, 8,352½ acres (*i.e.*, 81%) were provided with subsidised sulphur at the rate of Rs. 6·05 per acre and 1,875½ acres were supplied with sulphur dust at the non-subsidised rate of Rs. 12·10 per acre.

The average cost of dusting an acre was Rs. 12·21 including the cost of sulphur.

A follow-up Questionnaire was distributed a month after dusting to ascertain the results of sulphur dusting.

The answers reveal that :

1. Almost all the holdings were free of *Oidium* while the undusted ones were infected.

2. Incidence of *Oidium* in general has been less heavy than last year in undusted holdings.

3. In dusted holdings, specially in the partial and late winterers, infection of *Oidium* appeared on a very small scale.

4. Almost all 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.

Sulphur dusting during 1964.—Arrangements have been completed for sulphur dusting from January to March 1964 of approximately 10,348 acres of rubber in 3,100 holdings. A total of 104 sulphur dusting groups were accepted but due to difficulties in collecting money for sulphur dust and other expenses 4 groups dropped out of the dusting scheme. The distribution of sulphur dusting groups according to Revenue Districts would be as follows :

District	No. of Groups
Kalutara	24
Colombo	24
Kegalla	24
Ratnapura	15
Galle	9
Matara	8
Kandy	1
Total	100

The sulphur dust of the required quality has been purchased but as a result of the strike in the Port in December the sulphur had not been unloaded. Representations have however been made to get priority for unloading the sulphur.

Sulphur at the subsidised rates will be issued to approximately 8487 acres 3 roods 17 perches in 2945 smallholdings.

Twenty new sulphur dusting machines have been purchased for use in the scheme while all old machines have been repaired or serviced. The sulphur dusting demonstrations to train new group organisers, operators and labourers will start in January 1964.

Publicity Unit

The Publicity Unit of the Department held 65 publicity meetings and exhibitions. Only 11 meetings were held from January to June due to a defective lens. As no condenser lenses were available a larger condenser lens was adjusted and fitted by Messrs. Ceylon Theatres Ltd. After this the Unit functioned satisfactorily. Two films on Rubber were obtained on loan from the Rubber Research Institute of Malaya and were shown for the first time at the distribution of the Tapping Certificates to the Kegalla Division trainees at the Dippitiya School in Aranayake range on 30th November, 1963. These films were projected on the 16 mm Sound Projector which was bought for the Department in June. The Rubber Instructor, Publicity Unit, was trained in its use and in sound film projection by the Agents, Messrs. Ceylon Theatres Ltd. When the new power plant ordered through Messrs. Brown & Co., arrives, it is hoped to have both cine film and slide shows by the two types of projectors at our future Publicity Meetings.

Lectures, Demonstrations and Training Classes

Lectures—The Divisional Advisory Officers visited, on request, the Government Farm Schools at Wagolla, Horana and Batangala and conducted a series of lectures in Sinhala on Rubber planting, sheet manufacture and allied subjects to the students taking courses in practical agriculture.

Demonstrations—Rubber Instructors conducted 619 sheet making demonstrations, 692 tapping demonstrations, 459 demonstrations on disease control and 438 miscellaneous demonstrations on other topics.

For the purpose of improving smoking of smallholders' sheet, Rubber Instructors have paid 947 and 1692 visits to demonstration and ordinary smokehouses and persuaded smallholders to commence building 49 demonstration smokehouses and 72 ordinary smokehouses of which 44 demonstration smokehouses and 46 ordinary smokehouses were satisfactorily completed and a grant of Rs. 75/- was paid per demonstration smokehouse.

Training Classes.—Prior to extending the scheme of training smallholders in tapping from 6 classes in 1962 to 47 classes (one class per Range) it was thought desirable to train the balance Rubber Instructors. It was originally intended to train them at Dartonfield by the Deputy Director and Head of the Botany

Division with the assistance of other Heads of Divisions but due to unforeseen circumstances and pressure of work, arrangements had to be made to train the Rubber Instructors by our Assistant Advisory Officers and Divisional Advisory Officers. Thus two training classes, each lasting 3 days were held in April at Avissawella and Matugama to train all the Rubber Instructors.

Training Classes for smallholders were held in June and July after due publicity had been given to the scheme. Of the 47 classes two were abandoned as the smallholders lost interest half way. To the 45 training classes a total of 1,004 trainees were accepted. (Annexure 2). Of this only 817 participated in the scheme by attending lectures and practical classes. Of this, a total of 501 trainees were successful in the oral test and were awarded certificates. (Table III).

TABLE III

SMALLHOLDER-TRAINEES SUCCESSFUL IN THE TRAINING SCHEME IN TAPPING CLASSIFIED ACCORDING TO DIVISIONS

Division	No. of Trainees Accepted	No. of Trainees Participated	No. Successful
Kegalla	161	131	96
Avissawella	166	138	100
Colombo	165	139	70
Ratnapura	176	146	101
Matugama	209	174	97
Galle	127	89	87
Total	1004	817	501

Certificates were issued to the successful trainees of the Ratnapura Division on the Field Day of the Smallholdings Department by Mr. W. P. H. Dias, J.P., Smallholders' Representative on the Rubber Research Board. The other Divisions held separate functions for distributing the certificates.

It has been observed that smallholders, who are really interested in the welfare of their holdings, show a keen interest in this scheme of training. In addition, this scheme has forced the Rubber Instructors to revise their work thoroughly as questions are asked by smallholders even on topics other than those taught. In 1964 too every Rubber Instructor will organise a training class and this scheme of training, if carried on for a few years, is expected to improve the standard of tapping of smallholders and the condition of their holdings to the best possible level.

Surveys

Rainfall Survey

The Rubber Instructors continue to send the daily rainfall returns. This survey will be continued for a further period. The yearly rainfall was worked out not on a calendar-year basis but on a "growers year" basis, and consists of the full rainfall of the two monsoons *i.e.*, South West and North East. Thus the rainfall from 1st April, 1961 to 31st March 1962 has been used as the yearly rainfall. A map of the rubber growing area showing the distribution of the total rainfall in inches for the two monsoons is annexed. (Annexure 3).

The places from which the rainfall data were collected has been numbered from 1—47. The names of the places and the rainfall in inches are given in annexure 4. As these data are observations within one year, the rainfall map is not so accurate as one drawn with average figures for about 20 or more years.

It is however useful to note the range of rainfall distribution under which rubber is grown *i.e.* 76·55 inches at Ibbagamuwa (Polgahawela Range) and 199·22 inches at Pitipana (Homagama Range).

Survey of the Economics of a Rubber Smallholding

In this survey one part dealt with the cost of replanting a smallholding. The survey was carried out to find out the actual cost incurred by an average smallholder in replanting a smallholding. Information collected under the following heads are given as the cost per acre as an average for the whole rubber growing area. (Annexure 5).

		Rs. Cts.
1.	Cost of felling and clearing old Rubber	214·78
2.	Lining	6·54
3.	Cutting holes	61·83
4.	Filling holes	30·26
5.	Weeding	42·11
6.	Total cost of planting	115·40
7.	Cost of soil conservation works	115·94
8.	Fencing	110·70
9.	Tools	13·14
	Total ...	710·70

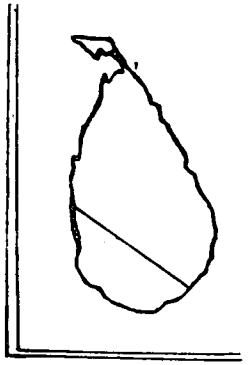
A replanting smallholder under the subsidy scheme who had completed the requirements to qualify for the first two instalments will get only Rs. 400/-. However the data collected in the survey reveal that his total efforts for the items of work exceeds Rs. 700/-. If a change in the payment of subsidy is envisaged in the near future, this data could be used to work out a new scheme. The present system of payment, though slightly lagging behind the efforts incurred helps to keep the smallholder interested in his work for a longer period.

Phytophthora Survey

A survey on climatic conditions and incidence of *Phytophthora* by means of leaf counts in selected plots were carried out at the request of the Head of the Plant Pathology Division.

Annexure 1

Distribution of Sulphur Dusting Groups According to Districts



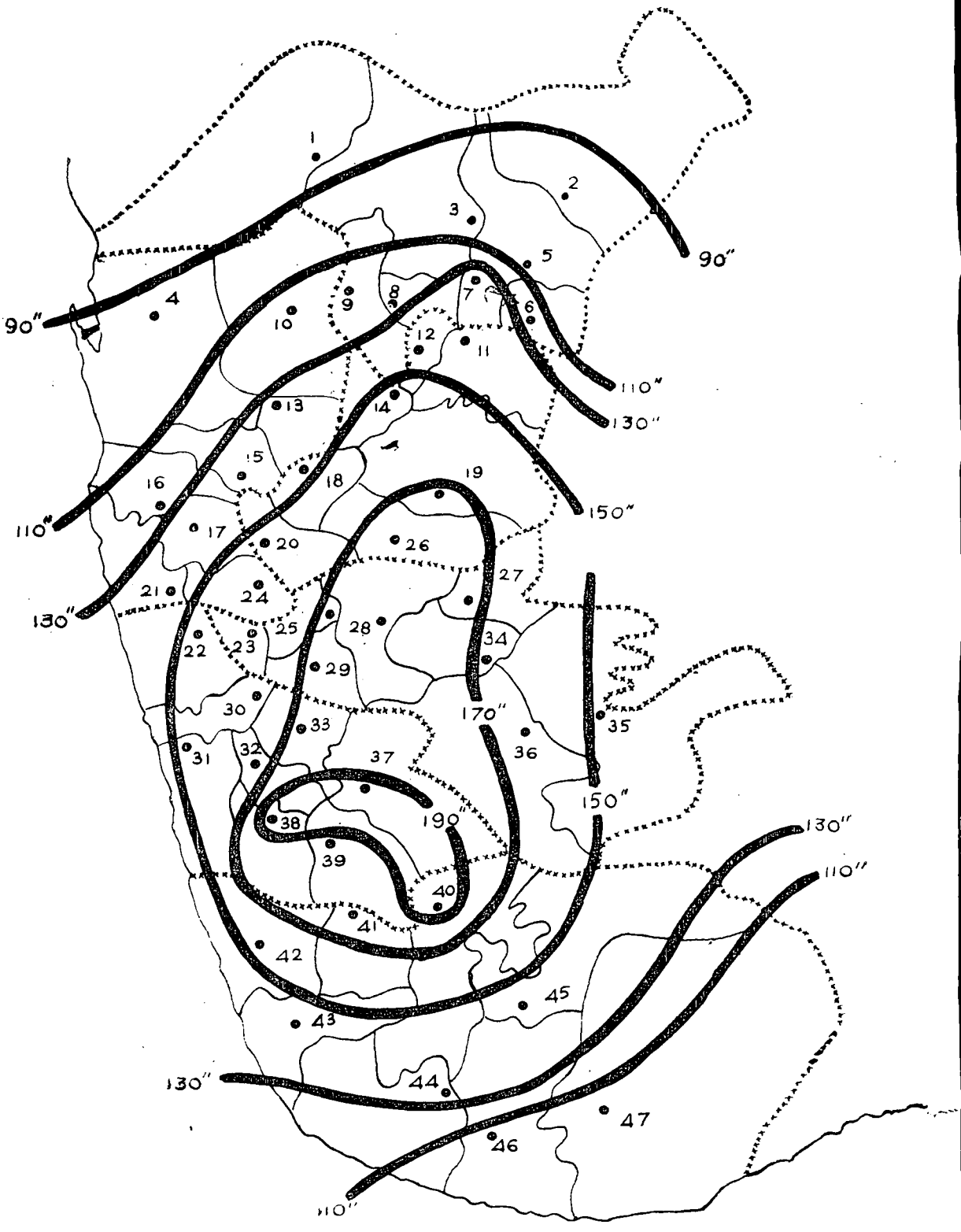
Rubber Dusting Groups

	No. of Groups
Colombo District	22
Kalutara ,,	26
Kegalla ,,	26
Galle ,,	9
Matara ,,	4
Ratnapura ,,	13
Kandy ,,	1
	101

North	No. Accepted	No. Participated	No. Successful	South	No. Accepted	No. Participated	No. Successful
Kegalla Division				*Ratnapura Division*			
Galagedera	16	10	5	Horana	15	8	5
Rambukkana	17	12	11	Ingiriya	20	18	15
Nelundeniya	17	10	8	Kiriella	16	15	8
Hettimulla	26	25	12	Ratnapura	35	25	13
Mawanella	20	17	12	Nivitigala	24	19	13
Warakapola	26	21	17	Pelmadulla	23	21	18
Aranayake	26	25	21	Kuruwita	23	21	19
Polgahawela	13	11	10	Bulathsinhala	20	19	10
Total	161	131	96	Total	176	146	101
Avissawella Division				*Matugama Division*			
				Migahatenne	33	27	16
Eheliyagoda	20	18	9	Baduraliya	32	27	20
Kosgama	22	13	12	Matugama	19	15	5
Dehiowita	27	26	12	Neboda	24	20	13
Pindeniya	30	22	17	Dodangoda	25	21	6
Ruwanwella	25	22	17	Welipenna	22	21	15
Padukka	18	16	13	Agalawatte	28	21	17
Undugoda	24	21	20	Bandaragama	26	22	5
Total	166	138	100	Total	209	174	97
Colombo Division				*Galle Division*			
				Pitigala	24	22	10
Pasyala	25	23	9	Kamburupitiya	19	16	5
Gampaha	22	18	8	Hiniduma	18	10	3
Pagoda	24	23	14	Akuressa	19	7	1
Dompe	14	11	3	Batapola	24	13	5
Talangama	18	18	5	Elpitiya	23	21	13
Kesbewa	22	16	13				
Millewa	20	16	10				
Homagama	20	14	8	Total	127	89	37
Total	165	139	70	Grand Total	1004	817	501

ANNUAL RAINFALL—1961/62

(1st April 1961—31st March 1962)



ANNEXURE 4.

RAINFALL IN INCHES FROM 47 RANGES

(1st April 1961— 31st March 1962)

Serial No.	Place	Rubber Instructor's Range	Rainfall in Inches
1.	Ibbagamuwa	Polgahawela	76·55
2.	Hataraliyadde	Galagedara	99·35
3.	Rambukkana	Rambukkana	98·80
4.	Minuwangoda	Gampaha	101·12
5.	Baminiwatte	Mawanella	79·10
6.	Aranayake	Aranayake	96·06
7.	Hettimulla	Hettimulla	133·56
8.	Ambanpitiya	Nelundeniya	114·10
9.	Halwala Estate	Warakapola	109·34
10.	Pasyala	Pasyala	119·49
11.	Undugoda	Undugoda	123·24
12.	Atale	Pindeniya	133·26
13.	Radawana	Pugoda	134·86
14.	Ruwanwella	Ruwanwella	165·84
15.	Dompe	Dompe	—
16.	Talangama	Talangama	109·40
17.	Fitipana	Homagama	199·22
18.	Kosgama	Kosgama	123·52
19.	Deraniyagala	Dehiowita	171·09
20.	Padukka	Padukka	162·33
21.	Makandana	Kesbewa	149·91
22.	Bandaragama	Bandaragama	175·05
23.	Horana	Horana	162·69
24.	Millewa	Millewa	161·69
25.	Ingiriya	Ingiriya	171·17
26.	Eheliyagoda	Eheliyagoda	177·21
27.	Kuruwita	Kuruwita	175·01
28.	Kiriella	Kiriella	171·12
29.	Egaloya	Bulathsinhala	181·95
30.	Warakagoda	Neboda	131·75
31.	Bombuwela	Dodangoda	159·30
32.	Matugama	Matugama	162·70
33.	Pimbura	Agalawatta	151·21
34.	Ratnapura	Ratnapura	161·39
35.	Pelmadulla	Pelmadulla	150·29
36.	Nivitigala	Nivitigala	164·84
37.	Baduraliya	Baduraliya	190·21
38.	Welipenna	Welipenna	196·14
39.	Migahatenne	Migahatenne	184·13
40.	Tawalama	Hiniduma	196·62
41.	Pitigala	Pitigala	182·86
42.	Igala	Elpitiya	158·59
43.	Ampegama	Batapola	136·62
44.	Yakkalamulla	Talgampola	138·91
45.	Pitabeddara	Pitabeddara	142·25
46.	Henegama	Akuressa	105·86
47.	Kamburupitiya	Kamburupitiya	104·95

ANNEXURE 5.

THE COST OF REPLANTING A SMALLHOLDING

(Cost incurred per acre in Rupees and Cents)

	Average for Kegalla Division	Average for Avissawella Division	Average for Colombo Division	Average for Ratnapura Division	Average for Matugama Division	Average for Galle Division	Total	Average for the whole rubber growing area
Cost of Felling and Clearing of Old Rubber	166·02	325·20	291·75	214·37	143·01	148·32	1288·67	214·78
Lining	5·72	5·67	8·63	7·24	4·94	7·07	39·27	6·54
Cutting Holes	58·69	43·26	79·86	62·79	56·48	69·89	370·97	61·83
Filling Holes	28·75	19·04	28·14	29·64	33·31	42·66	181·54	30·26
Weeding	36·18	59·84	37·72	46·94	31·59	40·39	252·66	41·11
Total Cost of Planting	110·99	104·49	106.22	121·96	121·87	126·89	692·42	115·40
Cost of Soil Conservation Works	83·97	126·64	114·19	165·14	88·58	117·14	695·66	115·94
Fencing	80·41	75·76	132·27	79·22	147·09	149·48	664·23	110·70
Tools	9·51	15·35	12·04	18·04	9·66	14·21	78·81	13·14
Total	580·24	775·25	810·82	745·34	626·53	716·05	4264·23	710·70

REVIEW OF THE ESTATE DEPARTMENT

By

L. Wijegunawardene

Summary

The extent of the Institute's stations at Dartonfield, Nivitigalakele and Hedigalla stands at 1,491 acres, 0 roods and 30 perches and carries a planted acreage of 1,002 of which 849¾ acres were in bearing, 134½ acres in immature rubber and 17¾ acres under budwood and stock seedling nurseries during the year. Fifty-seven acres were under nursery for the Rubber Replanting Subsidy Scheme at Hedigalla.

Weather conditions were most unfavourable for tapping and the harvesting of crop. The rainfall throughout the year was unprecedented and was the highest ever recorded at the three Divisions. The South-West and North-East monsoons merged completely, resulting in unusually wet weather and causing a heavy short-fall in crop.

A crop of 408,681 lb was harvested representing a poor average yield of 481 lb per acre. This was unavoidable.

The immature rubber acreage was reduced from 223 acres, 3 roods, 6 perches in 1962 to 134 acres, 2 roods 14 perches in 1963.

The " wintering " this year was very uneven, and the unfavourable weather conditions experienced during refoliation necessitated close rounds of sulphur dusting and " spot " dusting to minimize the attack of *Oidium heveae*. Late wintering clones were, however, adversely affected. It was very noticeable how unevenly the trees wintered due to the numerous clones planted in close proximity to each other. A satisfactory control of the disease was achieved.

The incidence of *Gloeosporium* was more marked this year and copper dusting was resorted to.

The incidence of *Phytophthora palmivora* was comparatively light in general on the mature areas. The susceptible clones in the immature areas were however affected, and spot dusting with copper based fungicidal dust received special attention. The dusting technique employed throughout the Group proved adequate. Bark rot was negligible among the better known clones. The use of the organo-mercurial fungicides, Antimucin and Kankerdood, proved very effective.

Budwood of the RRIC clones continued to be in demand and issues to all estates and small-holdings were attended to. Routine weeding, cultivation and other agricultural operations were carried out in all mature and immature areas in the Group.

The Rubber Replanting Subsidy Scheme Nursery at Hedigalla under the Rubber Controller continued to be supervised throughout 1963. The nursery was in full production.

Estimates for 1964, dealing with the working of the Group, field and factory experiments etc., were prepared by the writer and approved by the Rubber Research Board. The Hedigalla Nursery estimates for 1964 were also prepared and approved by the Rubber Replanting Advisory Board.

DETAILED REVIEW

General

Staff

The Superintendent, Mr. L. Wijeyagunawardene, and the Assistant Superintendent at Hedigalla Sub-station, Mr. M. R. T. Mendis, were on duty throughout the year.

Mr. L. P. de Mel, Senior Field Assistant at Kuruwita Sub-station was transferred to Nivitigalakele Sub-station in the same capacity on 1st January.

Mr. H. B. H. de Silva, was promoted as Senior Field Assistant and posted at Kuruwita Sub-station on 1st January.

Mr. A. K. Martin, Field Attendant at Nivitigalakele Sub-station, was promoted Field Assistant and posted at Hedigalla Sub-station.

Mr. M. C. Perera, Field Assistant at Nivitigalakele, was sent to Kuruwita Sub-station on 11th March to relieve Mr. H. B. H. de Silva.

The post of Factory Assistant was upgraded to Assistant Staff Grade I, and Mr. O. de Alwis who held the post was placed on the appropriate salary scale with effect from 1st July.

Mrs. K. P. Gunawardene was appointed as Estate School Teacher at Hedigalla on 28th August.

Mr. B. H. Withanachchi, Junior Clerk at Hedigalla, was promoted as a Grade II Clerk-Typist and transferred to the Head Office on 2nd September, and his place was filled by the appointment of Mr. A. L. Ratnayake on 16th December.

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	...	25
Minor Staff	...	23
		50

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.

Correspondence	Inward	...	711
	Outward	...	1,225

Weather (Estate Gauge)

Comparative rainfall figures (inches) for 1963 are given below:

Month	Dartonfield 1963	Dartonfield 1962	Nivitigalakele 1963	Nivitigalakele 1962	Hedigalla 1963	Hedigalla 1962
January ...	11·16	6·80	7·64	6·18	21·18	9·78
February ...	10·05	3·66	8·20	2·25	16·69	8·98
March ...	13·35	12·39	12·09	6·76	6·56	16·26
April ...	19·50	13·35	16·35	12·85	17·63	11·44
May ...	37·65	33·39	32·90	30·61	26·78	31·74
June ...	15·82	13·38	14·33	11·11	14·31	10·33
July ...	27·33	11·61	24·06	10·03	19·79	12·79
August ...	16·81	16·20	14·83	14·96	18·67	14·07
September ...	35·00	12·25	32·30	12·86	32·08	16·01
October ...	25·81	17·41	27·75	14·60	20·03	18·95
November ...	39·70	15·99	33·69	16·18	34·78	20·09
December ...	17·10	6·94	12·64	4·63	16·82	12·50
	269·28	163·37	236·78	143·02	245·27	182·94
Average (5 year period)	175·46″		168·93″		194·91″	
Total No. of Wet days	279	232	271	242	305	267

The rainfall for the year, the highest ever recorded at Dartonfield, Nivitigalakele and Hedigalla Divisions amounted to 269·3″, 236·8″ and 245·3″ on 279, 271 and 305 wet days and was above the five year average by 110·8″, 67·9″ and 50·4″ respectively. The distribution of the abnormally heavy rains was even with the third and fourth quarters recording unprecedented falls.

Acreage Summary—Dartonfield Group.

Rubber	Dartonfield A.	R.	P.	Nivitigalakele A.	R.	P.	Hedigalla A.	R.	P.	Total A.	R.	P.
Mature ...	95	0	19	115	2	31	638	2	21	849	1	31
Immature ...	31	1	0	30	3	28	72	1	26	134	2	14
Nurseries ...	6	0	0	11	3	7	—	—	—	17	3	7
Total ...	132	1	19	158	1	26	711	0	7	1001	3	12
Abandoned due to wind damage, etc. ...	—	—	—	4	2	4	—	—	—	4	2	4
Building sites ...	39	—	36	7	3	29	8	1	18	55	2	8
Pinewood Plantation ...	—	—	—	—	—	—	1	0	34	1	0	34
Roads ...	6	2	22	0	3	27	9	0	4	16	2	13
Swamp Area ...	—	—	—	0	2	8	0	2	20	1	0	28
Streams and Reservations	—	—	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.

Crop

The weather conditions were most unfavourable for tapping and harvesting of crop, and were the worst experienced for the last thirty years resulting in a heavy short fall in crop as against the estimated crop for the season. Tapping was only possible on 254 days at Dartonfield, 257 days at Nivitigalakele and 201 days at Hedigalla.

	1963	*1962*
Estimated ...	520,000 lb	461,000 lb
Harvested ...	408,681 ,,	459,717 ,,
Deficit ...	111,319 lb	1,283 lb

Comparative Yield Records of Individual Fields

Dartonfield	Acreage in tapping	Total yield in lb 1963	Total yield in lb 1962	Yield in lb per acre 1963	Yield in lb per acre 1962
1938 Replanted Area ...	4½	4,485	5,104	996·6	1,134·2
1941 ,, ,, ...	5	2,509	3,226	501·8	645·2
1947 ,, ,, ...	4	2,899	5,315	724·7	1,328·7
1950/51 ,, ,, ...	25¾	12,937	15,764	502·4	612·2
1952 ,, ,, ...	27	17,194	19,855	636·8	735·4
1953 ,, ,, ...	11½	4,127	5,065	358·9	440·4
1954 ,, ,, ...	7¾	1,657	1,256	213·8	162·1
1955 * ,, ,, ...	5	777	—	155·4	—
1955/56 * ,, ,, ...	4¾	535	—	112·6	—
	95¼	47,120	55,585	494·7	650·1

Nivitigalakele	Acreage in tapping	Total yield in lb 1963	Total yield in lb 1962	Yield in lb per acre 1963	Yield in lb per acre 1962
1927/28 Replanted Area ...	—	—	5,589	—	354·9
1935 ,, ,, ...	28½	18,177	20,695	637·8	726·1
1939 ,, ,, ...	10¼	6,286	7,147	613·3	697·2
1940 ,, ,, ...	9¾	6,672	7,437	684·3	762·8
1940 Swamp Area ...	3¼	2,831	3,535	871·1	1,087·6
1941 Clearing ...	7	6,108	6,537	872·6	933·8
1942 ,, ...	4½	3,979	4,868	884·2	1,081·7
1943 ,, ...	7	3,927	4,783	561·0	683·3
1944 ,, ...	4½	3,797	4,757	843·8	1,057·1
1946 Replanted Area ...	21	20,714	24,694	986·4	1,175·9
1953 Clearing ...	10	7,591	6,247	759·1	624·7
1954 ,, ...	10	7,980	10,087	798·0	1,008·7
	115¾	88,062	106,376	760·8	808·9

Hedigalla		Acreage in tapping	Total yield in lb 1963	1962	Yield in lb per acre 1963	1962
1943 Clearing	...	10¼	7,073	9,825	690·1	958·6
1944 ,,	...	11¾	7,255	9,734	617·5	828·4
1945 ,,	...	22¼	13,226	21,414	594·4	962·4
1946 ,,	...	12¾	7,322	10,807	574·3	847·6
1947 ,,	...	45	24,997	30,454	555·5	676·8
1949 ,,	...	34¾	21,855	26,735	629·0	769·4
1950/51 ,,	...	20	14,421	15,280	721·1	764·0
1952 ,,	...	79½	37,351	42,661	469·8	536·6
1953 ,,	...	142	62,483	68,597	440·0	483·1
1954* ,,	...	157½	46,986	42,301	298·3	338·4
1955* ,,	...	78	26,556	19,948	340·5	498·7
1956* ,,	...	25	3,974	—	159·0	—
		638¾	273,499	297,756	428·2	548·1
Total for the Group	...	849¾	408,681	459,717	480·9	604·7

Tapping

(*a*) Tapping was resumed after rest during refoliation on the 4th of March at Dartonfield and Nivitigalakele and on the 7th of March at Hedigalla Division. Tapping panels were marked with the appropriate bark consumption in keeping with the systems of tapping adopted in the various experimental areas.

(*b*) The following clearings were brought into tapping in 1963 :—

(i) 9½ acres of the 1955 and 1956 Replantings at Dartonfield.

(ii) 32½ acres in the 1954 Clearing, 38 acres in the 1955 Clearing and 25 acres in the 1956 Clearing at Hedigalla.

Analysis of tapping rounds on Dartonfield Group for 1963 (1962 figures in brackets).

Dartonfield	Early Tapping	Late Tapping	No Tapping Winter Rest	Rain	Holidays
1st Quarter	42 (46)	24 (19)	18 (16)	2 (3)	4 (6)
2nd ,,	42 (41)	24 (23)	— —	21 (22)	4 (5)
3rd ,,	28 (42)	20 (23)	— —	44 (27)	— —
4th ,,	39 (49)	35 (30)	— —	18 (12)	— (1)
	151 (178)	103 (95)	18 (16)	85 (64)	8 (12)

Nivitigalakele	Early Tapping	Late Tapping	No Tapping Winter Rest	Rain	Holidays
1st Quarter	45 (63)	22 (9)	17 (16)	4 —	2 (2)
2nd ,,	38 (54)	29 (15)	— —	18 (17)	6 (5)
3rd ,,	26 (49)	27 (21)	— —	39 (22)	— —
4th ,,	35 (59)	35 (18)	— —	22 (14)	— (1)
	144 (225)	113 (63)	17 (16)	83 (53)	8 (8)

Hedigalla	Early Tapping	Late Tapping	No Tapping Winter Rest	Rain	Holidays
1st Quarter	46 (48)	7 (11)	21 (22)	14 (8)	2 (1)
2nd ,,	47 (46)	6 (13)	— —	33 (27)	5 (5)
3rd ,,	30 (36)	4 (14)	— —	58 (42)	— —
4th ,,	30 (47)	31 (9)	— —	31 (35)	— (1)
	153 (177)	48 (47)	21 (22)	136 (112)	7 (7)

Manufacture

A summary of the various forms of manufacture during the year is given below :—

Latex Grades		*Total in lb*	*Percentage*
Pale Crepe No. 1	...	270,626	66·22
,, ,, ,, 2	...	24,253	5·94
,, ,, ,, 3	...	52,394	12·82
		347,273	84·98

Scrap Grades		*Total in lb*	*Percentage*
Scrap Crepe No. 1	...	43,124	10·55
,, ,, ,, 2	...	11,372	2·78
,, ,, ,, 3	...	6,912	1·69
		61,408	15·02
Grand Total	...	408,681	100·00

The production of a high percentage of uniform crepe No. 1 is made increasingly difficult with additional acreages of experimental areas of various clones with different latices coming into production.

Miscellaneous.

Field and Factory Experiments — The Chemistry, Botany, Plant Pathology and Soils Divisions were given assistance in carrying out their field and factory experiments.

Estimates — Estimates of Capital and Revenue Expenditure for 1964 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 order throughout the year.

Manuring — Mature areas of the Group received fertilizers in accordance with the Institute's programme.

Pests and Diseases

Oidium heveae

The wintering of trees was late this year, rainfall being one of the contributing factors. The very uneven wintering was marked by the unusual defoliation confined to the upper sector of the canopy of leaves of trees. The leaves of the lower branches remained intact for some time. The late refoliating lower branches subsequently were open to a fairly severe attack of *Oidium*. Due to the numerous clones on a per acre basis planted in close proximity to each other, a protracted spell of " spot " sulphur dusting was necessitated. Regular dusting rounds were maintained in areas where possible. The foliage was reasonably good despite the unfavourable weather experienced during the refoliation.

Gloeosporium alborubrum.

The incidence of *Gloeosporium* was much in evidence this year, and was first observed in April to affect both the immature and mature rubber clearings at Hedigalla. Copper dusting was carried out in the affected areas.

Phytophthora palmivora.

This leaf disease was comparatively mild although very wet conditions were experienced during the susceptible period. A marked atrophying of leaves occurred in May and was confined to the older replantings in tapping. The susceptible clones in the immature areas were however affected, and spot dusting with copper based fungicidal dust was resorted to. Protracted dusting was necessitated at Hedigalla Division. The dusting technique employed throughout the Group proved adequate and efficient.

Bark Rot.

The incidence of Bark Rot was negligible. The use of the organo-mercurial fungicides, Antimucin and Kankerdood, proved very effective.

Root Diseases.

In the mature areas a few scattered cases of *Fomes lignosus* and *Ustulina* were found and routine measures of control were adopted. The monthly reports of this department gave the details of loss of trees due to various causes.

Wind Damage.

The loss of trees due to wind damage on Dartonfield, Nivitigalakele and Hedigalla were 84, 81 and 353 trees respectively. The damage was less severe than last year.

CAPITAL ACCOUNT — AGRICULTURAL DEVELOPMENT

Dartonfield Division — Immature Areas.

1960/61 Replanted Area	$31\frac{1}{2}$	acres

Nivitigalakele Division — Immature Areas.

1962 Replanted Area	$16\frac{3}{4}$	acres
1963 ,, ,, ...	14	,,
	$30\frac{3}{4}$	acres

Hedigalla Division — Immature Areas.

1954 Clearing	20	acres
1956 ,, ...	35	,,
1957 ,, ...	$17\frac{1}{4}$	,,
	$72\frac{1}{4}$	acres

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.

Number of trees uprooted — Immature Areas.

Nivitigalakele	1962 Replanting	1963 Replanting
Fomes lignosus ...	145	12
Other causes ...	18	—
	163	12

Hedigalla	1956 Clearing
Wind damage ...	4
Fomes noxius ...	9
Fomes lignosus ...	5
	18

1961 Replanted Area (31½ acres) at Dartonfield.

Two tapping tasks of each of the clones RRIC 7, RRIC 45, 52, 88, RRIC 89, PB 28/59, PB 86 and RRIM 513 were planted in this area. Growth is above average and the plants are coming on well. Clones RRIC 45 and RRIC 52 continue to show vigorous growth. The area was well weeded, manured and all *Fomes* patches carefully attended to.

1962 Replanted Area (16¾ acres) at Nivitigalakele.

The following clones planted at 12′ × 20′ on the old contour platforms show good growth and is above average : 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. Of the above clones RRIC 90 and RRIC 97 were observed to be susceptible to *Phytophthora palmivora*. Weeding, manuring and attention to *Fomes* were carefully carried out.

1963 Replanted Area (14 acres) at Nivitigalakele.

The planting of this area was undertaken during the South-West monsoon and was completed by June. Five plots of 300 points each of clones RRIC 59, RRIC 60, RRIC 64, RRIC 75 and PB 86 and four plots of 150 points each of clones RRIC 6, RRIC 39, RRIC 41 and RRIC 98 were planted in keeping with the requirements of the Botany Division. A further 150 points were planted with PB 86. Extra budgraftings of each of the clones were planted in trenches in their respective plots in the field to be utilised later as stumped buddings for future vacancies that may occur. Cover crops were established and are spreading well. The growth of the young plants is quite satisfactory. Routine agricultural operations were carried out with special attention given to root diseases.

1964 Replanting (10 acres) at Nivitigalakele.

Uprooting and clearing operations were undertaken. Good progress was made. Lining and holing will be undertaken in February and the area would be ready for planting in the South-West season of 1964.

Nurseries

Seedling and Budwood Nurseries — Dartonfield.

(*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*) Plants bearing over-matured budwood were lopped systematically.

Seedling and Budwood Nurseries — Nivitigalakele.

(*a*) Weeding, clearing of drains and manuring were done.

(*b*) Vigorous-growing stocks in these nurseries were budded to meet the following requirements :

Nivitigalakele Planting	334	budded	stumps
Nivitigalakele — 1963 Replanted Area ...	2,250	,,	,,
Dartonfield Planting	562	,,	,,
Outside Estates	1,071	,,	,,
	4,217	,,	,,

(*c*) 788 yards of budwood of various clones were despatched to estates and small-holdings, 373 yards for Sub-station at Kuruwita and 302 yards for Nivitigalakele budgraftings.

Labour and Health

Labour force : The regular labour force was inadequate and temporary casual labour was employed to meet requirements.

Line rooms : Line room accommodation was satisfactory. Repairs to cottages, where necessary, were carried out according to the programme.

Wages: Wages were paid during the year in accordance with the Wages Board Ordinance in force.

Dartonfield Group.

Working Ceylonese	*Resident*	*Non-Resident*	*Total*
Men	118	190	308
Women	93	131	224
Children	—	—	—
Working Immigrants.			
Men	38	—	38
Women	24	—	24
Children	—	—	—
	273	321	594

Annual Holidays — Annual holidays with pay were given to all labourers who were entitled to these in accordance with the Ordinance.

Maternity Benefits — Thirty-three full maternity benefits and four medical wants benefit payments were made.

Feeding Children and Milk Foods — Free rations and ½ 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.

Births — Six children were born during the year on the Group.

Deaths — There was one death on the Group this year.

A list of diseases treated by the Institute's Apothecary is given below :

Influenza	1,103
Ulcers	408
Ankylostomiasis ...	74
Diarrhoea and Enteritis ...	189
Ear diseases	22
Other diseases	2,795
Total ...	4,591

Rubber Replanting Subsidy Scheme Nursery At Hedigalla

Supervision

The Estate Superintendent, R.R.I.C., paid supervisory visits to this nursery during the year.

Staff.—Mr. L. Samaranayake, Assistant Nursery Manager.

Rainfall.—245·27 inches were recorded this year as against 182·94 inches in 1962. There were 305 wet days in the year.

Seedling Nursery

(*a*) The nursery acreage of 57 remained unchanged. In accordance with the decision of the Rubber Replanting Advisory Board, one third of the total nursery acreage was allowed to be fallow for one year on a three year rotation scheme. The area not planted was sown with *Crotalaria anagyroides.*

(*b*) Nineteen acres of nursery beds were prepared during the second quarter of the year to receive Tjir 1 seed from the July/August seed fall. The seed crop in 1963 permitted the planting of only 6 acres out of 19 acres. The balance acreage will be planted in 1964.

Budwood Nursery

The number of plants was increased from 4,539 to 4,689 for purposes of obtaining budwood. This increase was made up of RRIC 52 budded stumps. The nursery supplied the entire quantity of budwood required for buddings for the year.

Maintenance

The seedling and budwood nurseries were satisfactorily maintained throughout the year. Routine weeding, manuring and attention to paths and drains were carried out.

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 the year necessitating several rounds of spraying with Perenox and Colloidal Copper as recommended by the Visiting Agent.

Planting Material

The issues of planting material from this nursery by the Rubber Control Department during 1963 was as follows :

	S.W. Planting	*N.E. Planting*	*Total*
Clonal Seedling ...	16,367	27,834	44,201
Budded Stumps ...	26,285	42,813	69,098
Total ...	42,652	70,647	113,299

Estimates

An estimate for maintenance of the Nursery for 1964 was prepared and submitted to Rubber Replanting Advisory Board.

Visiting Agent

Mr. E. O. B. Lover paid regular visits to this nursery.

REVIEW OF R.R.I.C. SUB-STATION, KURUWITA

By

B. Cocking

General

The adverse weather conditions experienced during 1963 have not been helpful to us either in regard to crop or clearing work but the programme of work for the season has been completed and the final cost of production at 76·42 cts. against an estimate of 83·05 cts. per lb, may be considered satisfactory.

Staff

Our permanent S. F. A., Mr. H. B. H. de Silva, has been under interdiction since February 1963 and Mr. M. C. Perera has been temporary S. F. A. for most of this year. Mr. G. D. A. Weerasooriya continues to be responsible for manufacture and tapping and I am pleased to commend this officer's good work during the years he has been with us.

Mr. W. B. Jonklaas paid his usual visits during the year and we are most grateful for his encouragement and useful advice.

Acreage

	A.	*R.*	*P.*
Mature Polyclonal Rubber	40	1	23
Old Seedling Rubber	18	2	27
Replanted, 1961	83	3	20
,, 1962	38	8	00
,, 1963	22	1	37
Uprooted for replanting in 1964 ...	17	2	09
Nurseries	2	1	24
Roads, Deniyas, Forests and Buildings ...	23	2	10
Total ...	247	2	30

We now have only 59 acres in tapping and our estimated crop for 1964 is correspondingly reduced and dependent for achievement on the application of yield stimulants.

There has been no further agitation from the villagers for the cutting of a public road through the 1962 clearing.

Weather

Comparative Rainfall Figures for 1962 and 1963

	1962	1963
January ...	6·14	6·14
February ...	4·04	9·87
March ...	8·78	10·34
April ...	15·29	20·95
May ...	29·16	17·90
June ...	9·20	21·94
July ...	9·15	23·24
August ...	14·90	18·71
September ...	18·93	24·94
October ...	23·03	25·99
November ...	17·00	17·03
December ...	5·29	8·45
Total ...	160·91	205·50

Weather conditions during the latter half of the year have been unusually wet and rainfall exceeded that of the previous season by 44·59 inches. These conditions have not been conducive to good crops over a period which normally yields our best harvests. The incidence of *Fomes* has also been more pronounced especially in low-lying areas.

Crop	1962	1963
Estimated ...	50,000 lb	50,000 lb
Harvested ...	54,544 lb	48,360 lb

A shortfall of 1,640 lb on the estimated crop for the year is perhaps excusable in the light of the weather conditions experienced during the latter half of the year.

Tapping	1962	1963
Estimated cost ...	35·14	30·00
Actual cost ...	27·11	28·17

Tapping costs are again below estimate and the standard of tapping is good with a regular outturn to work.

Manufacture

Throughout the year our latex crop has been manufactured into smoked sheet and our sales average, inclusive of manufactured scrap, is 86 cts. per lb. The slow process involved by the use of hand rollers enhances our curing costs but the saving in fuel for power is a compensating factor.

Curing cost estimated	—	5·99 cts. per lb
,, ,, spent	—	7·33 ,, ,, ,,
Fuel for power estimated	—	8·65 ,, ,, ,,
,, ,, ,, spent	—	3·57 ,, ,, ,,

Weeding

Two rounds of 'cheddy' weeding were completed in mature areas during the year.

Buildings

No new constructions were undertaken and only routine maintenance has been carried out during the year. The rest-room has been comfortably furnished in order that the Senior Staff shall have facilities for relaxation when visiting the Sub-station from Dartonfield. All cottages and store rooms have been white-washed and roofs tarred during December.

Labour

The labour force has worked quite well during the year and there has only been some slight factional unrest. Most of the workers have resigned their membership of the D.W.C. and have joined the S.L.F.P. Union.

Labour statement as at 31st December, 1963.

Working men	13
,, women	10
,, children	1
Non-working adults	3
,, children	37
Total	64

Clearings

Replanting 1961, 83A. 3R. 20P.

Apart from the incidence of *Fomes* in low-lying areas this clearing continues to make good progress.

Replanting 1962, 38A. 3R. 00P.

This clearing varies in growth but this may be expected in a field containing 23 plots of different experimental clones. The heavy rains experienced in the latter half of the year have made weeding in this clearing rather a problem.

Replanting 1963, 22½ A.

This clearing was planted in the period May/June 1963 and is growing well. *Pueraria* cover crops are now well established.

Replanting 1964, Preparatory Work.

Felling and clearing in the 8-acre polyclonal section now nears completion and holing has been completed in both blocks. This clearing should be ready for planting in April, 1964. Weeds are being destroyed by the spraying of sodium arsenite.

Roads

Field roads and the main cart road have been well maintained during the year. Unfortunately, we are still dependent on outside transport and a suitable vehicle for general purposes is an urgent requirement here. The problem is further aggravated by the lack of a telephone.

Summary of Costs

Revenue expenditure estimated Rs. 41,526·00 being 83·05 cents per lb
Revenue expenditure spent Rs. 36,957·71 being 76·42 cents per lb

PRINTED AT THE CAXTON PRINTING WORKS LTD., COLOMBO 12.