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ANNUAL REPORT

OF THE

COCONUT RESEARCH INSTITUTE

FOR

1959

PUBLISHED BY
THE COCONUT RESEARCH INSTITUTE OF CEYLON

3633—A

LABORATORY AND ADMINISTRATION BLOCK OF THE COCONUT RESEARCH INSTITUTE

ANNUAL REPORT 1959

No. 3/4 JULY/DECEMBER

NOTE BY DIRECTOR

It has been the practice to submit the Annual Report and accounts to the Hon. Minister of Agriculture, Lands, Irrigation and Power, in terms of Section 8 of the Coconut Research Ordinance, No. 29, 1928.

In view of the fact that the Report of the Auditor General is invariably delayed, even beyond the end of the year subsequent to the period reported, the publication of the Annual Report, as a Sessional Paper as has been the practice so far, is unduly delayed.

It has therefore, been decided at the 183rd Meeting of the Coconut Research Board that the Report, consisting of the reports of the Chairman, Coconut Research Board; Director, Coconut Research Institute and of Research Officers, Chief Advisory Officer, Planting Officer and the Superintendents of the Institute's estates, should be immediately published as a number of the Ceylon Coconut Quarterly.

M.L.M. SALGADO,
Director, Coconut Research Institute
and
Editor, Ceylon Coconut Quarterly.

1st November, 1960.

ANNUAL REPORT OF THE COCONUT RESEARCH INSTITUTE FOR 1959

The present report is the 31st Annual Report of the Coconut Research Institute which was established by Ordinance No. 29 of 1928 dated December, 1928.

REPORT OF THE CHAIRMAN

On January 1st 1959 the Coconut Research Board consisted of the following:—

Ex-officio Members:

Chairman—The Director of Agriculture: Dr. M.F. Chandraratne, Ph.D., B.Sc. (Lond.), D.I.C., *M.B.E.*

Treasury Representative: Mr. E.B. Wiratunge.

Coconut Rehabilitation Commissioner : Mr. B. Mahadeva, *C.C.S.*

Chairman, L.C.P.A. : Mr. C.S. Samaraweera.

Director, C.R.I.: Dr. M.L.M. Salgado, Ph.D. (Cantab.), B.Sc. (Lond.) Dip.Agric. (Cantab.).

Nominated Members

Nominated by the Honourable Minister from Senators and Members of Parliament:

Mr. J.C.W. Munasinghe, M.P., and Parliamentary Secretary to the Minister of Industries and Fisheries, Mr. W.I. Hugh Fernando, M.P.

Nominated by the Planters' Association of Ceylon: Mr. C.T. Van Geyzel, *J.P.*, and (Vacant).

Nominated by the L.C.P.A.: Mr. C.A.M. de Silva and Senator Thomas Amarasuriya.

Nominated by the Honourable Minister to represent the Small-Holders: Mr. E. Muttukumaru. *J.P.* and Mrs. L.J. de S. Seneviratne.

Mr. M.M. Kumarakulasingham was nominated by the Honourable Minister of Agriculture & Lands to represent the Small-Holders with effect from 7th January, 1959 in place of Mr. E. Muttukumaru.

Mr. C.S. Samaraweera was re-elected Chairman of the L.C.P.A.

Mr. E. Muttukumaru was nominated to represent the Planters' Association of Ceylon with effect from 17th February, 1959.

Mr. W.I. Hugh Fernando, M.P., Parliamentary Secretary to the Honourable Minister of Agriculture & Lands was re-nominated for a further term of 3 years with effect from 15th May, 1959.

Mr. J.C.W. Munasinghe, M.P., ceased to be a member of the Coconut Research Board and was succeeded by Mr. M.M. Mustapha, M.P. with effect from 30th May, 1959.

Mrs. L.J. de S. Seneviratne was granted 3 months leave of absence from Board Meetings.

Messrs. W.I. Hugh Fernando, M.P. and M.M. Mustapha, M.P., ceased to be members of the Coconut Research Board with the dissolution of Parliament on 5th December, 1959.

Meetings.—Seven Meetings of the Coconut Research Board were held during the year—on 12th January, 31st March, 27th April, 6th June, 1st August, 12th August and 17th October.

Committees

Administration Committee (Personnel at 1st January, 1959):

(1) Dr. M.F. Chandraratne, Chairman.
(2) Mr. E.B. Wiratunge.
(3) Mr. W.I. Hugh Fernando, M.P.
(4) Mr. C.A.M. de Silva.
(5) Senator Thomas Amarasuriya, *O.B.E.*
(6) Mr. C.S. Samaraweera.
(7) Mr. B. Mahadeva.
(8) Dr. M.L.M. Salgado, Director, C.R.I.

The 25th, 26th, 27th and 28th Committee Meetings of the Administration Committee were held on 2nd March, 10th June, 25th August and 3rd October respectively.

Extension Committee (Personnel at 1st January, 1959):

(1) Mr. C.T. Van Geyzel, *J.P.*
(2) Mr. C.A.M. de Silva.
(3) Mr. B. Mahadeva.
(4) Mr. W.I. Hugh Fernando, M.P.
(5) Mr. E. Muttukumaru.
(6) Mrs. L.J. de S. Seneviratne.
(7) Dr. M.L.M. Salgado, Director, C.R.I.

The 22nd and 23rd Meetings of the Extension Committee were held on 21st September and 24th October respectively.

Research Committee (Personnel at 1st January, 1959):

(1) Mr. M.M. Kumarakulasingham.
(2) Dr. M.F. Chandraratne.
(3) Mr. C.T. Van Geyzel, *J.P.*
(4) Mr. E. Muttukumaru.
(5) Mr. J.C.W. Munasinghe, M.P.
(6) Senator Thomas Amarasuriya, *O.B.E.*
(7) Dr. M.L.M. Salgado, Director, C.R.I.

The 30th and 31st Meetings of the Research Committee were held on 16th April, 29th May and 29th September respectively.

Buildings Sub-Committee (Personnel at 1st January, 1959):

(1) Mr. B. Mahadeva.
(2) Senator Thomas Amarasuriya, *O.B.E.*
(3) Mr. C.S. Samaraweera.
(4) Dr. M.L.M. Salgado, Director, C.R.I.

A Meeting of the Chairman and Directors of the three Research Institutes was held on 11th July, 1959.

A.V. RICHARDS,
Chairman, Coconut Research Board.

REPORT OF THE DIRECTOR

1. STAFF

The Staff of the Coconut Research Institute at the end of 1959 was as follows:

Administration Division

Director — Dr. M.L.M. Salgado, Ph.D. (Cantab.), B.Sc. (Lond.), Dip.Agric. (Cantab.).
Chief Administrative Officer and Secretary to the Board — Mr. S.C. Kahawita, B.Com. (Lond.).
Assistant Secretary — Mr. T.T.A.J.C. Samarasinghe, LL.B. (Ceylon).

Botany Division

Botanist — Dr. D.V. Liyanage, Ph.D. (Manch.), B.Sc. (Lond.).
Research Assistant — Vacant.

Chemistry Division

Chemist — Mr. W.R.N. Nathanael, M.Sc. (Lond.), A.R.I.C.
Research Assistant — Mr. T.S. Balakrishnamurthie, B.Sc. (Lond.).

Soil Chemistry Division

Acting Soil Chemist — Dr. D.A. Nethsinghe, D.Phil. (Oxon.), B.Sc. (Ccy.), A.R.I.C. (Lond.).
Research Assistant — Vacant.

Agrostology Division

Acting Agrostologist — Mr. K. Santhirasegaram, B.Sc. (Ceylon).
Research Assistant — Miss. N. Ramalingam, B.Sc. (Ceylon).

Planting Division

Planting Officer — Mr. P.D.L. Fernando.
Assistant Planting Officer — Mr. C.W.S. de Silva.

Advisory Division

Chief Advisory Officer — Mr. C.A. Wickremasuriya, B.Sc. (Ceylon).

Crop Protection

Crop Protection Officer — Mr. Hilary F. Goonewardena, B.Sc. (Sydney), B.Agric.Sc. (N.Z.): on overseas study leave.
Officer-in-Charge — Mr. J.K.F. Kirthisinghe.

Biometry

Biometrician — Mr. V. Abeywardena.
Research (Assistant) Statistics — Mr. J.K.T. Fernando, B.Sc. (Ceylon).

Dr. D.V. Liyanage, B.Sc. (Lond.), Ph.D. (Manch.), Botanist was away six weeks from March 16th, 1959 on a U.S.O.M. Scholarship visiting Philippines, Indonesia and Thailand.

Appointments

The following have been appointed to the Staff during the course of the year —

Senior Staff — Nil.
Intermediate Staff — Mr. J.K.T. Fernando, B.Sc. (Hons.) (Ceylon), as Research Assistant (Statistics).
Assistant Staff Grade I — Nil.
Assistant Staff Grade II — 4 Technical Assistants, 6 Coconut Instructors, 4 Clerk-Typists and 1 Field Assistant.
Minor Staff — 7 Nursery Attendants, 12 Lab. and Field Attendants, 1 Office Attendant and 1 Power House Attendant.

Promotions

The following were promoted during the course of the year —

Senior Staff — Nil.
Intermediate Staff — Dr. D.A. Nethsinghe, B.Sc. (Ceylon), D.Phil. (Oxon.), A.R.I.C., Research Assistant to Soil Chemist as Acting Soil Chemist with effect from 19-1-59.
Mr. C.A. Wickremasuriya, B.Sc. (Ceylon), Understudy to Chief Advisory Officer as Chief Advisory Officer with effect from 14-12-59.
Assistant Staff Grade I — Nil.
Assistant Staff Grade II — Mr. W.V. Fernando, Advisory Field Officer to Assistant Staff Grade I as District Coconut Instructor under the Citronella Subsidy Scheme, with effect from 15-12-1959.
Minor Staff — Mr. F.B. Perera, Field Attendant to the Soil Chemist was promoted to the Selection Grade.

Resignations

The following left the services of the Institute during the course of the year —

Senior Staff — Muh. Edwin A. Peiris, Chief Advisory Officer, since 14th December, 1957, left the services of the Institute on 14th December, 1959 after the completion of his contract.
Intermediate Staff — Mr. J.C.L. de Mel, B.A. (Cantab.), Research Assistant in Agricultural Economics.
Assistant Staff Grade I — Nil.
Assistant Staff Grade II — 2 Technical Assistants and 1 Field Assistant.
Minor Staff — 7 Members of the Minor Staff.

2. MEETINGS

The Director attended the following meetings, besides the meetings of the Coconut Research Board and its Committees — The Research Committee, the Administrative Committee and the Extension Committee:—

(i) Committee of Chairmen and Directors of Tea, Rubber and Coconut Research Institutes.
(ii) Department of Census and Statistics: Agricultural Census.
(iii) Conference at the National Planning Council with the Delegates of the International Atomic Energy Commission (with Soil Chemist).
(iv) Permanent Secretary to Minister of Agriculture and Lands and the Chairman regarding control of the Coconut Caterpillar Infestation at Ganewatte.

(v) Meeting of Heads of Departments convened by Hon. Minister of Agriculture and Lands at Moneragala.

(vi) Meeting of the Planning Committee of the Hon. Minister of Agriculture and Food.

(vii) Land Commissioner's Department on the Supply of Planting Material (with Planting Officer).

(viii) Symposium on Pasture organised by the Faculty of Agriculture, Peradeniya (with Acting Agrostologist).

(ix) FAO Fertilizer Pool (at Ministry of Commerce).

3. CONFERENCES

Conferences were held to discuss the following subjects:

(*a*) A Research Conference and Field Day at Vanatavillu, where 2,000 acres of virgin jungle had been alienated to middle class allottees for planting with coconuts. Various aspects of the geology, soils, agro-climatology and systems of catch cropping were discussed.

Dr. C.R. Panabokke of the Dry Farming Research Station, Maha Illuppalama and Mr. D.B. Pattiarachchi of the Department of Mineralogy addressed the Conference and participated in the discussions and in the field tour of the area.

(*b*) Dr. H.H. Smith of the International Atomic Energy Commission delivered an Illustrated Lecture and participated in a discussion on a Radio Isotopes.

(*c*) 'Radio Active Isotopes in Agricultural Research' discussion led by Dr. D.A. Nethsinghe.

(*d*) Pasture and Animal Husbandry with reference to Coconut Cultivation in which Prof. C.M. Donald participated in the discussion.

(*e*) Acquisition of land in Puttalam and Kurunegala Districts for Sub-Stations.

(*f*) 'Survey of Livestock under Coconuts' — which was attended by Dr. Louis Moss of the United Nations Economic and Social Council who was attached to the Department of Census and Statistics.

(*g*) Development of Pottukulama Sub-Station.

(*h*) Study Leave for Technical Assistants.

(*i*) Conference of Advisory Field Officers were held in April and December.

(*j*) A Technical Conference attended by Coconut Planters was held on 18th December at the Chamber of Commerce, Colombo, presided over by Mr. M.M. Kumarakulasingham, Chairman, Research Committee at which the following papers were read:

(i) Investigations on Manurial and Cultivation Problems of the Coconut Palm by Dr. D.A. Nethsinghe, Soil Chemist.

(ii) Some Aspects of Copra Deterioration by Mr. W.R.N. Nathanael, Chemist.

(iii) Seed Production in Coconuts by Dr. D.V. Liyanage, Botanist.

(iv) Some Problems of Pasture Production on Coconut Estates by Mr. K. Santhiresagaram, Acting Agrostologist.

(v) First Steps in Crop Protection in Coconut Cultivation by Mr. J.K.F. Kirthisinghe, Officer-in-Charge, Crop Protection Division.

(vi) A discussion on the Control of Coconut Caterpillar, was led by Dr. V.P. Rao, Entomologist in-Charge, Commonwealth Institute of Biological Control, Indian Station, Bangalore.

4. FAO CONFERENCE

The FAO Conference on Copra Quality and Grading held in Colombo was attended by the Director, Chemist, and Botanist.

The Chemist read a paper on 'Moisture and other Quality Factors of Copra'.

5. VISITORS

The Visitors during the year included the following —

Dr. H.H. Smith of the International Atomic Energy Commission.
Prof. C.M. Donald of the Waite Research Institute, Adelaide.
Dr. F.J. Simmonds, Director, Commonwealth Institute of Biological Control, Ottawa, Canada.
Dr. V.P. Rao, Entomologist, in Charge, Indian Station of the Commonwealth Institute of Biological Control, Bangalore.
Dr. A. Ringoet, Plant Physiologist of INEAC, Belgian Congo.
Dr. Tanada, who visited to advise the Soil Chemist regarding work on Radio Isotopes.
Mr. E.A. Rosenquist, Agronomist, Chemara Research Station, Malaya.
Mr. T.A. Jones, Coconut Industry Board, Jamaica, spent a week at the Institute.
Dr. Ajit Singh Sidhu, Agronomist, Department of Agriculture, Malaya.
H.R.H. Prince Tungi of Tonga.
Mr. D. Rhind of the Colonial Office, U.K.
The Chinese Delegation to Ceylon.
Delegation of Soviet Scientists.
FAO Fertilizer Team.
Delegates to the FAO Conference on Copra Quality and Grading.
Mr. W.V.D. Peiris, FAO, Regional Agricultural Officer (Coconut Improvement). FAO Expanded Technical Assistance Programme.
Mr. L. Gouin of the Potascheme (India).
Mr. Pierre Gascon, Geneticist, IRHO, Paris.
Mr. Gomes Pedro from Portuguese East Africa spent two weeks at the Institute.

6. TRAINEES

Mr. L.C. Zuniga, Bureau of Plant Industry, Philippines spent three months at the Institute on a Scholarship sponsored by the U.S.O.M.

7. STUDY LEAVE FOR AND TRAINING OF TECHNICAL ASSISTANTS

Three Technical Assistants — Messrs. M.A.P. Manthriratne (Botanist's Division), M.A.T. de Silva and D.G. Nedimale (Soil Chemist's Division) passed the Part I of the London B.Sc. Examination.

A Scheme of Study Leave for Technical Assistants to complete the B.Sc. (London) Part II was approved by the Board.

Mr. Camillus Silva, Senior Technical Assistant, Soil Survey Unit went through a course of training in Aerial Photo Interpretation in the Survey General's Department.

8. RECRUITMENT OF RESEARCH ASSISTANTS

The two vacant posts of Research Assistant of the Botanist's and Soil Chemist's Division which were advertised could not be filled as there were no applicants with the minimum qualifications.

9. PUBLICATIONS

(i) Contribution to 1958. Annual Reports of the Planters' Association of Ceylon and the Low Country Products' Association:

'Coconuts' and 'Summary of Work carried out by the Coconut Research Institute in 1958' by Director.

(ii) Contribution to the Times of Ceylon Annual Industrial and Agricultural Supplement:

'Some recent developments in Coconut Research' by Director.

(iii) 'Heritabilities of certain yield characteristics of the Coconut Palm' by Dr. D.V. Liyanage and Dr. K.I. Sakai, was submitted for publication in the Journal of Genetics.

(iv) 'Moisture and other Quality Factors of Copra' by Mr. W.R.N. Nathanael, Chemist (read at the FAO Conference on Copra Quality and Grading).

(v) 'Coconut Caterpillar': Leaflet No. 34.

10. VISITS

The Director's visits to coconut estates included the following:—

(i) A circuit in the Southern Province in January with the Advisory Field Officer inspecting estates affected by yellowing of crowns in the Gonapinuwala-Baddegama Area, and inspection of the Koggala Nursery.

(ii) Pothukulama Sub-Station in connection with the Soil Survey.

(iii) Inspection of palms affected by an unknown disease causing death of palms in Ampegama and Gonapinuwala in the Southern Province (with Officer-in-Charge, Crop Protection Division).

(iv) Inspection of estates suitable for acquisition for the proposed Puttalam and Kurunegala Sub-Stations (with Heads of Research Divisions).

(v) Inspection of estates affected by Coconut Caterpillar in the Kurunegala District and of the Field Laboratory at Nikadalupotha (two circuits with Officer-in-Charge, Crop Protection Division).

(vi) Inspection of Vanathavillu Middle Class Scheme (with A.F.O., Puttalam Range).

(vii) Inspection of yellowing palms in the Southern Province (with Soil Chemist).

11. NOTES ON REPORTS OF DIVISIONS

The following notes draw attention to points of interest relating to the detailed reports of the technical and extension work of the Institute.

Soil Chemistry

With the return of Dr. D.A. Nethsinghe from overseas study leave and his appointment as Acting Soil Chemist, new lines of work were approved.

With the high prices fetched by copra, and the financial assistance rendered by the Government Manure Subsidy Scheme, there was a demand for information on the economic response to higher rates of application of manures. To meet this requirement a new experiment where manures are applied at four levels was laid down on the new land acquired at Bandirippuwa.

A similar experiment on young palms has been projected at the new Sub-Station at Pothukulama where jungle clearing was commenced in the course of the year.

In view of the high cost of application in the traditional method of circular trench manuring, a new manurial experiment on placement of manure has been laid down at Walahapitiya Estate, Nattandiya with the co-operation of Messrs. Noorani Estates, Limited.

Through the kind co-operation of Dr. Yates, Head of the Statistical Department of Rothamstead Experiment Station, arrangements have been made for a complete analysis of the 24 year data of the 3 × 3 × 3 NPK manurial experiment at Bandirippuwa.

Pronounced yellowing of crowns on estates regularly manured with NPK Mixtures have been observed in estates on laterite soils of the Piliyandala-Aturugiriya-Meegoda area of the Western Province. Similar symptoms were observed in estates of the Gonapinuwala-Batapola area in the Southern Province. Magnesium deficiency is suspected and simple trials with dolomite and magnesium sulphate have been laid down.

The Board also approved the purchase of necessary equipment for work on experiments with Radio Isotope P 32.

Chemistry

The Chemist has continued his fundamental work in studies on the technique of foliar diagnosis of nutrient deficiencies of the coconut palm.

Chemical analysis of the macro-nutrients of the Coconut Apical Bud were carried out. The data have shown that even in the early phases of development of the bud there are centres of accumulation of particular nutrients.

The main work of interest has been the Pot Culture experiment using a technique developed by the Chemist where seedlings are grown in sand using a subtractive intermittent flowing technique.

The oil content of copra from 15 varieties of coconut were determined and it was found that Dwarf Green, Gon Thembili, Bodiri, Nawasi, and Pora Pol have given somewhat higher figures than the commercial tall palm for oil content.

In studies on the change in the coconut endosperm during development, it was found that the oil contents increase with the ripening of the fruit (from 16 to 68 per cent).

Other work include studies of the changes in the coconut endosperm during germination and a study of oil and moisture gradients in the coconut endosperm. It was observed that the section least rich in oil (56·3 per cent) is on the inside nearest the water cavity and richest in oil (75·4 per cent) nearest the testa.

Botany

The work on Hybridisation between Varieties and Forms have been continued. The first generation palms of the tall × dwarf crosses have produced a yield equivalent of 103 nuts equivalent to 49 lbs. copra per palm in the 9th year — an extremely satisfactory performance with considerable potentialities for the coconut industry of the future.

To study the performance of these hybrids in different coconut districts of Ceylon, 70 plants each were issued to planters in 1957 and 1958 and their growth was observed to be satisfactory.

Pollination work has been continued and a pollen bank developed. Estates were assisted by training personnel for pollination work.

A progeny trial was planted at Bandirippuwa to identify prepotent palms.

The progeny trial at Government Farm, Walpita which had been abandoned was handed back to the Institute.

Agrostology

Besides the pot experiments for the purpose of soil fertility studies, the main development during the year has been the premanurial recording of the pasture × manurial experiment at Bandirippuwa Estate to study the effect of the two varieties of pasture (Brachiaria brizantha and Brachiaria miliformis) and their manuring on the yield of the coconut palms. The grasses were planted and manures applied in April 1959.

Crop Protection

The significant development during the course of the year was the outbreak of Coconut Caterpillar in the Ganewatte area and in other parts of the Kurunegala District. A crop protection campaign, with the co-operation of the Entomologist of the Department of Agriculture was organised and the pest brought under control.

A Field Laboratory for the breeding of the parasite *Trichospilus pupivora* was established on an estate at Nikadalupotha.

Following the visit of Dr. F.J. Simmonds, Director, Commonwealth Institute of Biological Control, a project for the introduction of exotic parasites for the control of Coconut Caterpillar and Coconut Scale was approved by the Board.

With the extension of areas under young plantations, both replanted and new clearings, Red Weevil appears to be the main insect pest capable of causing serious damage. A simple technique using Systox, a systemic insecticide, injected to the stem has been successfully worked out by the Crop Protection Division.

Biometry

Besides assisting in the statistical work of the Research Divisions, the Biometrician has continued the preliminary work on Agri-meteorological studies, with particular reference to effect of climate on coconut crops.

Soil Survey

The Soil Survey Unit carried out a detailed Survey of Pothukulama jungle.

Reconnaissance surveys of the Negombo area north of Ma-Oya and of the Chilaw District have been carried out and a provisional Soil Map of the latter area has been prepared.

Advisory

The main development during the year has been the inauguration of a Scheme for the planting of 24,000 acres of Citronella Lands in the Southern Province with Coconuts under a Government Subsidy Scheme. The Advisory Division was placed in charge of the implementation of this Scheme.

Nurseries

1,984,675 seednuts were planted in 14 nurseries during the year.

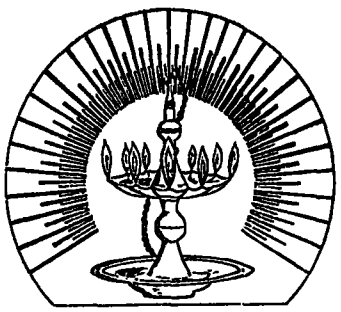
Under the Citronella Subsidy Scheme, a new nursery was opened at Mapalana and 175,000 seednuts planted.

The demand for seedlings exceeded the available supply and orders for 1,296,768 seedlings were accepted during the year.

M.L.M. SALGADO,
Director.

REPORT OF THE SOIL CHEMIST

FIELD EXPERIMENTS



During the course of the year 1959, there were 5 major field experiments and 2 simple observation trials on yellowing palms in progress. The observation trials at Bandirippuwa on inorganic Vs organic fertilizers were discontinued in early 1959. Premanurial records were maintained on the new responsecurve experiment which is to be laid down at Bandirippuwa. Premanurial recording was also commenced on a new field experiment to be laid down at Walahapitiya Estate, Nattandiya, on methods of fertilizer placement. At the new sub-station in Pottukulama, jungle clearing was commenced for the proposed response curve experiment on young palms.

1. 3 × 3 × 3 N.P.K. Experiment (Bandirippuwa Estate)

The 24th year of this experiment was completed in November 1959. The yield data for the main effects for 1959 are given below in Table I (*a*).

TABLE I (a)

Treatment	*Lb. copra per acre*	*Calculated as %*	*Difference lb. copra/ acre*	*Copra out-turn nuts/ candy*	*Difference in nuts/candy*
N_0	1,409	100	—	1,347	—
N_1	1,433	102	+24	1,384	+37
N_2	1,348	96	-61	1,426	+79
P_0	1,369	100	—	1,347	—
P_1	1,431	105	+62	1,385	+38
P_2	1,390	102	+21	1,422	+75
K_0 (now K_1)	1,199	100	—	1,442	—
K_1 (now K_2)	1,453	121	+254	1,370	-72
K_2 (now K_3)	1,538	128	+339	1,355	-87

Significant difference P·05 = 77·4 lb./acre.

Nitrogen and phosphoric acid have continued to show no significant effects, while potash at both levels have again shown a marked response. None of the interactions NP, NK, or PK showed any significance.

The mean yield in 1959 (lbs. copra/acre) for the various treatment combinations are given in the two-way tables below (Table I (*b*)) :—

TABLE I (b)

	N_0	N_1	N_2	*K — Total*
K_1	1,270	1,209	1,118	1,199
K_2	1,489	1,498	1,373	1,453
K_3	1,468	1,592	1,554	1,538
N — Total ..	1,409	1,433	1,348	1,397

	P_0	P_1	P_2	*K — Total*
K_1	1,167	1,231	1,199	1,199
K_2	1,470	1,449	1,441	1,453
K_3	1,472	1,613	1,529	1,538
P — Total ..	1,369	1,431	1,390	1,397

	P_0	P_1	P_2	*N — Total*
N_0	1,345	1,494	1,388	1,409
N_1	1,432	1,414	1,453	1,433
N_2	1,332	1,385	1,328	1,348
P — Total ..	1,409	1,433	1,348	1,397

2. Manurial × Cultivation Experiment (Ratmalagara Estate)

This factorial experiment compares the effect of potash, phosphoric acid, and ploughing on adult palms. It includes all combinations of the following treatments and is of the 3 × 2 × 2 type consisting of 6 blocks of 6 plots each.

K_0 = no potash
K_1 = 1 lb. K_2O/palm
K_2 = 2 lb. K_2O/palm

P_0 = no phosphate
P_1 = 1 lb. phosphoric acid

C_0 = no cultivation
C = Ploughing once in 2 years at the time of manuring

All plots are given a basic application of 3 lb. Sulphate of Ammonia per palm.

The 16th year of this experiment and its 9th biennial manuring was concluded in June 1959.

The yield data for the main effects for the year 1958-1959 are given below in Table II (*a*).

TABLE II (a)

Treatment	*Lb. copra/ acre*	*Calculated as percentage*	*Difference lb. copra/ acre*	*Copra out-turn nuts/ candy*	*Difference in nuts candy*
P_0	1,012	100	—	—	—
P	1,850	183	+838	1,219	+74
C_0	1,307	100	—	1,210	—
C	1,555	119	+248	1,178	−32
Significant difference P·05 = 156 lb. copra/acre.					
K_0	1,350	100	—	1,220	+ 7
K_1	1,407	104	+ 57	1,203	−17
K_2	1,537	114	+187	1,159	−61
Significant difference P·05 = 192 lb. per acre.					

The high response to phosphate has been maintained and the increase of 838 lb. copra per acre has been the highest recorded for this experiment.

Ploughing has produced a significant response for the second year in succession, although from the 4th to the 14th year of the experiment no response had been obtained. It is possible that the lack of response to ploughing in the previous years was due to the fact that the entire experimental area was disc-harrowed thrice or four times a year to control weeds. Since 1956 this practice was stopped, and weed control done by slashing only. It appears therefore that where regular harrowing is carried out to control weeds, further cultivation by ploughing may be superfluous.

3. 3 × 3 × 3 N.P.K. Manurial Experiment on Young Palms — (Ratmalagara Research Station)

This experiment compares the effect of applying nitrogen, phosphoric acid and potash to young palms at three different levels in all combinations. It consists of 6 blocks of 9 plots each, and is of factorial design where the higher order interactions are confounded with that of blocks. The 11th year of the experiment was completed in 1959, and the annual manuring carried out in November. The rates of fertiliser application, which were the same as in the previous year, are as follows:—

N_0 = no nitrogen
N_1 = 1½ lb. Sulphate of Ammonia/palm } ×
N_2 = 3 lb. Sulphate of Ammonia/palm

P_0 = no phosphoric acid
P_1 = 1½ lb. Saphos phosphate/palm } ×
P_2 = 3 lb. Saphos phosphate/palm

K_0 = no potash
K_1 = 1½ lb. Muriate of Potash (60%)/palm
K_2 = 3 lb. Muriate of Potash per palm.

(*a*) *Palms in flower:* At the end of the 11th year of this experiment (December 1959), 918 palms were in flower, out of a total of 972 experimental palms. The distribution of the palms in flower according to the main treatment effects are shown in Table III (*a*) below:—

TABLE III (a)

	Palms in flower	%	*% of Total*
N_0 ..	313	100	97
N_1 ..	309	99	95
N_2 ..	296	95	91
P_0 ..	289	100	89
P_1 ..	312	108	96
P_2 ..	317	110	98
K_0 ..	297	100	92
K_1 ..	306	103	94
K_2 ..	315	106	97

(*b*) The yield data in lb. copra per acre for the main effects is given in Table III (*b*).

TABLE III (b)

Treatment	*lb. copra/acre (55 palms per acre)*	*Calculated as percentage*	*Difference in lb. copra per acre*	*Copra out-turn nuts/candy*	*Difference in nuts/candy*
N_0	950	100	—	1,214	—
N_1	1,091	115	+141	1,202	−12
N_2	1,000	105	+ 50	1,243	+29
P_0	655	100	—	1,190	—
P_1	1,204	184	+549	1,211	+21
P_2	1,182	180	+527	1,244	+54
K_0	895	100	—	1,254	—
K_1	979	109	+ 84	1,219	−35
K_2	1,167	130	+272	1,193	−61

Significant difference P·05 — 82·5 lb. copra/acre

Phosphoric acid has produced a marked effect on yield at the lower level (P_1), which however is not further increased at the higher level. Potash produces a significant difference in yield at the lower level, which however is markedly increased at the higher level.

The mean yields for 1959 (lb. copra/acre) for the various treatment combinations are given in the 2-way tables below:—

TABLE III (c)

Treatment	N_0	N_1	N_2	*K — Total*
K_0	808	1,036	842	895
K_1	895	1,061	983	979
K_2	1,149	1,176	1,176	1,167
N — Total	950	1,091	1,000	1,014

	P_0	P_1	P_2	*K — Total*
K_0	600	993	1,092	895
K_1	578	1,172	1,189	979
K_2	788	1,448	1,266	1,167
P — Total	655	1,204	1,182	1,014

	P_0	P_1	P_2	*N — Total*
N_0	737	1,130	985	950
N_1	678	1,313	1,282	1,091
N_2	551	1,170	1,280	1,000
P — Total	655	1,204	1,182	1,014

4. Manurial Experiment on Methods of Application (Marandawila Group, Bingiriya).

This experiment compares the effect of broadcasting and ploughing in of fertilisers with that of circular trench manuring. It consists of 3 blocks of 9 plots each and is of an unreplicated 3 × 3 × 3 factorial design comparing all combinations of N.P. and K. applied in the following ways:—

N_O = No nitrogen
N_C = Nitrogen applied in circular trenches (3 lb. Sulphate of Ammonia/palm)
N_B = Nitrogen broadcast and ploughed (3 lb. Sulphate of Ammonia per palm)
} ×

P_O = No Phosphoric acid
P_C = Phosphoric acid applied in circular trenches (2 lb. Saphos Phosphate per palm)
P_B = Phosphoric acid broadcast and ploughed (2 lb. Saphos Phosphate per palm)
} ×

K_O = No Potash
K_C = Potash applied in circular trenches (2 lb. Muriate of Potash per palm)
K_B = Potash broadcast and ploughed (2 lb. Muriate of Potash per palm)

The 10th year of this experiment was completed in June 1959. The biennial manuring was carried out in June 1959. The yield data for the 10th year is given in Table IV (a) and it is seen that even after the 10th year of this experiment there is no significant difference shown between the two methods of application, although there is a response to nitrogen, phosphoric acid and potash.

TABLE IV (a)

(Yields adjusted by covariance analysis)

Treatment	*lb. copra/ acre*	*Calculated as percentage*	*Difference in lb. copra/acre*
N_O	1,653	100	—
N	1,855	112	+205
N_C	1,935	118	+282
P_O	1,575	100	—
P_B	1,893	120	+318
P_C	1,898	120	+323
K_O	1,633	100	—
K_B	1,857	114	+224
K_C	1,913	117	+280

Significant difference P·05 = 188 lb. copra/acre.

5. Manurial Experiment on Organics vs. Inorganics (Marandawila Group) Bingiriya.

This experiment comparing the effects of annual and biennial application of inorganic and organic manures on adult palms was commenced in June 1958. The experiment is of randomised block design, consisting of 6 blocks of 6 plots each. The treatments are as follows:—(*a*) Control (*b*) Inorganic mixture applied annually, (*c*) Inorganic mixture applied biennially, (*d*) Organic mixture applied annually, (*e*) organic mixture applied biennially, and (*f*) Cattle manuring and supplements applied biennially.

The inorganic mixture consists of equal parts by weight of sulphate of ammonia, saphos phosphate, and muriate of potash (50 per cent). The rate of application is 5 lb. per palm annually, and 10 lb. biennially.

The organic mixture is composed of fish guano (4 lb.) bone meal (1½ lb.) and muriate of potash 50 per cent (1¾ lb.). The rate of application is 7 lb. per palm annually, and 14 lb. biennally.

The cattle manuring treatment consists of tethering a pair of neat cattle for 5 nights supplemented with saphos phosphate (2¾ lb.) and muriate of potash 50 per cent (2½ lb.) per palm.

The 1st year of this experiment was completed in June 1959. It is still too premature to draw any conclusions from the yield data which do not show any significant differences between the various treatments.

6. Observation Trials on Organics vs. Inorganic manures (Bandirippuwa Estate).

These simple trials which were initiated in 1950 were closed down in early 1959. Five plots, each consisting of about 90 adult palms were subject to the following treatments:—

1. Control.
2. Coir dust applied at the rate of one double bullock cart load per square, and dug over with mammotties.
3. All plant products, except coconut oil, returned to the soil.
4. Inorganic manures only. The following fertilizer mixture was applied biennally in circular trenches:—

Sulphate of Ammonia	3 lb.	Per palm.
Saphos Phosphate	2 lb.	
Muriate of Potash	2 lb.	

5. Organic manures only. Crushed poonac was used as the source of nitrogen, and ash to supply potash and phosphoric acid — the amounts applied being equivalent to 0·6 lb. N. 0·6 lb. P_2O_5 and 1·2 lb. K_2O per palm (similar to the inorganic mixture).

Statistical analysis of the yield data for the period 1950—1958 has shown the different treatment to have the following order of efficiency:—

1. Inorganics
2. Organics
3. All plant products returned
4. Coir dust
5. Control.

7. Observation trials on Yellowing Palms, Walgama Estate, Rukmale and Mattegoda, Polgasowita.

These trials were commenced in 1956 to ascertain whether the inexplicable yellowing of regularly manured palms in certain areas could be arrested by the application of magnesium or cattle manure. Magnesium has been applied either as dolomite or magnesium sulphate.

The problem of yellowing has been largely associated with palms growing on highly acid lateritic soils of the Western and Southern Provinces. In 1959, a further treatment—liming — was introduced at Walgama Estate to find out whether a rise in soil pH would be helpful.

Hitherto there has been no noticeable change in the colour of the foliage of palms receiving the different treatments.

C. LABORATORY INVESTIGATIONS

Considerable time was spent in examining the reliability of new and quicker methods for the chemical analysis of potash, calcium and magnesium in soils and plant materials. The use of the EEL flame photometer for estimating potash in soil extracts, leaflet samples and nutwater was found to be much more reliable and quicker than the old precipitation method. The volumetric E.D.T.A. method for estimating calcium and magnesium has also been found to be more convenient than the standard precipitation techniques.

Analysis of nitrogen in soils at Bandirippuwa showed a significant accumulation of ammoniacal and nitrate nitrogen even at depths of 8—10 ft.

Chemical analysis of soils, leaflet samples and nut water from the trials on yellowing palms at Walgama and Mattegoda estates has hitherto not given any conclusive results regarding the cause of yellowing.

Studies on the effects of air drying on the potash status of a sample of soil from Bandirippuwa Estate indicated that while drying caused no change to occur in its content of exchangeable potash, the concentration of potash in a 10^{-2} molar calcium chloride extract of the soil increased.

Chemical analysis of soil samples taken from the Methods of Application experiment at Marandawila in 1950 (premanurial) was carried out as a preliminary step in studying the effect of fertiliser placement on the distribution of nutrients in the soil.

The results of potash and phosphate analysis on nutwater from the manurial experiments on young palms at Ratmalagara, and the N.P.K. experiment at Bandirippuwa showed the same trends as in the previous years.

Details of the above investigations are given below.

(I) New methods of Chemical analysis.

(a) Estimation of potash using the EEL flame photometer.

The EEL flame photometer was tested for the direct determination of potash in nutwater, water and acid extracts of ashed plant materials and extracts of soil with normal ammonium acetate and 10^{-2} molar calcium chloride solutions. Its high sensetivity has proved to be particularly useful for the direct estimation of potash in soil extracts where the concentration of potash is in the very low region of 0 — 10 ppm. K_2O. Highly reproducible results were obtained and excellent recoveries made of standard amounts of added potash. It was found that acid extracts if kept too long in contact with glassware dissolved sufficient potash from the glass to give significant errors in the measurement of low concentrations of potash.

Comparison of the flame photometric method with the usual sodium cobaltinitrite precipitation method (Treadwell and Hall: Analytical Chemistry Vol. II. p. 69, Wright: Soil Analysis — p. 87), however failed to show any concordant results. A detailed investigation was therefore carried out to ascertain the cause of this discrepancy. It was found that the standard precipitation method is subject to the following errors which must necessarily give rise to variable results:—

(i) The potassium cobaltinitrite precipitate tends to dissolve in the various wash liquids recommended — 10 per cent acetic acid, 2.5 per cent sodium sulphate, or water, giving results lower than what is theoretically expected. Greatest solubility was shown in acetic acid, and least in water. The amount of precipitate dissolved increased with increasing amounts of wash liquid used. The prescribed methods do not specify the amounts of wash liquid to be used. Variable results could be obtained by using different quantities of the wash liquid. The results given in Table I (*a*) show the amounts of precipitate lost by washing with 10 per cent acetic acid as determined by analysing the wash liquid by the flame photometer.

The quantity of potassium in the wash liquid however did not reflect the changes in the actual weight of precipitate after each washing. This was apparently governed by other factors as well, which are

discussed below. These studies werec arried out with 10 mg. quantities of K^2O (i.e. equivalent of about 50 mg. potassium cobaltinitrite precipitate).

TABLE I (a)

Potash in aliquots of 10 per cent acetic acid washings of potassium, cobaltinitrite precipitate

Precipitate No.	*Wash No.*	*Potash in wash liquid (mg. K_2O)*	*Loss of K_2O as cobaltinitrite precipitate (mg.)*	*Total Loss of precipitate (mg.)*
	1	0.16	0.77	
	2	0.25	1.21	
1	3	0.295	1.42	
	4	0.34	1.64	
	5	0.35	1.69	6.73
Weight of precipitate No. 1 before 1st wash = 50.6 mgms.				
Weight of precipitate No. 1 after 5th wash = 46.3 mgms.				
	1	0.09	0.43	
	2	0.21	0.99	
2	3	0.34	1.64	
	4	0.30	1.45	
	5	0.43	2.07	6.58
Weight of precipitate No. 2 before 1st wash = 55.1 mg.				
Weight of precipitate No. 2 after 5th wash = 45.0 mg.				
	1	0.06	0.31	
	2	0.17	0.80	
3	3	0.32	1.54	
	4	0.27	1.33	
	5	0.40	1.93	5.91
Weight of precipitate No. 3 before 1st wash = 52.1 mg.				
Weight of precipitate No. 3 after 5th wash = 42.8 mg.				

Similar results were obtained with 2.5 per cent sodium sulphate and water. With sodium sulphate, the situation was more complicated since the potash precipitate tends to increase in weight with washing due to the absorption of sodium sulphate by the precipitate, while at the same time potash was found to be dissolved in the wash liquid. Subsequent washing of the same precipitate with water confirmed this, for the absorped sodium sulphate was now washed off the precipitate, as was detected by the flame method.

(ii) Incomplete washing away of the sodium cobaltinitrite reagent tends to give results higher than what is expected theoretically.

(iii) The use of tared filter paper for weighing precipitates gives rise to errors due to the creeping of precipitate from the inner to the outer paper. The use of sintered glass filter crucibles is sometimes subject to error due to loss of weight of the crucible itself on repeated washing, possibly due to a gradual breakdown of the sintered glass plate.

(iv) The composition of precipitate is liable to vary from that given by the accepted standard formula K_2 Na (CO NO_6) H_2O). Various quantities of potassium cobaltinitrite previously precipitated, thoroughly washed with 10 per cent acetic acid and dried were accurately weighed out and dissolved in 10 per cent Analar hydrochloric acid. The potash in solution determined by the flame method was found to be distinctly higher than that which was theoretically expected from the above formula (see Table I (a^1). According to Milton and Walkers (Methods of quantitative Micro — Analysis — p. 178), the precipitate would also consist of some K_3 Co (No_2)6, the amount of which is largely governed by the temperature and speed of precipitation.

These investigations have clearly shown that the flame photometric method is superior in all aspects to the old precipitation method for estimating potash. The latter method is likely to give results of poor reproducibility subject to serious errors particularly in estimates of small quantities of potash.

TABLE I (a^1)

Comparison of K_2O theoretically expected from precipitate with that actually found by the flame method.

Weight of potassium cobaltinitrite precipitate dissolved (mgms.)	*K_2O (mg.) expected theoretically from $K_2Na\,Co\,(No_2)\,H_2O$*	*K_2O (mg.) found by flame method*
70	14.52	17.0
92	19.08	20.5
139	28.83	32.3
178	36.91	40.0
235	48.73	50.5
327	67.81	70.0

(b). E.D.T.A. method for estimating calcium and magnesium in soil extracts, leaflets samples and nut water.

The volumetric method as described by Cheng and Bray (Soil Science 72 p. 449 — 58) offers a simpler and more rapid means of estimating calcium and magnesium when compared with the usual oxalate and pyrophosphate methods. Investigations were carried out for testing the suitability of the method for estimating exchangeable calcium and magnesium in N. ammonium acetate leachates of soils, and the total calcium and magnesium in leaflet samples and nut water.

The ammonium acetate solutions were subject to the usual evaporation and extraction procedure after adding varying amounts of standard calcium and magnesium ranging from 1 — 10 mg. Ca and Mg. The method gave high reproducibility of results and good recoveries of added Ca and Mg.

The method also proved suitable for estimating calcium and magnesium in leaflet samples which had been subject to the dry ashing technique. But wet digestion with sulphuric, perchloric and nitric acids was unsatisfactory as considerable difficulty was encountered in obtaining a clear end point in the titration — possibly owing to the presence of the acid radicals in high concentration.

The estimation of total Ca and Mg. in nut water by the E.D.T.A. method was not successful whether the dry ashing or wet acid digestion technique was used to oxidise the nut water. The problem needs further study.

(II) Soil Nitrogen Studies.

Previous studies on soils from coconut estates and virgin jungles from different parts of Ceylon have shown the general pattern that there is a greater proportion of ammoniacal nitrogen than nitrate nitrogen both in the top and sub-soils (vide Annual Reports C.R.I. 1954, 1955, 1956, 1957). Further investigations on Bandirippuwa soils have shown that this pattern is maintained right down the soil profile—and that there is a considerable accumulation of both ammoniacal and nitrate nitrogen even up to depths of 10 feet.

Table II (*a*) gives the moisture, ammoniacal and nitrate nitrogen pH and total exchangeable base of soil samples taken at different depths from a pit in the Bracharia brizantha plot of Agrostologist's Division.

TABLE II (a)

Depth	*Moisture %*	*Nitrate N ppm.*	*Ammoniacal N ppm.*	*pH*	*Total exchangeable bases m.e./ 100 gms. soil*
0 — 9″	11.6	9.7	17.6	5.8	0.91
9 — 18″	4.2	8.0	15.4	5.4	1.04
18 — 27″	13.1	6.0	8.8	5.2	0.71
27 — 36″	6.2	5.5	9.9	4.9	—
36 — 45″	9.2	5.5	7.7	4.9	1.45
45 — 54″	10.3	7.0	6.6	4.6	1.15
54 — 63″	11.9	5.5	9.9	4.8	1.04
63 — 72″	9.4	6.2	11.5	4.7	0.86
72 — 81″	9.6	5.5	11.5	4.7	0.89
81 — 90″	10.5	11.0	8.8	4.9	0.97
90 — 96″	10.9	12.0	4.9	4.6	1.02

Three soil profile pits were dug at Bandirippuwa estate opposite the Chemist's laboratory in a traverse due east at intervals of about 200 yards. The land slopes in an easterly direction. Nitrate and ammoniacal nitrogen estimations on the soils at different depths show the accumulation of significant amounts of nitrogen even at 8 — 10 feet. The results are given in Table II (b).

TABLE II (b)

	Pit No. 5		*Pit No. 6*		*Pit No. 7*	
Depth of Soil Profile	*Nitrate N ppm.*	*Ammoniacal N ppm.*	*Nitrate N ppm.*	*Ammoniacal N ppm.*	*Nitrate N ppm.*	*Ammoniacal N ppm.*
0 — 9″	7.0	16.6	5.5	22.4	6.25	12.8
9 — 18″	6.0	13.9	2.5	16.0	10.0	11.8
18 — 27″	1.25	16.0	2.5	16.0	5.5	10.1
27 — 36″	4.0	18.0	6.2	16.0	4.0	10.7
36 — 45″	2.5	17.1	2.7	14.4	9.0	26.2
45 — 54″	2.0	16.6	6.2	14.4	5.5	26.7
54 — 63″	2.7	16.0	2.5	19.3	5.5	19.8
63 — 72″	2.5	18.0	7.0	10.7	6.0	23.5
72 — 84″	4.0	17.1	2.0	18.0	2.5	28.9
84 — 96″	6.2	21.4	5.5	17.1	5.6	28.3
96 — 108″	8.75	14.9	—	—	—	—
108 — 120″	5.5	17.1	—	—	—	—
120 — 132″	6.0	22.4	—	—	—	—

(III) Chemical studies of soil, leaflet and nut water samples from the trials on yellowing-palms at Walgama and Mattegoda Estates.

(*a*) *Analysis of soils from Walgama Estate.*

Two series of soil samples were taken from Walgama Estate from areas in which the palms were yellowing and in which they appeared to be normal and green. Each sample was composed of three borings. The first series was air dried and then subject to chemical analysis for N, P, K, Ca and Mg. The pH's were measured in $10.^{-2}$ molar calcium chloride. The results are given in Table III (*a*).

The second series of soil samples were collected in polythene bags and treated with toluene. The soils were analysed in their damp state — without air drying — for total, nitrate, and ammoniacal nitrogen. The results are shown in Table III (a^1).

Chemical analysis of the soils has failed to show any consistent differences between the soils from the good and affected areas.

(*b*) *Chemical analysis of leaflet samples from adult yellow and green palms from trials at Mattegoda Estate.*

Leaflet sampling was carried out in December 1958 on groups of adult yellowing palms subject to the following treatments:—

A — No manure
B — 5 lbs. Baur's special per palm
C — 5 lbs. Baur's special per palm + 454 gms. $Mg.SO_4$
D — 5 lbs. Baur's special per palm + 408 gms. Dolomite
E — Cattle manure + 2½ lbs. saphos phosphate + 2 lbs. 50 per cent muriate of potash.

Leaflet samples were also taken from normal healthy looking green palms receiving 5 lbs. Baur's special only.

The samples were taken from the 1st fully opened leaf, and also from a mature leaf — either from 12th — 15th leaf, or 16th — 19th leaf. Each sample was composed of leaflets from three palms. The leaflets were chosen from the centre part of the leaf, and only the middle portions of leaflets — free of mid ribs were taken for analysis after air drying.

TABLE III (a) (*Series* 1)

Chemical analysis of soils from Walgama Estate (Series I sampled on 16-3-59)

Good Area — (Green Palms)

Sample No.	*Layer*	*pH*	*Total N. ppm.*	*Truog P_2O_5 ppm.*	*Total exchangeable bases me%*	*Exch. K_2O me%*	*Exch. Ca. me%*	*Exch. Mg. me%*	*Exch. Mn mg/ 100 gm. Soil*
(*a*) MANURE CIRCLES									
2	0— 9″	4.5	1,700	54	2.54	0.063	1.70	0.44	0.18
5	0— 9″	4.3	350	65.6	1.29	0.052	0.73	0.30	0.13
6	9—18″	4.5	220	34.4	0.84	0.070	0.39	0.20	0.07
13	0— 9″	4.8	60	277	2.68	0.091	1.95	0.43	0.04
15	0— 9″	4.5	190	12	1.34	0.099	0.65	0.24	0.06
16	9—18″	4.2	190	9.6	0.97	0.070	0.39	0.10	0.02
17	0— 9″	3.8	90	180	1.64	0.165	1.04	0.33	0.03
18	9—18″	3.3	70	46.4	1.55	0.066	0.91	0.48	0.04
(*b*) SQUARE CENTRES									
1	0— 9″	3.7	1,030	20	0.89	0.130	0.37	0.18	0.08
3	0— 9″	4.5	690	54	0.89	0.093	0.281	0.20	0.09
4	9—18″	4.6	310	42	0.79	0.201	0.30	0.15	0.07
Affected Area — (Yellow Palms)									
(*a*) MANURE CIRCLES									
9	0— 9″	5.2	240	108	1.82	0.080	1.22	0.20	0.06
10	9—18″	4.8	240	43.2	1.59	0.048	0.90	0.23	0.06
11	0— 9″	4.8	120	94	1.85	0.059	1.34	0.24	0.08
12	9—18″	4.0	80	34	1.34	0.069	0.92	0.23	0.06
14	0— 9″	4.8	70	124	3.44	0.148	2.81	0.42	0.07
19	0— 9″	3.5	50	110	2.10	0.134	1.27	0.58	0.04
20	9—18″	3.4	60	18.4	1.05	0.377	0.64	0.37	0.04
(*b*) SQUARE CENTRES									
7	0— 9″	4.8	250	28.8	1.78	0.064	1.03	0.42	0.07
8	9—18″	5.4	330	41.6	2.06	0.063	1.05	0.21	0.06

TABLE III (a[1])

Nitrogen analysis of soils from Walgama Estate (Series II sampled on 12-5-59)

Good Area—(Green Palms)

(*a*) MANURE CIRCLES

Sample No.	*Layer*	*% Moisture*	*Total N. ppm.*	*Nitrate N. ppm.*	*Ammoniacal N. ppm.*
8	0— 9″	12.4	980	7.1	40.1
	9—18″	10.9	650	9.0	26.4
10	0— 9″	12.8	1,040	8.0	32.0
12	0— 9″	14.9	1,020	9.4	36.0

(*b*) SQUARE CENTRES

7	0— 9″	13.8	1,320	16.0	31.8
	9—18″	12.4	430	3.1	25.0
9	0— 9″	15.2	1,220	6.5	39.5
11	0— 9″	15.6	1,290	9.5	42.9

Affected Area—(Yellow Palms)

(*a*) MANURE CIRCLES

2	0— 9″	14.5	1,230	7.3	24.3
	9—18″	10.4	330	7.0	6.7
4	0— 9″	15.9	1,150	13.4	24.8
	9—18″	13.9	870	10.2	8.2
6	0— 9″	15.0	1,020	11.8	23.2
	9—18″	12.1	660	11.4	6.9

(*b*) SQUARE CENTRES

1	0— 9″	14.7	1,290	9.4	28.3
	9—18″	12.7	620	10.0	21.6
3	0— 9″	16.7	970	12.0	25.0
	9—18″	13.2	480	9.2	13.3
5	0— 9″	16.2	1,110	9.5	29.5
	9—18″	15.6	640	9.5	26.0

TABLE II (b)

Chemical analysis of leaflet Samples from Yellow and green palms of Mattegoda Estate.

1ST LEAF

		Sample No.	*%N.*	*%P_2O_5*	*%K_2O*	*%Ca.*	*%Mg.*	*ppm. Fe.*	*ppm. Mn.*
Green Palms	—	1	1.45	0.19	2.93	0.241	0.098	567	125
Yellow Palms Treatment									
A	—	2	1.67	0.13	2.23	0.286	0.117	217	117
	—	14	1.25	0.21	2.00	0.375	0.135	192	75
B	—	6	1.13	0.15	2.73	0.268	0.045	150	100
	—	16	1.56	0.21	—	0.281	0.028	—	84
C	—	5	1.48	0.13	2.90	0.244	0.089	117	84
	—	18	1.02	0.23	2.58	0.258	0.110	567	73
D	—	4	1.54	0.15	2.90	0.255	0.047	225	150
	—	8	1.91	0.21	1.53	0.390	0.123	150	108
E	—	3	1.75	0.21	3.00	0.274	0.023	217	117
	—	13	1.64	0.23	2.59	0.258	0.084	108	50
			16TH — 19TH LEAVES						
Green Palms	—	11	1.67	0.11	1.09	0.475	0.061	152	225
Yellow Palms Treatment									
B	—	12	1.56	0.16	1.95	0.305	0.090	134	85
C	—	15	1.78	0.18	1.54	0.399	0.018	150	158
D	—	10	1.33	0.11	—	0.408	0.067	242	142
E	—	9	1.73	0.15	1.74	0.293	0.043	—	200
			12TH — 14TH LEAVES						
Green Palms	—	7	2.30	0.18	1.40	0.535	0.084	192	142
Yellow Palms Treatment									
B	—	17	1.08	0.17	1.59	0.386	0.016	275	108

Chemical analysis of the samples for N.P.K. Ca. Mg. Fe and Mn. are given in Table III (b). The results do not show any marked differences between the yellow and green palms.

(c) Analysis of nut water from trials on yellowing palms.

Nut water from the trials at Mattegoda and Walgama Estates were analysed for nitrogen, phosphoric acid and potash. Again, the result failed to show any noticeable differences between the green and the yellow palms.

The investigations on the problem of yellowing have hitherto not given any conclusive results. Further work is being carried out.

(IV) Studies on the effect of drying on the nutrient status of soils.

The object of this study is to determine the changes which occur in the availability of soil nutrients when soils are subject to drying. As a preliminary step, investigations were made to find out whether any changes occurred in the exchangeable potash content and the potash concentrations in 10^{-2} mola. calcium chloride extracts of the soil when a sample of soil from Bandirippuwa Estate was subject to varying degrees of drying.

10gm. samples of the fresh soil from the field were shaken up overnight in 150mls. 10^{-2} M. Ca. Cl_2. The potash content of the solution was determined after filtration. 10gm. samples of the damp soil were subject to similar extraction after air drying, and oven drying. The exchangeable potash in the fresh air dry and oven dry samples were determined by leaching 25gms. soil (weighed fresh) with 500cc. N. ammonium acetate. From the figures given in Table IV it is seen that while the drying has caused a distinct rise in the potash content in 10^{-2} M. Ca. Cl. 2 extracts of the soil, it has made no changes in the exchangeable potash, as indicated by the concentration of K_2O in the ammonium acetate leachates.

Schofield has suggested that the potash status of a soil can be better judged by finding the equilibrium concentration of potassium ions in a 10^{-2} molar Ca. Cl. extract of the soil than from its total exchangeable potash. (Schofield—Proceedings of the 11th International Congress of Pure and applied Chemistry, July 1947, 3, 257—261). These results, together with the observations of Paltridge and Santhiresegaram (C.R.I. Bulletin No. 11) on the increased availability of soil potash to plants on drying, support Schofield's hypothesis.

TABLE IV

Effect of drying on soil potash (Bandirippuwa Soil)

		ppm. K_2O in Solution 10^{-2} M. Ca. C. 2 extract	*N. Ammonium acetate leachate*
Fresh Soil	1 ..	2.80	1.60
	2 ..	3.00	1.60
	3 ..	2.95	1.65
Air dry Soil	1 ..	4.35	1.65
	2 ..	4.55	1.65
	3 ..	4.55	1.80
Oven dry Soil	1 ..	4.80	1.65
	2 ..	4.80	1.65
	3 ..	4.65	1.60

(V) Chemical analysis of soil samples taken from Methods of Application Experiment (Marandawila).

This work was commenced to study the effects of fertiliser placement on the distribution of nutrients in the soil. The following analysis were completed on row and manure circle top and sub soil samples taken from all the experimental plots before the first differential manuring was done in 1950:—

(i) Total exchangeable bases.
(ii) Exchangeable potash.
(iii) Total nitrogen.
(iv) Truog phosphate.
(v) pH.
(vi) Mechanical analysis (on soil samples from 12 plots).

(VI) MISCELLANEOUS

(*a*) Two series of pasture samples (a total of 30) from the Agrostology Division were analysed for nitrogen, total protein, potash and moisture content.

(*b*) The total exchangeable bases, exchangeable calcium and magnesium were determined in some soil samples from Vannankerney Estate, Pallai.

The Soil Chemist delivered the following papers during the course of the year :—

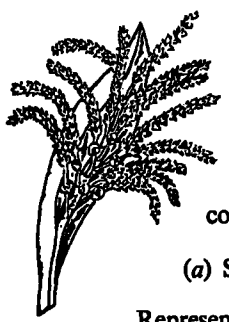
(*i*) " The use of Radio-active Isotopes in Agricultural Research " to the Chilaw-Negombo Planters' Association.

(*ii*) " Some new ideas on the availability of soil phosphorus to plants " to the Chemical Society of Ceylon.

(*iii*) " Investigations on manurial and cultivation problems of the Coconut Palm "—at the C.R.I. Technical Conference.

D.A. NETHSINGHE,
Soil Chemist.

REPORT OF THE CHEMIST



1. Distribution of Macro-nutrients in the Components of the Coconut Apical Bud.

It is reckoned that before initiating studies on the technique of foliar diagnosis of the coconut palm it is important to determine the distribution of the macro-nutrients in the components of the tender apical bud.

It is always possible to distinguish and isolate the following rudimentary components in the tender bud :—

(*a*) Stem (*b*) Petioles (*c*) Leaflets and (*d*) Flower Spathes.

Representative bulk samples of these four components were carefully drawn from 25 apical buds. These samples were then dried in a dehydrator and the dried material analysed. The analytical results obtained for the macro-nutrients nitrogen, phosphorus, potassium, calcium and magnesium are presented in Table I.

Parallel analyses for the macro-nutrients were also carried out on twelve *composite* samples off apical buds of comparable size and age, carefully drawn from twelve palms in normal growth and vigour. The analytical results are summarised in Table II. Some figures have been reported earlier for the composition of composite samples of apical buds, but those unlike the present ones were drawn at random from palms of different ages and vigour. Further, the earlier samples were analysed only for nitrogen, phosphorus and potassium.

TABLE I

Analytical Data on the Components of the Coconut Apical Bud.

(*Powdered air-dry samples*)

1	2	3		4		5		6		7		8	
Component	% *Moisture*	% *Nitrogen (as N)*		% *Phosphorus (as P_2O_5)*		% *Potassium (as K_2O)*		% *Calcium (as Ca)*		% *Magnesium (as Mg)*		% *Ash (Sulphated)*	
		Wet	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*
Stem	11.93	2.49	2.83	1.28	1.45	3.74	4.25	0.38	0.43	0.63	0.72	11.11	12.61
Petiole	11.86	2.47	2.80	1.12	1.28	3.13	3.55	0.27	0.31	0.70	0.80	10.98	12.40
Leaflet	10.37	4.72	5.27	2.00	2.23	3.56	4.61	0.34	0.38	0.53	0.60	11.44	12.76
Spathe (1)	16.58	2.66	3.18	1.45	1.74	2.94	3.53	0.65	0.78	0.65	0.77	12.21	14.64
Spathe (2)	16.06	2.68	3.19	1.45	1.72	2.81	3.34	0.64	0.76	0.65	0.77	12.33	14.69

TABLE II

Analytical Data on Composite Samples of Coconut Apical Bud.

(Powdered air-dry samples)

1	2	3		4		5		6		7		8	
Sample	% *Moisture*	% *Nitrogen (as N)*		% *Phosphorus (as P_2O_5)*		% *Potassium (as K_2O)*		% *Calcium (as Ca)*		% *Magnesium (as Mg)*		% *Ash (Sulphated)*	
		Wet	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*
1	9.95	2.59	2.88	1.53	1.70	2.88	3.20	0.350	0.389	0.637	0.707	12.12	13.45
2	10.19	3.51	3.91	1.62	1.81	2.87	3.19	0.410	0.457	0.635	0.707	12.20	13.59
3	12.86	2.60	2.98	1.57	1.80	2.43	2.79	0.523	0.600	0.562	0.646	10.19	11.69
4	15.56	2.90	3.43	1.35	1.59	2.64	3.13	0.338	0.400	0.555	0.657	9.16	10.86
5	13.51	2.88	3.33	1.52	1.75	1.97	2.28	0.420	0.485	0.550	0.636	8.48	9.80
6	9.94	2.89	3.21	1.69	1.87	2.25	2.50	0.615	0.682	0.611	0.678	9.83	10.91
7	17.67	2.72	3.30	1.32	1.60	2.16	2.62	0.333	0.405	0.585	0.710	9.30	11.29
8	18.60	2.63	3.23	1.27	1.57	2.01	2.47	0.350	0.430	0.568	0.698	8.70	10.68
9	18.67	2.61	3.21	1.31	1.60	1.66	2.04	0.416	0.512	0.564	0.693	8.46	10.40
10	14.26	2.66	3.10	1.39	1.62	2.93	3.41	0.327	0.382	0.585	0.682	10.19	11.88
11	12.66	3.12	3.56	1.85	2.13	2.41	2.76	0.546	0.625	0.611	0.699	11.03	12.64
12	14.96	2.62	3.08	1.29	1.52	3.07	3.61	0.322	0.378	0.493	0.579	10.15	11.94
Mean	14.07	2.81	3.27	1.48	1.71	2.44	2.83	0.412	0.479	0.580	0.674	9.98	11.59
Range	9.94 to 18.67	2.59 to 3.51	2.88 to 3.91	1.27 to 1.85	1.52 to 2.13	1.66 to 3.07	2.04 to 3.61	0.322 to 0.615	0.378 to 0.682	0.493 to 0.637	0.579 to 0.710	8.46 to 12.20	9.80 to 13.59
S.D.	3.17	0.28	0.28	0.18	0.17	0.45	0.48	0.098	0.105	0.040	0.039	1.28	1.18
C.V. (%)	22.53	9.96	8.56	12.16	9.94	18.44	16.96	23.79	21.92	6.90	5.79	12.83	10.18
S.E.	0.92	0.08	0.08	0.05	0.05	0.13	0.14	0.028	0.030	0.012	0.011	0.37	0.34

S.D. = Standard Devisation S.E. = Standard Error C.V. = Co-efficient of Variation

The results charted in Tables I and II reveal the interesting fact that the distribution of the mineral constituents in the various components of the tender bud is not uniform. In other words, even during the early phases of development of the bud there are centres of accumulation of particular nutrients. It would doubtless be interesting to follow how the respective concentrations change during progressive stages of development of the different components of the bud and the unfurling of the fronds. It is proposed to carry out these studies prior to the application of the technique of foliar diagnosis, as it would afford a better understanding of the pattern of distribution of the macro-nutrients in the progressive developmental stages of the fronds and suspensory elements in the crown of the coconut palm.

2. Pot Culture Experiment.

It has been reported last year that a preliminary sand pot-culture experiment using a subtractive intermittent flowing technique has been laid down. The design and experimental procedure has already been described. Further particulars of this experiment are as follows :—

Crop from which nuts were drawn — Bandirippuwa May/June 1958.
Size group — 6 to 8 inches (short axis) — random.
Selected drupes planted in Botanist's nursery — 1,000.
Date of planting in nursery — 20th June 1958.
Number uprooted from nursery — 850.
Date of uprooting and husking — 11th August 1958.
Seedlings damaged during husking — 123.
Rejections (oversize and undersize sprouts) — 294.
Seedlings planted in pots (typical range) — 288.
Seedlings (typical range) used for initial analyses — 145.
Seedlings planted per pot — 36.

NOTE—Out of the 150 seedlings left behind in the nursery, 36 seedlings (comparable in physical characteristics and representative of the 36 planted in each pot) were selected and tagged to serve as a control for the experiment.

The above experiment has been maintained satisfactorily during the year. Growth measurements were recorded at monthly intervals on all seedlings. Four seedlings (two amputated and two non-amputated) were uprooted each month from every pot and the various components were sampled for analysis after recording weight characteristics.

As the organization and maintenance of this experiment has involved a prodigious amount of manipulative work, it has not been possible to clear up the analysis of all the samples prepared.

Average Analytical and Weight Characters of the Experimental Seedlings, on the day of planting in the pots (11-8-58).

The 145 selected seedlings representative of the 288 planted in the pots were carefully examined for the analytical and weight characters of the different components, viz. husk, shell, kernel, nut water, haustorium, shoot and roots.

After weighing the components of each seedling individually, bulk samples of the respective components were prepared by combining the 145 individual samples. After triplicate moisture estimations on each lot, the bulk samples were dried in a dehydrator, were ground up and then analysed for N.P.K.Ca. and Mg. The results obtained in this study are charted in Tables III and IV. It is reckoned that the average figures represent the analytical and weight characteristics of the seedlings on the day of planting in the pots.

NOTE — (It should be mentioned that though the husks were not removed from the 36 control seedlings in the nursery the 288 seedlings in the pots were planted without the husks).

TABLE III

Moisture Contents and Average Weights of the Component Parts of the Seedling (on day of planting in the pots — 11-8-58).

1	2	3		4
Component	*% Moisture*	*Average Wt. of Component/Nut*		*Dry Weight of Component as % of Total Dry Matter/ Seedling*
		Wet Weight (Gms.)	*Dry Weight (Gms.)*	
Husk	57.16	782.0	335.0	51.7
Shell	17.01	179.7	149.1	23.0
Kernel (by diff.)	41.08	237.4	139.9	21.6
Nut water	96.23	16.4	0.6	0.1
Cotyledon	86.45	120.5	16.3	2.5
Shoot	84.83	37.8	5.7	0.9
Roots	82.44	9.2	1.6	0.2
Whole seedling	53.13	1,383.0	648.2	100.0
Seedling minus husk	47.89	601.0	313.2	48.3

TABLE IV

Distribution of Mineral Nutrients in the Components of the Seeding on 11-8-58 (on the powdered samples as analysed)

1	2		3		4		5		6		7		8	9
Component	*% Ash (Sulphated)*		*% Nitrogen (as N)*		*% Phosphorus (as P)*		*% Potassium (as K)*		*% Calcium (as Ca)*		*% Magnesium (as Mg)*		*% Moisture*	*% Dry Matter*
	Wet	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*		
Husk	3.85	4.37	0.425	0.483	0.017	0.020	0.557	0.632	0.117	0.133	0.098	0.112	11.87	88.13
Shell	0.666	0.743	0.203	0.224	0.006	0.006	0.105	0.115	0.022	0.024	0.080	0.089	9.69	90.31
Kernel	1.56	2.64	0.83	1.41	0.131	0.223	0.307	0.515	0.011	0.018	0.064	0.108	41.08	58.92
Nut Water	0.496	13.16	0.009	0.239	0.008	0.198	0.074	1.95	0.019	0.512	0.014	0.366	96.23	3.77
Cotyledon	7.51	9.05	1.15	1.39	0.342	0.412	1.83	2.21	0.175	0.211	0.196	0.236	16.99	83.01
Shoot	7.93	9.35	1.53	1.81	0.250	0.295	2.04	2.41	0.107	0.126	0.284	0.334	15.15	84.85
Roots	8.82	10.57	1.23	1.48	0.253	0.303	1.98	2.37	0.057	0.068	0.206	0.247	16.52	83.48

The results given in Table IV for the kernel are calculated figures based on the actual analytical data obtained on the oil-free meal. The data obtained on the oil-free meal and the corresponding figures calculated for the original kernel are shown in Table V.

TABLE V

Analytical Data on the Extracted Meal and Calculated Data for the Kernel.

1	2		3		4		5		6		7		8	9
Component	% *Ash*		% *Nitrogen*		% *Phosphorus*		% *Potassium*		% *Calcium*		% *Magnesium*		*% Moisture*	*% Dry Matter*
	Wet	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*		
Oil-free Meal	7.57	8.71	4.05	4.66	0.647	0.743	1.49	1.71	0.051	0.059	0.309	0.356	13.09	86.91
Kernel (Calculated)	1.56	2.64	0.83	1.41	0.131	0.223	0.307	0.515	0.011	0.018	0.064	0.108	41.08	58.92

From the data presented in Tables III and IV it should now be possible to compute average values for the actual amounts of the macro-nutrients N.P.K. Ca and Mg present in each of the components of the seedlings at the time of planting in the experimental pots. In other words, we could obtain a quantitative assessment of the mineral reserves with which the seedlings start off at the commencement of the experiment, before they are subjected to the different treatments. The calculated data are given in Table VI bellow.

TABLE VI

Distribution of the Nutrients, in the Various Components of the Seedlings.

(a) Grammes of Nutrient per Component and Seedling.

1	2	3	4	5	6	7	8	9
Nutrient	*Husk*	*Shell*	*Kernel*	*Nut Water*	*Shoot*	*Roots*	*Cotyledon*	*Whole Seedling*
Ash	14.64	1.11	3.69	0.079	0.533	0.169	1.48	21.7010
Nitrogen (as N)	1.62	0.334	1.97	0.0014	0.103	0.0237	0.227	4.2791
Phosphorus (as P)	0.067	0.009	0.312	0.0012	0.017	0.0048	0.0672	0.4782
Potassium (as K)	2.12	0.171	0.720	0.0117	0.137	0.0379	0.360	3.5576
Calcium (as Ca)	0.446	0.036	0.025	0.0031	0.0072	0.0011	0.0344	0.5528
Magnesium (as Mg)	0.375	0.133	0.151	0.0022	0.0190	0.0040	0.0385	0.7227

(b) Nutrients in the Components as a Percentage of Nutrients/Seedling.

Ash	67.4	5.1	17.0	0.4	2.5	0.8	6.8	100.0
Nitrogen (as N)	37.9	7.8	46.0	0.1	2.4	0.5	5.3	100.0
Phosphorus (as P)	14.0	1.9	65.2	0.3	3.6	1.0	14.0	100.0
Potassium (as K)	59.6	4.8	20.2	0.3	3.9	1.1	10.0	100.0
Calcium (as Ca)	80.7	6.5	4.5	0.6	1.3	0.2	6.2	100.0
Magnesium (as Mg)	51.9	18.4	20.9	0.3	2.6	0.6	5.3	100.0
Wet Weight (per Seedling)	782.0	179.7	237.4	16.4	37.8	9.2	120.5	1383.0
Dry Weight (per Seedling)	335.0	149.1	139.9	0.6	5.7	1.6	16.3	648.2

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On the basis of the results summarised in the above tabulations, we could now arrive at the following figures for the actual quantities of the different macro-nutrients (expressed in order of decreasing magnitude) present per seedling (with and without husk) at the initial stage of the experiment.

Macro-Nutrients per Seedling

Nutrient		*Seedling with husk (as planted in nursery) grammes per seedling*	*Seedling without husk (as planted in pots) grammes per seedling*
Ash (Sulphated)		21.70	7.06
Nitrogen as N		4.28	2.66
Potassium	as K	3.56	1.44
	as K_2O	4.29	1.73
Magnesium	as Mg	0.72	0.35
	as MgO	1.20	0.58
Calcium	as Ca	0.55	0.11
	as Ca.O	0.77	0.15
Phosphorus	as P	0.48	0.41
	as P_2O_5	1.09	0.94

It can be said that the above quantities represent the actual nutrient reserves available to the growing seedling. It will be seen that the amounts of nitrogen and potassium present are comparatively high. It is also noteworthy that in the whole seedling the amounts of magnesium and calcium are higher than the phosphorus present, when calculated as Mg. Ca. and P. respectively.

3. Copra from varieties grown in Ceylon.

The *typica* or tall coconut palm which is cultivated on a plantation scale represents the variety that is propagated essentially for commercial purposes. Besides this there are also other varieties and forms which are grown to a limited extent in the island. The economic possibilities of evolving hybrids (with high oil contents in the kernel) by selective breeding is no doubt an interesting speculation well worth investigation. Fifteen fresh samples of copra (uncomplicated by the changes accompanying deterioration and germination) sent by the Botanist were carefully examined and analysed for moisture and oil contents. The results obtained in this study are presented in Table VII. It will at once be apparent from the analytical results that the dwarf green (69.9%), Gon Thambili (69.2%), Bodiri (69.6 %), Nawasi (69.5%) and Pora Pol (69.7%), are the only ones if at all which have given somewhat higher figures than the commercial tall palm for oil content.

TABLE VII

(Oil content of the varieties and forms of Coconut grown in Ceylon).

1	2	3	4		5	6	7	8
Sample	*Variety or Form*	*% Moisture*	*% Oil*		*No. of Nuts*	*Wt. of copra lbs.*	*Out-turn nuts/ candy*	*Copra Quality*
			Wet basis	*Dry basis*				
1	Tall palm (composite) (Variety—TYPICA)	6.8	63.7	68.3	2600	1133.96	1284	Uniformly good
2	Dwarf Green (Variety—NANA)	6.2	65.6	69.9	102	24.00	2380	Fair (not uniform)
3	Dwarf Red (a form of NANA)	6.8	60.8	65.2	90	17.25	2922	Inferior
4	Dwarf Yellow (a form of NANA)	7.1	60.8	65.5	100	24.75	2263	Inferior
5	King Coconut (Variety)	7.4	60.8	65.6	100	31.25	1792	Fair
6	Ran Thambili (a form of TYPICA)	7.5	63.3	68.5	19	9.25	1150	Good
7	Gon Thambili (a form of TYPICA)	6.6	64.6	69.2	55	28.00	1100	Good
8	Bodiri (a form of TYPICA)	7.2	64.6	69.6	20	2.25	4978	Inferior
9	San Ramon (a form of TYPICA)	8.0	60.4	65.6	66	42.50	870	Good
10	Kamandala Giant (a form of TYPICA)	7.2	62.8	67.7	45	37.50	672	Good
11	Nawasi (a form of TYPICA)	6.9	64.7	69.5	19	7.50	1419	Uniformly good
12	Nawasi Thambili (a form of TYPICA)	7.0	63.5	68.1	20	6.39	1753	Fair
13	Pora Pol (a form of TYPICA)	7.3	64.6	69.7	20	5.95	1882	Fair
14	Tall Palm (Green) (Variety—TYPICA)	6.6	64.4	68.9	102	45.19	1264	Uniformly good
15	Tall Palm (Reddish Brown) (Variety—TYPICA)—(1 Candy — 560 lb).	7.1	63.9	68.8	102	41.67	1371	Good

4. Moisture content of the Coconut Kernel.

It is generally reckoned, that in the fresh state, the kernel of the coconut contains about 50 per cent of moisture. Though this figure may be employed for rough and ready calculations it is felt that the actual moisture content could vary with the maturity of the drupe itself, and also perhaps conditions of storage. Further, it is likely that there is a moisture gradient within the kernel itself. Whether or not this is true can only be established on the basis of proper quantitative experiments.

It is hoped that in connection with certain proposed studies on quality factors of copra that all aspects of moisture in the kernel will be exhaustively investigated. In this context (certain) preliminary quantitative estimations of moisture content of the kernel have been made on certain carefully drawn samples. The results are presented in Table VIII below.

TABLE VIII

Moisture Content of the Coconut Endosperm.

1	2	3	4	
Sample	*Picked ripe Green Nuts (Immediately on harvesting)*	*Fallen nuts (Dead ripe nuts naturally falling from the palm)*	*Picked Ripe Green Nuts*	
			After 15 days seasoning on the field	*After 30 days seasoning on the field*
1	44.44	43.93	43.99	45.92
2	44.48	41.98	43.34	44.98
3	43.50	42.91	44.00	45.76
4	44.54	43.87	42.55	44.58
5	43.66	43.48	43.80	43.58
6	43.18	34.22	43.46	44.88
7	43.74	43.52	44.51	43.74
8	43.88	43.62	44.11	42.70
9	43.17	44.38	43.50	42.50
10	43.65	43.62	43.04	43.73
Mean	43.82	43.45	43.63	44.24
S.D.	0.5096	0.6532	0.5720	1.1812
C.V. (%)	1.16	1.50	1.31	2.67
S.E.	0.16	0·21	0.18	0.37

For each category of nuts in the experiment 250 nuts were taken and these were sampled and analysed for moisture content in ten lots of 25 nuts each.

On the basis of these studies it could be concluded that there is no significant difference between the moisture contents of the kernel from harvested ripe green nuts and that from dead ripe nuts naturally falling from the palm. It could also be assumed that the moisture content in the freshly harvested nut does not change appreciably on seasoning for periods of 15 or 30 days on the field.

5. Changes in the Coconut Endosperm during Development.

When we consider the floral biology and development of the coconut, it should be possible to identify at least 25 distinct stages from the time the rudimentary inflorescence makes its appearance until the cluster of fully ripe nuts is ready for harvesting. The kernel (endosperm) first makes its appearance as a jelly like substance at stage 18 in this series. This would correspond to an age of about 5 months from the time the flower spathe burst open into flowers. At stage 25 the kernel would be fully formed and mature and thus ideally suited for the preparation of quality copra. The age of the ripe drupe corresponding to stage 25 would be about 12 — 13 months from the time of opening of the spathe.

The changes taking place in the oil and moisture contents of the endosperm were followed during the course of its progressive development between stages 20 and 25. It has not been possible to accumulate sufficient quantities of the dried endosperm at stages 18 and 19 for analysis. It is hoped that it would be possible to carry out the analysis when sufficient material becomes available.

The results so far obtained on the average oil and moisture contents in the kernel during the course of its progressive development between stages 20 and 25 are chartered in Table IX below. Parallel data are also given showing the total wet and dry weights of endosperm per drupe.

The results reveal the following interesting features:—

TABLE IX

Changes in the Moisture and Oil Contents of the Coconut Endosperm during Progressive Stages of Development.

1	2	3		4		5
Stage	*Total Moisture in Endosperm*	*Weight of Endosperm per nut (grammes)*		*% Oil*		*Description*
		Wet	*Dry*	*Wet basis*	*Dry basis*	
1 — 17	No Endosperm					No pulp
18	—	—	—	—	—	—
19	—	—	—	—	—	—
20	94.6	22	1.2	0.9	16.0	Very Tender Kurumba
21	83.9	111	16.9	7.7	47.5	Tender Kurumba
22	74.3	165	42.2	14.8	57.3	Kurumba
23	65.2	216	75.0	23.2	66.6	Tender Kalati
24	49.0	260	132.0	36.1	70.7	Kalati
25	42.5	273	161.4	41.7	68.1	Ripe Green Nut

(*a*) That the moisture content steadily drops from about 95 per cent in the very tender gelatinous kernel to about 43 per cent in the ripe fruit.

(*b*) That the oil contents (dry basis) unlike the moisture increases with the ripening of the fruit. The figures recorded show an increase from 16 per cent to 68 per cent. The high value (70.7 per cent) obtained in this study for stage 24 is rather interesting.

(*c*) That there is a progressive increase in the deposition of dry matter in the kernel — the results showing an increase from 1 gramme to 161 grammes between stages 20 and 25.

6. Changes in the Coconut Endosperm during Germination.

It has been reported earlier that a simple *ad hoc* germination experiment has been laid down to ascertain quantitatively the mineral reserves in the fruit components and also the changes in the composition of the leaves of the seedlings during progressive stages of germination. It should be appropriate to refer to certain observations made in this experiment on the changes that take place in the endosperm of the coconut during germination. These observations are reckoned to be of some significance since certain commercial grades of copra invariably include the kernel from germinated coconuts. The analytical data reviewed in Table X below represent the changes that take place in the kernel during the progress of germination up to a period of 7½ months from planting.

The distinctive features of the results presented in the tabulation may be summarised as follows:—

(*a*) There is a decided tendency for a drop in the moisture content of the kernel during germination. This becomes particularly marked after 20 weeks from planting, from which stage onwards there is a steady fall in moisture from 41.9 per cent to 33.4 per cent.

(*b*) Unlike moisture, the tendency for changes in the oil content is definitely in the reverse direction. It will be seen that after 20 weeks this becomes very marked — the oil percentage steadily rising from 72.9 per cent to 76.7 per cent (dry basis).

TABLE X

Changes in the Moisture and Oil Content of the Coconut Endosperm during Germination.

1	2	3		4	5	
No. of weeks in nursery	*% Total moisture in kernel*	*Weight of kernel per nut (grammes)*		*Weight of oil/nut (grammes)*	*% Oil*	
		Wet	*Dry*		*Wet basis*	*Dry basis*
Nil	43.7	345	194	133.3	38.7	68.7
2	43.2	346	197	134.2	38.7	68.1
4	45.1	351	193	131.8	37.5	68.3
6	43.3	339	192	134.4	39.7	70.0
8	42.1	350	203	139.9	39.9	68.9
10	42.3	343	198	138.8	40.4	70.1
12	42.9	344	196	135.8	39.6	69.3
14	42.6	346	199	139.3	40.2	70.0
16	42.2	336	194	137.0	40.8	70.6
18	41.5	324	190	133.8	41.2	70.4
20	41.9	303	176	128.3	42.4	72.9
22	40.1	289	173	127.7	44.2	73.8
24	40.0	281	169	124.9	44.3	73.9
26	39.2	271	165	123.6	45.5	74.9
28	37.5	242	151	115.1	47.6	76.2
30 (7.5 months)	33.4	216	144	110.4	51.1	76.7

(*c*) Regarding the question of actual oil recoveries per nut it will be seen from column 4, that there is a persistent drop after 18 weeks from 133.8 grammes to 110.4 grammes.

(*d*) Though the oil contents are high when expressed as a percentage, it will be seen that these high values actually correspond to lower recoveries of oil per nut. The inference can therefore be drawn that from the commercial point of view, *on a weight basis* the low grade copra prepared from well germinated coconuts will doubtless yield more oil on expression. Though this will be of value to the oil miller, yet it should be remembered that the quality of oil and also the poonac recovered is inferior and should entail refinement losses. From the point of view of production economics however there is no significance or advantage in preparing copra from germinated coconuts because the quantity of oil recovered per nut is below average. That this is so will be evident when we consider the fact that the average oil recovery per nut during the first 18 weeks of planting is 136 grammes and for the period 20-30 weeks is only 122 grammes. (Computed from Table X, Column 4).

7. Oil and Moisture Gradients in the Coconut Endosperm.

In order to find a plausible explanation for the observations made in the germination experiment, an investigation was carried out to test the presence of moisture and oil gradients in the coconut kernel.

The figures presented in Table XI below demonstrate conclusively that there are to be found in the coconut kernel definite oil and moisture gradients when sliced tangentially, parallel to the testa or brown integument.

TABLE XI

Oil and Moisture Gradients in the Coconut Endosperm.

Region	*% Moisture*	*% Oil (Wet basis)*	*% Oil (Dry basis)*
T	29.1	44.2	62.4
RT	32.9	50.6	75.4
IR	44.1	37.9	67.8
RW	59.3	22.9	56.3

T = Testa IR = Intermediate region
RT = Region near testa RW = Region near water cavity

For the experiment, the fresh kernels from ungerminated coconuts alone were used. These were split into half cups in the usual way and 1/8" radial strips were taken from each cup by making longitudinal cuts. Each of these strips was then sliced parallel to the testa so that besides the parings three sections of equal thickness were obtained from the white meat. The corresponding sections from each strip were then bulked, and analysed for moisture and oil content.

The results show that the section least rich in oil (56.3 per cent) is on the inside nearest the water cavity. The section richest in oil (75.4 per cent) is nearest the testa, and the intermediate section fits in between with an oil content of 67.8 per cent. The testa itself contains 62.4 per cent oil. It will be seen that the moisture gradient is in the reverse direction.

With a knowledge of these facts it is indeed easy to understand the changes that have been observed to take place in the kernel during germination. In germination it would appear that the inside tissues least rich in oil progressively break down as the haustorium (or apple) develops leaving the layers which are richer in oil. That this is plausible will be seen from the fact that the oil content of 76.7 per cent recorded for the very thin kernel wafer from drupes that have been in the nursery for 7½ months is not far different from 75.4 per cent the oil content registered for the region of the kernel nearest the testa.

The explanation for the drop in moisture content of the kernel with the progress of germination is similarly provided by the fact that the tissues on the inside which break down first are richer in moisture (59.3 per cent) than the residual layers nearer the testa (29.1 per cent).

8. Moisture Changes during Copra Drying in the Standard Ceylon Dryer

An experiment was carried out to study the moisture changes in the coconut kernel when dried in the standard Ceylon Dryer in accordance with the operational schedule outlined in C.R.I. Leaflet No. 15. Table XII below gives a summary of the figures obtained during successive stages when the copra was cured in the form of (*a*) cut kernels and (*b*) half cups.

TABLE XII

Moisture Changes in Copra during Curing Procedure in Ceylon Kiln.

1	2	3		4		5	
Stage	*No. of hrs. since splitting*	*% Moisture*		*Total moisture lost since splitting*		*Total moisture lost as % of original*	
		Cut Kernels	*Half Cups*	*Cut Kernels*	*Half Cups*	*Cut Kernels*	*Half Cups*
On splitting	nil	43.5	43.3	nil	nil	nil	nil
After Sun-drying	10	38.0	37.8	5.5	5.5	12.6	12.7
After 1st Fire	19	25.7	24.8	17.8	18.5	40.9	42.7
After 2nd Fire	34	17.1	16.4	26.4	26.9	60.7	62.1
After 3rd Fire	43	11.9	10.0	31.6	33.3	72.6	76.9
After 4th Fire	58	10.1	8.0	33.4	35.3	76.8	81.5
After 5th Fire	67	8.5	7.4	35.0	35.9	80.5	82.9
After 6th Fire	82	8.4	6.5	35.1	36.8	80.7	85.0
After 7th Fire	91	7.8	6.0	35.7	37.3	82.1	86.1
After 8th Fire	106	6.6	5.4	36.9	37.9	84.8	87.5

The results show that under climatic conditions prevailing in Ceylon only about 12 per cent of the total moisture is lost during 10 hours of initial sundrying.

Regarding essential drying principles it is generally agreed that :—

(1) The moisture content of the kernel has to be reduced from 50 per cent to 35 per cent preferably within 24 hours.

(2) During the second 24 hours the moisture content should be reduced to about 20 per cent.

(3) In the next 24 hours the moisture content should be reduced to 5 to 6 per cent.

It will be seen from Table XII column 3 that for the Ceylon Dryer the above requirements are more than fulfilled during the first 48 hours which may be regarded as the critical period of drying. After 48 hours the dryage is definitely slow in terms of the requirements. It would take at least 96 hours for the moisture to be reduced to 5.6 per cent in the Ceylon kiln as against the limit of 72 hours. It may be said that from the point of view of copra quality the slower drying towards the end is a desirable feature. When the bulk of the moisture in the kernel has been expelled, overheating would definitely tend to caramelize the sugars with resultant discolouration, decomposition and also hardening of the meat.

The principal virtue in the Ceylon kiln is its adaptability to both small and large scale processing. It can be said that there should be no difficulty in producing fairly uniform high grade copra with it, provided the standard operational procedure is rigidly adhered to.

9. Experiment on Copra Storage.

Consequent on a request made by the F.A.O., Working Party on Copra Quality and Grading, an experiment has been laid down to estimate economic losses to the producer resulting from loss of anhydrous copra during storage due to mould action, insect attack and general deterioration. The results of the experiment will be reported later on.

10. Miscellaneous Work.

Analyses and reports were made on a few samples of copra, poonac and vinegar.

W.R.N. NATHANAEL,
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REPORT OF THE BOTANIST

1. Hybridisation between Varieties and Forms.

Typica × *Nana*.—The performance of the first generation (F_1) palms of *typica* × *nana* (*i.e.*, the tall variety × dwarf variety) during the 5th to 8th years after planting has been summarised in the Annual Report for 1958. During the year under review *i.e.*, the 9th year, these palms have continued to give good yields (Table 1). The mean yield per progeny per year from the 6th to the 9th year has been 68, 86, 65 and 103 nuts or 34, 39, 35 and 49 lb. copra respectively. A mean yield of 103 nuts equivalent to 49 lb. copra per palm in the 9th year after planting is indeed very satisfactory.

TABLE 1

Mean yield per progeny of *typica* × *nana* in the 9th year

Cross	*No. of progenies*	*No. of nuts*	*Weight of husked-nuts (lb.)*	*Weight per husked-nut (lb.)*
360 × 1713 ..	4	97	144.0	1.48
218 × 1713 ..	5	104	203.8	1.64
360 × 1712 ..	5	112	168.7	1.50
139 × 2646 ..	4	83	116.4	1.41
778 × D ..	3	73	82.7	1.13
273 × 2646 ..	1	144	198.5	1.38
Mean per progeny ..	—	103	147.0	1.48

It has been pointed out previously, that considerable and significant variations exist between families with at least 4 progenies each. In 9 year old palms yield has varied between 65 and 37 lb. of copra per palm. Thus in any programme to utilise vigour of F_1 palms of *typica* and *nana*, it is necessary to take cognizance of the variation between families and isolate as far as possible desirable combinations for seed multiplication. With that end in view, a crossing trial using 25 selected *nana* palms and 5 selected *typica* palms was carried out during the year. The main purpose of this trial is to identify *nana* palms that show general combining ability.

To study the performance of *typica* × *nana* hybrids in the different coconut growing districts of Ceylon, 70 plants including both hybrids and *typica* open pollinated were issued to planters in 1957 and 1958 to be planted in different parts of the country. These plants were examined during the year and their growth so far has been satisfactory.

Pollinations for the production of seed was carried out at three stations and 9,800 female flowers were pollinated. 3,124 nuts from crosses done in 1958 were harvested and planted.

Typica × *Typica.*—An extensive programme of paired crosses between the tall variety palms was carried out at seven stations using selected palms as the female parents and a ' prepotent ' palm as the male parent. Altogether 31,000 female flowers were pollinated. 4,500 nuts from the crosses done during the previous year were harvested and planted in the nursery. Four of the prepotent palms were selfed with a view to fix prepotency and also to continue their line since they are senile.

A *Pollen Bank* has been developed with pollen collected from prepotent palms. Besides, using pollen samples for our crosses, 4,610 samples were issued to six private estates who are carrying out a programme of controlled pollination for production of seed. These estates were further assisted by training personnel for pollination work and by checking work in progress whenever necessary.

2. Identification of Prepotent Palms.

During the year, three more *typica* palms were provisionally classified as 'prepotent,' bringing the total of such palms to seven.

A progeny trial was planted at Bandirippuwa Estate in December, 1959, to identify prepotent palms by the method of comparison of open-pollinated progenies. Seed-nuts of 125 selected high-yielding palms were planted in a nursery, and 9 seedlings taken at random from each family were transplanted. The design of the trial is a cubic (5^3) lattice, with 3 progenies per plot and 3 replications.

The progeny trial that was planted at the Government Farm, Walpita and which was subsequently abandoned due to various difficulties of management was handed back to the Institute in June 1959. During the year agricultural operations were undertaken to put the block in order. Yield recording of individual palms would be continued from January 1960.

3. Replantation.

A field trial was initiated in 1950 to study the relative merits of three methods of underplanting senile coconut plantations, *viz.*, (*a*) *New clearing* — planting after the removal of the old stand of palms completely, (*b*) *Gradual thinning* — under planting and removing the old stand of palms gradually, and (*c*) *No thinning* — under planting without removal of the old palms, the latter to be removed during the initial stages of bearing of the young palms. The design of the trial is a randomised block layout with 25 palms per plot and 7 replications.

Under gradual thinning about 20 per cent of the old palms were removed before underplanting and thereafter 10 per cent every year. All the old palms in the no thinning treatment were uprooted at the end of the 8th year.

With regard to leaf production and early flowering in the young palms, it has been shown that the three systems of underplanting could be placed in the following order of merit :—(i) new clearing (*ii*) gradual thinning and (*iii*) no thinning (Annual Report for 1957).

Flowering Period.—The flowering period of a palm has been taken as the period from transplanting a seedling to the emergence of the first spathe on the palm. The percentage of palms in flower, cumulative for each year is given in Table 2.

TABLE 2

Percentage of palms in flower in the Replantation Experiment

Treatment	*Year after planting*				
	5th	*6th*	*7th*	*8th*	*9th*
New clearing	12.0	44.0	63.3	84.6	89.7
Gradual thinning	3.4	25.1	45.1	65.7	74.3
No thinning	1.7	12.0	26.3	44.0	53.1

The variance ratio for each year is significant indicating that the type of treatment had an effect on the flowering period of the palm. The presence of the old stand of palms has retarded the growth of the second plantation considerably that only 53 per cent of the palms were in flower during the 9th year whereas over 74 per cent of the palms of the other two treatments have flowered. An analysis of variance of the palms in flower in the 9th year is indicated in Table 3.

TABLE 3

Analysis of variance of palms in flower in the 9th year

		Degrees of freedom	*Sum of squares*	*Mean square*	*F*
Blocks	..	6	152	25.3	
Treatments	..	2	295	147.5	8.38 ***
Error	..	12	211	17.6	
Total	..	20	658	—	

****Significant* $P < 0.01$

The new clearing and gradual thinning treatments have given significantly more palms in flower than in the no thinning treatment, but the differences between the first two treatments are not significant.

Yield of Nuts.—Yield of nuts and copra during the 8th and 9th years after planting are given in Table 4. The yield of copra has been calculated as 32 per cent of the weight of husked-nuts. The analysis of variance for each factor for each year shows that the differences between treatments are statistically significant for $P < 0.05$.

In the 8th year, palms in the new clearing treatment have given significantly more nuts and copra than those in the other two treatments; differences between gradual thinning and no thinning treatments are not significant, although the former has given appreciably more nuts and copra than the latter (Table 4).

TABLE 4

Yield of nuts and copra per acre in the Replantation Experiment

		8th year		*9th year*	
		Nuts	*Copra (cwts.)*	*Nuts*	*Copra (cwts.)*
New clearing	..	1,065	5.71	1,718	8.45
Gradual thinning	..	538	2.72	1,245	5.78
No thinning	..	225	1.21	594	2.97
Critical difference	..	521	2.95	762	3.96

In the 9th year the yield with respect to nuts and copra has been in the following order of merit :— (*i*) new clearing, (*ii*) gradual thinning and (*iii*) no thinning. The differences between treatments (*i*) and (*ii*), (*ii*) and (*iii*) are not significant, yet yields of (*ii*) are appreciably more than that of (*iii*). The new clearing has given significantly more nuts and copra than the no thinning treatment.

General.—On the basis of data collected from the replantation trial, certain *provisional* recommendations could be made regarding underplanting of senile coconut plantations. The system of underplanting leaving the old stand of palms completely and removing them when the young palms are 7 to 8 years old cannot be recommended as the presence of the old palms adversely affect the growth and flowering of the under plantation. Although the new clearing method has shown the best results on an experimental scale, yet it cannot be recommended as the performance of the young palms relative to the gradual thinning method has not been so remarkable so as to offset the loss in crop due to removal of the old stand of palms completely.

Thus, considering particularly the small holders, a feasible and efficient method of under planting is the gradual thinning system. The following procedure is provisionally recommended. After lining out the area to be underplanted, remove all the old palms lying within 6 feet of the new planting sites and the other unproductive palms. Under this category about 30 per cent of old stand of palms may have to be removed. Thereafter, 20 per cent of the original stand of palms should be removed at the end of 2nd, 4th and 6th years. At the second thinning of palms *i.e.*, at the end of the 2nd year, palms lying within 10 feet of the young palms should be uprooted. Subsequent thinnings could be done on a basis of yield of the old palms. All the remaining old palms should be removed at the end of 8 years.

4. Planting Techniques.

Size of Seed Hole.—This field trial initiated in November 1955 is to study the relationship if any, between the size of seed hole used to transplant a coconut seedling and its subsequent growth. Number of leaves produced during the year and the total number of green leaves per plant were scored and the data are presented in Table 5. The analysis of variance indicates that there are no significant differences between the treatments with respect to the two characters listed above.

TABLE 5

Leaf production at the end of the 4th year in the Size of Seed Hole Experiment

	Mean per plant	
Type of seed hole	*No. of new leaves produced during the year*	*Total No. of green leaves*
A 1 × 1 × 1 feet	10.1 ..	16.0
B 3 × 3 × 3 feet	9.9 ..	16.1
C Cruciform	9.7 ..	16.3
D Post hole borer	10.1 ..	16.2

Depth of Planting.—The field trial laid down in November 1956 to study the relationship, if any, between depth of planting a coconut seedling and its subsequent growth has completed three years. Leaf characters were recorded as for the previous experiment (Table 6). Here again, the differences between treatments with respect to leaf production are not significant.

TABLE 6

Leaf production at the end of the 3rd year in the Depth of Planting Trial

	Mean per plant	
Treatment	*No. of new leaves produced during the year*	*Total No. of green leaves*
6 inches deep planting	8.4 ..	11.7
12 inches deep planting	7.7 ..	10.8
18 inches deep planting	8.5 ..	11.5
24 inches deep planting	8.3 ..	11.4

Hedge Planting.—The observation plots of this new system of planting have completed three years. It is yet premature to make any observations.

5. Miscellaneous.

Routine observations and yield recording of the Latin Square Selection Experiment and other trials were continued.

Isolated Seed Garden.—Five acres were planted with selected dwarf palm seedlings in December 1959 for the mass production of Dwarf × Tall hybrid seed. When the dwarf palms flower, it is proposed to emasculate them systematically, so that their female flowers would be naturally crossed with the tall variety palms in the Seed Garden; thus, making available a large quantity of hybrid seed.

Mother Palm Selection.—Seven estates were visited for selection of mother palms and 396 palms were selected.

Personnel.—Dr. D.V. Liyanage, Botanist visited Thailand, Philippine Islands and Indonesia in March/ April 1959 under the auspices of the United States Operations Mission to study coconut varieties and forms found in those countries. Dr. Liyanage attended as a delegate of Ceylon the Second Session of the FAO Group on Coconut and Coconut Products Working Party on Copra Quality and Grading held at Colombo in August 1959. Mr. M.P. Manthiriratne, Technical Assistant, was granted two years leave from August 1959 to do a course of studies leading up to the degree. Mr. M. Goonewardene was recruited as a Field Assistant in July 1959.

Publications.—A paper entitled, 'Heritabilities of Certain Yield Characters of the Coconut Palm' by Dr. D.V. Liyanage and Dr. K.I. Sakai was submitted for publication in the Journal of Genetics. Dr. Liyanage read a paper on 'Seed Production in Coconuts' at the Coconut Conference held in December 1959 and addressed a meeting of the Southern Province Planters' Association in June 1959.

D.V. LIYANAGE,
Botanist.

REPORT OF THE ACTING AGROSTOLOGIST

Introduction

During the year under review, most of the work was carried out smoothly. However, at the end of the year, there was some delay in setting up pot experiments due to the non-availability of viable *Paspalum commersonii* seeds. The pest responsible for the destruction of seeds was believed to be the 'paddy-bug'. Measures to irradicate this pest are being taken.

Most of the pasture trials where *Paspulum commersonii* was used were planted to *Brachiaria brizantha,* thus providing increased replications.

Certain areas — both in Bandirippuwa and Ratmalagara Estates have been planted to *Brachiaria brizantha* and *Brachiaria milliformis* to provide feed for the cattle during the 'non-grazing periods' of the pasture trials.

B. Soil Fertility Studies

1. Lateritic Soils at Bandirippuwa Estate

(*a*) *Follow-up Experiments:*

The two experiments commenced last year with soils one year after manuring were completed.

Experiment I

This was a $4^2 \times 3$ factorial experiment planted to *Paspalum commersonii.* The nutrients nad levels tested were as follows:

N as $(NH_4)_2SO_4$	..	..	..	Nil and 5 cwts./acre.
P as NaH_2PO_4	..	..	..	Nil and 3 cwts./acre.
K as K_2SO_4	..	..	..	Nil and $4\frac{1}{2}$ cwts./acre.
Ca as $Ca(OH)_2$	..	..	..	Nil and 10 cwts./acre.

This experiment was carried through two harvests. N gave very high positive responses. P also gave positive responses that were neither high nor consistent as with N. Calcium was responsible for depression in yields.

The results obtained for the three soil types at the two harvests are summarized in the following table:

TREATMENT		Ca_0		Ca_{10}		Effective Treatment	Level of Significance
		KO	K 4½	KO	K 4½		
1st H A R V E S T SAND	N_0P_0	1.17	2.00	1.92	2.64	N	0.1%
	N_5P_0	6.72	7.05	6.32	6.52	P	1.0%
	N_0P_3	3.17	2.28	3.60	2.22		
	N_5P_3	13.11	16.39	7.93	10.92		
LOAM	N_0P_0	1.75	1.45	3.58	3.21	N	0.1%
	N_5P_0	8.45	12.37	5.55	11.98		
	N_0P_3	3.42	2.07	2.92	2.30		
	N_5P_3	10.20	7.67	10.49	5.43		
GRAVEL	N_0P_0	2.56	4.33	3.32	4.82	N	0.1%
	N_5P_0	2.83	5.91	3.88	3.79	P	0.1%
	N_0P_3	3.72	3.14	3.98	5.17	NP	1.0%
	N_5P_3	11.74	12.31	9.01	9.78		
2nd H A R V E S T SAND	N_0P_0	1.03	0.96	1.29	1.43	N	0.1%
						K	1.0%
	N_5P_0	2.79	1.66	2.81	5.48	Ca	0.1%
						NK	1.0%
	N_0P_3	1.29	0.88	1.51	1.56	NCa	1.0%
	N_5P_3	0.93	3.73	2.90	7.01	NPCa	1.0%
LOAM	N_0P_0	1.50	0.67	1.65	1.38	N	0.1%
	N_5P_0	4.05	6.59	4.16	7.52		
	N_0P_3	2.17	1.00	2.37	1.80		
	N_5P_3	3.63	5.78	3.42	6.53		
GRAVEL	N_0P_0	0.58	0.84	0.40	0.56		
	N_5P_0	0.22	1.36	0.82	3.95		
	N_0P_3	0.93	0.78	0.68	2.03		
	N_5P_3	3.24	5.55	2.51	2.76		

Table I.—Showing yield (gms. dry wt.) and level of significance of effective treatments at the two harvests.

Experiment II

This was a 4 × 4 × 3 factorial experiment planted to *Paspalum commersonii* to determine the optimum dosages of the deficient nutrients, N and K for the three soil types.

The nutrients and levels tested were as follows :—

N as $(NH_4)_2SO_4$ — Nil, 1¼, 2½ and 5 cwts./acre.
K as K_2SO_4 — Nil, 1½, 3 and 4½ cwts./acre.

The experiment was carried through two harvests.

Results were summarized in the following table :—

Treatment	*Sand*	*Loam*	*Gravel*
N_0	5.13	6.53	10.68
$N_{1\frac{1}{2}}$	19.35	19.27	14.02
$N_{2\frac{1}{2}}$	27.70	22.67	16.52
N_5	23.84	22.38	24.12
K_0	13.97	18.63	16.81
$K_{1\frac{1}{2}}$	20.29	15.77	17.22
K_3	19.84	18.72	16.22
$K_{4\frac{1}{2}}$	21.92	17.73	15.20

Table II.—Showing total mean yields for the two harvests (gms. dry wt.) for different levels of treatment for the three soil types.

The optimum requirements of N and K for the various soil types were as follows :—

(*a*) Sand — $N_{2\frac{1}{2}}$ cwts./acre
$K_{1\frac{1}{2}}$ cwts./acre

(*b*) Loam — $N_{1\frac{1}{2}}$ cwts./acre
K no response

(*c*) Gravel — $N_{1\frac{1}{2}}$ cwts. per acre
K no response.

Soils were again sampled two years after manuring in November, and an experiment was set up with the three soil types. This was a 3 × 3 × 4 factorial experiment with K (Nil, $1\frac{1}{2}$, 3 and $4\frac{1}{2}$ cwts./acre), P (Nil, $1\frac{1}{2}$ and 3 cwts./acre) and Ca (Nil, 5 and 10 cwts./acre) for the three soil types. The experiment was planted to *Paspalum commersonii* and is in progress.

A further experiment using the lateritic sand from the newly acquired section of B/E was set up. This was a 3 × 3 × 4 factorial experiment of N (1, 2, 4 and 6 cwts./acre), P (1, 2 and 4 cwts./acre) and K (1, 2 and 4 cwts./acre); planted to *Brachiaria milliformis*. Commercial fertilizers were used and limbux (40 cwts./acre) was applied as basal dressing. The experiment was planted in clay pots 12" diameter and kept on wooden benches in the open. Rain water is being used to water the pots.

2. Cinnamon Sand at Horrekelly Estate.

(*a*) *Follow-up Experiments :*

Further to last year's report, soils were sampled 2 years after manuring in April and the results of the studies including the preliminary experiments indicate the following initial dressing (*vide* Bulletin No. 11) :—

1. After 6 months an appropriate dressing of N and K will be required.
2. After 12 months there will be a need for still more N, with perhaps some additional K to tide over a potential deficiency.
3. After two or possibly three years some additional Ca will be required.
4. Any addition of P should be withheld or at least applied with caution only after the second year.
5. There appears to be no need for application of Mg.

3633—D

3. Hard-Pan from the Cinnamon Sand.

The three experiments set up last year were completed and the results are being written for publication. The summary and conclusions are as follows :—

The data from these experiments indicate an acute deficiency of N, P, K, Ca, Mg and B. The top soil was also found deficient in all these nutrients.

4. Forest Soil at Ambakelly.

The studies with the sub-soil at Ambakelly were completed and a paper " 3C " in the series was submitted for publication under the joint Authorship of K. Santhirasegaram and D.E.F. Ferdinandez.

The summary and conclusions are as follows :—

"The sub-soil was found to be deficient in N, P and K as was the top soil. Comparison of the relative yields indicate that the sub-soil is more deficient in N and P than the top soil. The pattern of responses however, appear to be similar in both cases.

Unlike the top soil, the sub-soil gave marked response to Calcium which was due not to a deficiency of the nutrient but to the low "Buffer Capacity" as indicated by change in pH and lack of response to calcium applied as sulphate."

5. Soil at Ratmalagara Estate.

(a) Preliminary Studies :

The surface and sub-soil at Ratmalagara were studied in some detail. The results have been written up for publication. The summary and conclusions are as follows :—

1. For the purpose of these investigations the lateritic soils at Ratmalagara Estate have been briefly described, and two types — " gravel " and " loam " have been defined. This paper records experiments on these and the " sub-soil " beneath the " loam." Detailed studies were carried out only with the " loam."
2. The data shows that these soils are deficient in nitrogen, phosphate and potash, and that the acuteness increases with time.
3. Application of calcium was found to be harmful for the growth of plants where significant depressions were recorded for initial application of 10 cwts. $CaCO_3$/acre, on all soils.

   There was no apparent deficiency of magnesium, iron, copper, zinc, manganese, boron or molybdenum.

   Nitrogen was at all times an important limiting factor in plant growth and on the basis of 100 per cent for plants receiving N, P and K, relative yield for *Paspalum commersonii* (lam) — grown without any application of nitrogenous fertilizer — decreased from an initial valve of 25.5 at thinnings to 5 at subsequent harvests in the loam.
4. In absence of phosphatic fertilizers highest relative yields recorded was 8.7 at first harvest and at second harvest all plants that did not receive phosphorus died.
5. In absence of potassium relative yield of 97.8 was recorded at thinnings (27 days) which steadily dropped to 4.8 at the last harvest (82 days).
6. Optimum requirements of phosphorus and potassium were found to be 2 cwts./acre NaH_2PO_4. $2H_2O$ and K_2SO_4 respectively.

(*b*) *Follow-up Trials.*

Studies 6 months after manuring :

The soils were sampled 6 months after manuring in December and two experiments set up.

The first is a $2^2 \times 3$ factorial experiment with P (O and 2 cwts./acre), K (O and 2 cwts./acre) and N (O, $2\frac{1}{2}$ and 5 cwts./acre); and the second is a 4^2 factorial experiment with P (Nil, 1, 2 and 4 cwts./acre) and K (Nil, 1, 2 and 4 cwts./acre). Both experiments were planted to *Paspalum commersonii* and are in progress.

6. Lateritic Gravel at Mattegoda Estate.

(*a*) *Top-soil :*

The studies with the top-soil are nearing completion. The top-soil as evident from the data of experiments was found to be deficient in N, P, K and B.

(*b*) *Sub-soil :*

Studies on the sub-soil were commenced during the later part of the year.

In addition to the nutrients deficient in the top-soil, the sub-soil appears to be deficient in Ca and Mg. These experiments are in progress.

The results of all these experiments on Mattegoda lateritic gravel will be written up for publication.

7. Vanathavillu Forest Soil.

Two soil types were recognised on the catena. One a red loam on the ridges and the other a yellowish brown clayey loam along the slopes.

Experiments laid on these two soil types with soils before and after the forest was burnt, are nearing completion.

The experiments indicate a deficiency of N, P and K in both soil types — both before and after the forest was burnt. Calcium gave a depression in yields which was more acute in soils after the forest was burnt.

No deficiency of micro-nutrients was detected.

The results of these experiments will be written up for publication.

8. Pothukulama Forest Soil.

The forest soil from Pothukulama was sampled in August and experiments laid with this soil.

The data of the experiments so far obtained indicate a deficiency of N, P and K. No deficiency of micro-nutrients was detected.

The experiments are in progress.

C. PASTURE TRIALS

Based on the results obtained in 1958, *Paspalum commersonii* was eliminated from most of the experiments and the designs were altered to either increase the number of replicates or to substitute *Brachiaria milliformis*. Due to these operations which were carried out during May/June the experiments were not grazed during greater portions of the year.

1. *Comparison of four grasses.*—In this experiment the *Paspalum* plot where by the end of 1958 nearly all *Paspalum commersonii* plants were dead is being maintained under natural cover and is being referred to as Control.

The *Brachiaria brizantha, Brachiaria milliformis* and this control plot were grazed with five heifer calves. Grazing commenced in the three plots at the same time. The Guinea grass however was grazed as in previous years.

In April and October all plots received 1 cwt./acre Sulphate of Ammonia. In October all plots were sub-soiled before the application of fertilizers.

The yield of nuts were as follows.—

Grass	*No. of nuts/plot*	*No. of nuts/acre*
(i) Paspalum Commersonii (Control) ..	558	2,976
(ii) *B. brizantha* ..	649	3,461
(iii) *B. milliformis* ..	665	3,546
(iv) *P. maximum* ..	531	2,832

This year the third experimental year has been completed and no definite indications are shown except a slight depression due to Guinea grass. With the control plot the next year should show some indications.

Plots (i) - (iii) which were grazed with five Sinhala heifers each, showed no difference in the live weight increase of the animals during the three months under observation from July to September.

The Guinea grass was grazed four times during the year giving 675 'grazing days' which was the same as in 1958. The following herbage yields were observed:—

	1st	*2nd*	*3rd*	*4th*
Before grazing ..	4.58	2.32	2.98	2.32
After grazing ..	2.96	1.70	1.40	0.96
No. of days of grazing ..	22	17	16	20

Herbage yield of *P. maximum* (tons dry matter/acre).

2. *Pasture × type of manuring trial B/E.*—The *Paspalum* pasture of this experiment has now been converted to *B. milliformis* and the two plots will be used to compare two intensities of grazing as from 1960. No grazing was carried out in 1959 as the former *B. milliformis* plot was cut and cuttings used to plant other experiments. The plots were manured with 1 cwt./acre Sulphate of Ammonia in April and October. The 3rd palm manuring is due in 1960 October. The nut yields of various treatments were as follows:

	Fertilizer buried in Trenches	*Buried in Circles*	*Broadcast in Strips*	*Broadcast in Circles*	*Total*
Paspalum ..	329	272	342	381	1,324
Brachiaria ..	327	244	224	316	1,111
Total ..	656	516	566	697	2,435

Cultivation × Pasture Experiment R/E

3. During the last two years this experiment consisted of pastures of *Paspalum commersonii* and *Brachiaria brizantha*. The *Paspalum* plots have now been planted to *Brachiaria brizantha* and grazing will commence early next year when all plots will be grazed at an intensity of one animal/acre/year in such rotation that animals are moved from plot to plot at 28 days interval irrespective of season.

The nut yields for the year due to cultivation treatments do not show any marked difference from that of previous years.

	Not sub-soiled	*Sub-soiled*	*Total*
P. commersonii ..	974	698	1,672
B. brizantha ..	804	1,038	1,842
Total ..	1,778	1,736	3,514

Intensity of grazing trial R/E

4. All *Paspalum* treatments on this experiment have now been discontinued and the design reconstituted so as to estimate the effect of the three intensities of grazing of *B. brizantha* pastures more accurately by introducing a further replicate of the plots. The reconstituted design is as follows:

1. Two $\frac{1}{2}$ acre plots without grass (control).
2. Two $\frac{1}{2}$ acre plots with *B. brizantha* (ungrazed).
3. Two 1 acre plots with *B. brizantha.*
4. Two $1\frac{1}{2}$ acre plots with *B. brizantha.*
5. Two 2 acre plots with *B. brizantha.*

The grazing management has been changed so that plots 3, 4 and 5 of each replicate are grazed and rested at the same time. This would have uniform effect on all palms on the experiment.

Nut yields for various treatments are given below as per last year.

	Average yield/ palm (No. of nuts)	*Computed yield per acre*
Control (No grass) ..	87.5 ..	5605
Control Paspalum ..	87.0 ..	5567
Paspalum 1 acre/beast ..	90.3 ..	5781
„ 1½ „ „ ..	79.5 ..	5091
„ 2 „ „ ..	86.6 ..	5543
Control Brachiaria ..	79.2 ..	4816
Brachiaria 1 acre/beast ..	75.0 ..	4800
„ 1½ „ „ ..	73.9 ..	4732
„ 2 „ „ ..	80.0 ..	5120

Examination of these data will show that compared to the control (no grass) plots the depression caused by *Paspalum* is 110 nuts/acre (5605 to 5495) while that caused by *Brachiaria* is 738 (5605 to 4867). It should however be noted (*vide* Annual Report 1958) the growth of *Paspalum* was very scanty hence the low depression is not an expression of the real effect. The depression in *Brachiaria* plots may however be considered as due to the grass. The results over the next two years with the new design should provide interesting data.

Mixed Pasture R/E.—Here too the *Paspalum* plots have been replanted to *Brachiaria brizantha* and from early 1960 the four plots will be divided into two replicates of continuous *vs.* rotational grazing.

Frequency of cutting trial R/E.—Two seasons data with *Paspalum commersonii* have been completed and the material is preserved for chemical analysis. The plots were ploughed up in May and planted to *Brachiaria milliformis.* Similar observations will commence with this species as from June 1960.

Pasture × Manurial Experiment B/E.—One year of pre-experimental record was completed with the 4th pick. The experiment was planted to the various grasses in April and manurial treatments applied for the first time during that time. It was originally planned to commence grazing following the N/E rains but due to delay in completion of fencing it is now postponed to June 1960.

D. Animal Husbandry.

Cattle Population.

The herd strength on 31st December 1959.

	Cows	*Bulls*	*Heifers*	*Bull Calves*	*Total*
Bandirippuwa ..	27	1	33	32	93
Ratmalagara ..	18	2	15	8	43
	45	3	48	40	136

Number of Calvings and Sex.

	Males	*Females*
Bandirippuwa ..	11 ..	11
Ratmalagara ..	15 ..	8

The three bulls were used for service as follows :—

A2 (Bandirippuwa) — 35
R4 (Ratmalagara) — 20
K111 (Ratmalagara) — 5

The details of milk production are as follows :—

Month	Total yield in pts.		Av/cow/month		Av/cow/day	
	B/E	R/E	B/E	R/E	B/E	R/E
January ..	1174	533	102.1	131.1	3.2	4.2
February ..	1167	506	100.6	112.5	3.6	4.02
March ..	1392	1347	139.1	158.3	4.5	5.3
April ..	1827	1897	153.5	147.7	5.1	4.9
May ..	1954	2214	161.0	154.9	5.2	4.9
June ..	2954	995	156.0	135.3	5.2	4.5
July ..	3607	1368	146.0	124.2	4.7	4.0
August ..	3669	1547	142.0	117.5	4.6	3.8
September ..	3017	1255	123.0	112.2	4.1	3.7
October ..	2679	1092	111.0	117.7	3.6	3.9
November ..	2436	1054	110.0	136.2	3.6	4.5
December ..	2066	1351	110.1	160.0	3.6	5.2
Total ..	27942	15159	—	—	—	—
Mean ..	2328.5	1263.25	129.5	134.0	4.25	4.40

Milk Production.

	Bandirippuwa	Ratmalagara
Issues to Staff ..	17,164.5 pints	3,701 pints
Issued to Milk Board ..	6,582.0 „	12,192 „

Animal Disposal.

	Bulls	Cows	Heifers	Bull-calves	Total
Sold ..	1	7	—	2	10
Dead ..	—	—	—	—	—
Total ..	1	7	—	2	10

Animal Health.

During the year the health of the herds have been satisfactory. There have been a few cases of mastitis, and rumen impaction, but they were not widespread. Bull No. R4 at Ratmalagara suffered from a disease very much like the symptoms produced by acute " Photosensitation " where large areas of the skin become inflamed, tender, and in the latter stages cracked and peeled off. However it responded to treatment.

There have been no cases of sterility or abortion during the year.

Disease Prevention.

All the animals have been immunized against H.S. during the year. Further, the milking animals have been immunized against hoof and mouth disease.

All animals were wormed every three months. A new wormicide — Coopane was used which proved very effective.

K. SANTHIRASEGARAM,
Acting Agrostologist.

REPORT OF OFFICER-IN-CHARGE, CROP PROTECTION DIVISION

It was found that experimental work in the control of pests and diseases could be done best in the field, as and when pest infestations and incidence of diseases occur. Therefore, no major laboratory experiments were initiated this year. The Crop Protection Officer (Mr. Hilary F. Goonewardena) was away on Study at Rutgers University in America. Since he was away, no laboratory research was undertaken other than direct investigational work in the identification of diseases.

A. Laboratory Work.

Specimens of diseased parts of palms, suspected to be affected by Bud-rot Stem bleeding, Grey blight (*Pestalozzia palmarum*) were examined. A positive identification was not readily available in the first two diseases mentioned.

B. Field Experiments.

It was observed that common field experimental designs do not lend themselves easily to experimental work with most pests of the palm. It was found advisable to conduct simple trials in the first instance.

(1) Control of Red Weevil (*Rhyncophorus ferrugineus*). Field trials were conducted to find methods of injecting a Systemic insecticide, into trunks of palms, to kill Red Weevil grubs, found therein. The method of treatment described below was found satisfactory.

A hole is bored into the trunk above the area of infestation. A tin funnel is fixed, and 10 c.c. or two teaspoonfuls of Systox is poured into the tin funnel can, containing $\frac{3}{4}$ bottle of water. For the trials, Systox was issued in glass ampules with tapered ends. When the ends are broken the contents flow into the funnel can; thus touching the chemical is avoided. The insecticide will get translocated in the palm. It will kill all the grubs.

A sealing material is used to prevent leaks. Locally available material were found to be satisfactory *i.e.*, a mixture of old jak tree latex (*Artocarpus incisa*) and gum resin.

Although very satisfactory results were obtained, the use of Systox is not generally recommended as yet, because of possible hazards in handling.

C. Pest Control Service.

Spraying campaigns were conducted to control :—

(*a*) Coconut caterpillar (*Nephantis serinopa*) infestations at Kurunegala and Ambalantota, using Arkotine D. 18.

(*b*) Coconut scale (*Aspidiotus destructor*) control at Hikkaduwa and Madampe. Kerosene oil emulsion was used.

(*c*) Grey blight (*Pestalozzia palmarum*) control at Embilipitiya; a heavy attack on seedlings. The fungicide manzate was used.

(4) *Coconut caterpillar pest out-break at Nikadalupotha.*—This infestation broke out towards the end of the previous year. A survey was done to assess the extent of damage. Nearly 500 acres were heavily damaged, and about 1,000 acres were partially affected. A control campaign was organised. Circular letters were sent out advising cultural methods of control. The heavily infested areas were sprayed with Arkotine D. 18. The Department of Agrarian Services loaned Spraying machines and personnel to assist the Coconut Research Institute staff and equipment.

The scheme of work was later intensified. A field laboratory was established in the area. Parasites were bred and liberated. The officers of the Department of Agriculture collaborated. The Entomologist, Department of Agriculture, sent parasites to supplement our breeding. He paid several visits to watch the progress of work.

Towards the end of the year, the pest populations declined and eventually the infestations disappeared. The Field laboratory was still maintained with a watch for re-infestations.

D. Advisory Work.

Following reports of the Advisory Field Officers, visits were made to estates and small holdings, to inspect, identify and recommend control measures of pests and diseases.

E. Parasite Breeding.

The breeding of *Trichospilus pupivora*, pupal parasite of *Nephantis serinopa* was intensified, particularly to meet the demand following a heavy out-break of the pest. *Tetreastichus israeli*, a pupal parasite, was introduced by Dr. V.P. Rao, of the Commonwealth Institute of Biological Control, Indian Station. Few alterations to the Insectary building have been suggested and the Architects will shortly attend to it.

F. Records of Pest infestations and incidence of diseases.

A proper census of pest infestations and the incidence of diseases is necessary to assess actual damage from pests and diseases. These records were begun from this year. The data collected, includes ecology studies and unusual symptoms; also other observations worthy of record. This information is considered absolutely necessary before launching research projects and control campaigns.

G. Lectures and Articles.

Talks on recent pests outbreaks were given at meetings of the Planters' Association, Kurunegala, and the Low Country Products Association, Colombo. A paper was read at a Research Conference on "The First Steps in Crop Protection in Coconut Cultivation."

H. Visitors.

Mr. W.V.D. Peiris, Regional Officer, F.A.O.
Dr. F.J. Simmonds, Director of the Commonwealth Institute of Biological Control.
Dr. V.P. Rao, Chief Entomologist, Indian Station, of the Commonwealth Institute of Biological Control.

I. Training.

A number of newly recruited Coconut Instructors and students were given training in the control of pests and diseases of the Coconut Palm, with lectures in the laboratory and demonstrations in the Field.

J.K.F. KIRTHISINGHE,
Officer-in-Charge, Crop Protection Division.

REPORT OF THE BIOMETRICIAN

Statistical Work.

As in other years, all the Research Divisions of the Institute were helped by the Biometrician, in the design of experiments and statistical analysis of data. Moreover, the Biometrician was always co-opted whenever Research Officers were engaged in the interpretation of experimental results.

During this year, preliminary steps were taken for several new experiments. The most noteworthy of those for which designs were prepared by us were (1) Response curve experiment on young palms with catch-cropping, (2) Response curve experiment (4^3 confounded factorial design) at Bandirippuwa Estate, (3) Fertilizer placement trial (split plot design) at Walahapitiya Estate and (4) The Progeny Trial at B/E.

Routine statistical work of a mechanical nature is now on the increase and a new Field Assistant had to be recruited for the Division to cope up with the work.

Agri-Meteorological Stations.

The Agri-Meteorological Stations at Bandirippuwa and Ratmalagara Estates were maintained satisfactorily.

The new Meteorological Station at Isolated Seed Garden, Ambakelle; functioned as from February, 1959.

Agri-Meteorological Studies.

(1) A yield survey was commenced with a view to do a preliminary study of the influence of climate on coconut crops. All Estate Agencies responded spontaneously to our call for co-operation. Several estates have already been visited and very reliable and useful data have been collected. This work will be continued in 1960.

(2) A study of the incidence of dry spells in coconut growing areas was commenced. The daily rainfall figures during the last 25 years for about a hundred representative rainfall stations were collected from the Observatory and these are now being statistically analysed.

The Weather Report.

The rainfall in 5 stations representative of certain important coconut growing areas is given below :

Rainfall — 1959 and Crop Prospects — 1960 Rainfall in Representative Areas

Area	*Total Rainfall* 1959	1958	1953-58 *Average*	*Effective Rainfall* 1959	1958	1953-58 *Average*	*Distribution Indices*	1959	1958	1953-58 *Average*
Lunuwila .. (B/E)	71.08	76.19	78.96	71.08	65.99	74.14	(i)	1.39	1.34	1.71
							(ii)	1.96	1.72	2.94
Madampe .. (R/E)	64.37	55.94	65.33	64.37	55.94	64.81	(i)	1.39	1.32	1.52
							(ii)	1.83	1.59	2.25
Chilaw ..	70.19	40.66	61.92	60.69	40.66	59.85	(i)	0.84	1.29	1.38
							(ii)	1.44	1.59	1.87
Puttalam ..	48.74	46.65	45.60	48.74	46.65	43.33	(i)	0.98	1.15	1.15
							(ii)	1.19	1.44	1.41
Kurunegala ..	97.15	92.49	88.51	94.12	83.85	80.23	(i)	1.72	1.49	1.66
							(ii)	2.92	2.15	2.42

Except for areas around Lunuwila, most coconut growing areas have recorded a higher total rainfall and also effective rainfall during 1959, as compared with the previous year's rainfall or the average rainfall during recent times for the respective areas.

The rainfall distribution too showed an improvement in Lunuwila and Madampe as compared to 1958, although yet below average. The rainfall distribution in Kurunegala was much above average. In Chilaw and Puttalam however, the distribution has been relatively poorer.

Therefore Kurunegala area should enjoy very good crops during the year 1960. Lunuwila and Madampe areas too will show an improvement over the last year. Chilaw and Puttalam area, however, may not to the same extent, reflect the improved crop prospects that will be a general feature in most coconut growing areas during 1960.

Production and Exports.

The estimated production of coconuts in 1959 is 2,491,000,000 nuts, which is 12.9 per cent above the production in 1958, 1.7 per cent above the last 5 years' average and 9.3 per cent below the peak production recorded in 1955.

Total exports (in terms of nut equivalent) in 1959 is 1,139,586,000 nuts — this being 28.0 per cent above 1958, 5.1 per cent lower than last 5 years' average and 26.1 per cent lower than the peak exports recorded in 1955.

The average value of exports per 1,000 nuts is Rs. 213.97 in 1959 which is 16.5 per cent above 1959, 28.8 per cent above the average for the last 5 years, and 17.2 per cent lower than the recent highest price recorded in 1951.

General.

The Biometrician attended two meetings of the Chilaw Planters' Association and one of the Kurunegala Planters' Association.

A joint paper with the Soil Chemist, Rubber Research Institute of Ceylon on " Fertilizer responses of Hevea Braziliensis on two different soils in Ceylon " was read at the last sessions of the Ceylon Association for the Advancement of Science.

A talk on " Climate and Crops " was delivered at the Technical Conference of the Coconut Research Institute, held in Colombo.

V. ABEYWARDENA,
Biometrician.

REPORT OF THE SOIL SURVEY UNIT

Introduction.

The Soil Survey Unit inaugurated in September 1958, started its programme of work only with the beginning of 1959.

Vanathavillu Soil Survey.

The Analytical work on some soils brought from Vanathavillu was continued. Judging on the physical properties of the soil a major portion of the area surveyed was found suitable for coconuts. These soils also showed an appreciable amount of exchangeable bases and lesser amount in the other major nutrients.

Pottukulama Soil Survey.

A detail soil and land use Survey of about 300 acres of secondary jungle was carried out at Pottukulama. This was for the main purpose of establishing a Sub-Station. After the field work was completed a land use map of the area under review was compiled on a scale of 4 chains to an inch. Based on this map 40 acres of land was selected by the Soil Chemist for starting an experiment. Detail Chemical Analysis of these soils was completed and are given below.

Mechanical Analysis of Pottukulama Soil

Pit No. 1

Profile	1	2	3	4	5	6
Coarse sand %	75.75	80.99	73.68			
Fine sand %	17.11	12.27	17.56			
Silt %	6.45	.55	.65			
Clay %	7.80	7.8	7.65			
Moisture	6.89	.409	.524			
Colour	5 YR. 5/2	10 YR. 7/3	10 YR. 7/4			
Soil Type	Loamy Sand	Loamy Sand	Loamy Sand			

Pit No. 2

Profile	1	2	3	4	5	6
Coarse sand	78.17	62.58	66.01			
Fine sand	9.57	23.67	19.72			
Silt	2.30	3.90	2.30			
Clay	13.0	7.70	7.30			
Moisture	.7256	1.1585	1.1365			
Colour	10 YR. 7/4	7.5 YR. 3/2	7.5 YR. 5/4			
Soil Type	Sandy Loam	Sandy Loam	Sandy Loam			

Pit No. 10

Profile	1	2	3	4	5	6
Coarse sand	78.20	79.60	74.30	72.50		
Fine sand	10.913	10.266	12.366	16.82		
Silt	1.90	1.65	1.80	1.65		
Clay	8.10	9.0	13.45	9.00		
Moisture	1.056	.9428	1.209	1.722		
Colour	5 YR. 5/3	7.5 YR. 6/4	7.5 YR. 7/6	10 YR. 6/6		
Soil Type	Loamy Sand	Sandy Loam	Sandy Loam	Sandy Loam		

Pit No. 6

Profile	1	2	3	4	5	6
Coarse sand %	78.64	80.24	72.94	76.34	78.30	70.0
Fine sand	4.24	5.32	10.32	6.49	4.47	8.45
Silt	7.85	11.66	5.4	4.0	.35	.85
Clay	10.35	4.10	11.2	14.15	17.70	21.60
Moisture %	.4601	.3190	.3734	.5814	.6907	.7293
Colour	5 YR. 6/3	7.5 YR. 6/4	10 YR. 6/4	10 YR. 7/3	7.5 YR. 5/4	10 YR. 6/4
Soil Type	Sandy Loam	Loamy Sand	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Clay Loam

Pit No. 7

Profile	1	2	3	4	5	6
Coarse sand	83.38	82.02	75.65	66.65	83.85	66.25
Fine sand	10.45	5.43	2.59	12.32	1.91	1.29
Silt	4.9	1.15	3.65	—	5.15	5.05
Clay	12.05	13.05	14.35	—	19.30	22.25
Moisture	.2838	.4551	.6613	1.695	1.0785	1.0601
Colour	5 YR. 6/4	7.5 YR. 6/4	7.5 YR. 6/6	7.5 YR. 5/6	7.5 YR. 7/6	7.5 YR. 7/6
Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Clay Loam

Pit No. 8

Profile	1	2	3	4	5	6
Coarse sand	87.87	88.94	80.40	83.79	80.67	65.97
Fine sand	5.53	6.30	7.96	7.92	5.43	12.58
Silt	7.30	4.25	13.10	2.40	5.79	18.75
Clay	8.75	7.75	4.95	7.2	10.15	4.85
Moisture	.4571	.2165	.3814	.3956	.8044	1.2392
Colour	7.5 YR. 6/4	10 YR. 8/4	10 YR. 8/3	2.5 YR. 8/4	7.5 YR. 7/6	10 YR. 7/4
Soil Type	Loamy Sand	Loamy	Sandy	Sandy	Sandy Loam	Sandy Loam

Pit No. 13

Profile	1	2	3	4	5	6
Coarse sand	68.90	73.60	63.60	66.10	60.40	—
Fine sand	23.84	16.47	28.81	25.0	24.13	—
Silt	2.15	1.10	.15	3.35	1.05	—
Clay	6.25	11.20	6.45	6.55	12.45	—
Moisture	.3130	.2285	.2737	.5409	.9428	.8603
Colour	7.5 YR. 5/2	7.5 YR. 7/4	10 YR. 6/4	10 YR. 6/4	2.5 YR. 8/4	10 YR. 7/4
Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	—

Pit No. 19

Profile	1	2	3	4	5	6
Coarse sand	78.36	80.81	77.03	89.97	82.0	
Fine sand	11.45	13.05	13.85	5.46	8.22	
Silt						
Clay	6.85	5.75	7.15	8.45	6.95	
Moisture	1.0683	.3825	1.4435	1.0244	.2768	
Colour	2/5 YR. 3.2	5 YR. 5/4	5 YR. 6/4	7.5 YR. 6/4	7.5 YR. 5/4	
Soil Type	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	

The description of the profile of a representative area will be as follows (Pit 13).

A_1 0—9 ins. Yellowish grey loam — upper 5 ins. Brownish black, humic layer — coarse granular to nodular :—porous — roots not so abundant — acid — horizon boundary clearly distinct.

A_2 9—36 ins. Yellowish grey compact loam — mottled yellowish — red patches due to the formation of ferrugenous concretions — Quartz not so abundant — Not so dry but friable — porous — root growth decreases with depth — acid — horizon boundary not very distinct.

C. 36 ins.—6 ft. Yellowish heavy loam, with an abundance of quartz fairly compact — not so porous — roots rare — lateral roots absent — acid.

Chemical Analysis of Pottukulama Soils

Nitrogen estimation in m.e. /100.

Pit No.	*Profile* 1	*Profile* 2	*Profile* 3	*Profile* 4	*Profile* 5	*Profile* 6
1 ..	.0052	.0214	.0022	—	—	—
7 ..	.0227	.0129	.0076	.0049	.0032	.0071
13 ..	.0010	.0059	.0018			
18 ..	.00012	.00036	.0004	.0007	.00018	.00016

Loss on ignition %

Pit No.	1	2	3	4	5	6
6 ..	5.245	1.402	8.946	5.561	1.187	8.988
7 ..	2.986	5.8051	6.1006	6.4556	9.683	8.4391
8 ..	4.801	1.2086	8.1690	6.069	1.835	.5108
13 ..	3.652	2.923	1.319	2.514	1.015	1.974
19 ..	3.330	.827	.578	.936	.662	

Carbon %

Pit No.	1	2	3	4	5	6
13 ..	.615	.295	.250	—		
1 ..	2.19	.585	.39	.366		
2 ..	1.65	.55	—	—		

Soil Reaction

Pit No.	1	2	3	4	5	6
10 ..	4.8	4.9	4.9	4.8	4.8	4.6
1 ..	5.46	5.4	4.93	4.6	5.13	4.6
2 ..	5.6	6.1				

Total exchangeable bases of pit 13: m.e., per 100 grms.

	1	2	3	4	5
Ca ..	1.18	1.29	.7543	.9913	1.134
Mg ..	.587	.587	.75	.65	.53
Total Bases ..	1.94	1.94	1.86	1.69	1.44

The results show that the soils are sandy and the texture becomes heavier with small increases in depth. The clay content varies from 1 per cent to 11 per cent. The colour changes from yellowish grey to yellowish red, with increase in depth. The moisture content also follows the same pattern though they have in general a low hygroscopic and combined water content. They were found to be rich in organic carbon and exchangeable base content but significantly poor in nitrogen. The soil reaction varied from 4.6 to 6.6.

Soil Survey — Negombo one-inch sheet.

The area selected was North of Ma Oya and that represented in the Negombo one-inch sheet. This area is about 21 square miles in extent and has an annual rainfall of about 78.5 inches per annum. The land is for the most part a flat deep coastal plain and a deep slightly undulating mantle plain starting from about 4 miles from the western coast. The parent material which underlies these soils are of a pleistocene or recent nature. The results of chemical analysis of these soils show that the soils are either loamy, clayey or bacteritic in nature. The colours differ from dusky red (7.5 YR. 3/4) to dark yellowish brown (10 YR. 4/4). These soils were also found to be acidic in reaction.

Soil Survey — Chilaw one-inch sheet.

The soil survey of the area North of Ma Oya on the Negombo one-inch sheet was continued on the Chilaw one-inch sheet. This covers an area of about 145 square miles. The average annual precipitation is about 78.5 inches per annum. The geology and geomorphology of this area (as shown in the provisional geological map of Ceylon) show that it is recent or pleistocene in nature. The land form varies from the coastal plains which is sandy to a deep undulating mantle plain towards the eastern boundary of the area surveyed. The vegetation is predominantly coconut estates, as well as small coconut holdings. The soils for the most part are well drained and are provisionally called (1) the Marawila series (2) Horekelle series (3) the Ratmalagara series (4) the Kohombe series (5) Coastal sands (6) Flood plains. A reconnaissance soil map of the area has been drawn up and more detail work is required to perfect this map and make it more accurate. Small quartizitic soils and rock knob plains, were noticed but were not represented in the map.

The survey of the area represented by the Battulu Oya and Puttalam one-inch sheets has now been started.

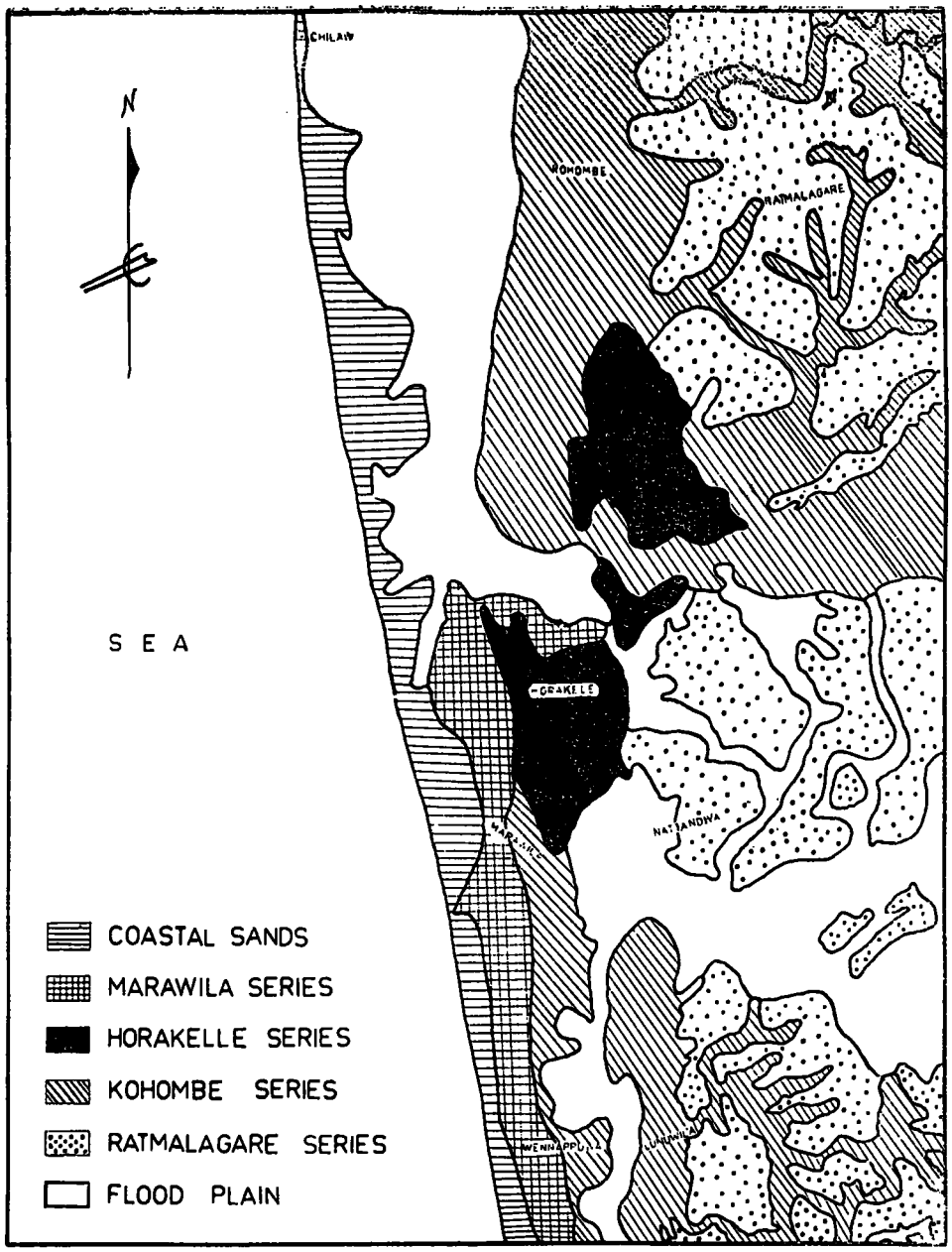
General.—During the year under review a good proportion of work was held up due to the lack of a technical assistant and the Senior Technical Assistant being sent out for short courses of training in methods of reconnaissance surveys. At the Air Survey branch of the Survey General's Department he was given a short course of training for 1½ months in photogrametery and the possible use of air photos in Soil Survey Work.

At Nakkala in the Moneragala district he worked with the head of the division of land use in recommending some Chena lands for coconut cultivation. The Ca, Mg and total exchangeable base content of these soils were also determined by us.

In September he spent about a month with the Photographic Survey Corporation at their land forms and soil, field camps at Kegalle and Kuliyapitiya. The land forms, geology and soils of these areas were investigated, making use of the basic principles of land forms and soil surveys.

We are thankful to all those who helped in the training of this Officer.

CAMILLUS SILVA,
Senior Technical Assistant,
Soil Survey Unit.



RECONNAISSANCE SOIL MAP —— CHILAW

A.G.K

REPORT OF THE CHIEF ADVISORY OFFICER

Staff.—Muhandiram E. A. Peiris who until 14th December, 1959, functioned as Chief Advisory Officer, relinquished the post and Mr. C. A. Wickremasuriya was appointed Chief Advisory Officer as from this date.

The following new appointments were made during the year. Messrs. C. A. Fernando, D. Weerasekera and V. Arunasalam as Coconut Instructors; Mr. A. F. Silva as Office Attendant in place of Mr. Milton Fernando who died under tragic circumstances.

The following transfers were effected during the period under review. Mr. P. A. H. Gomes as A.F.O., Kurunegala, Mr. P. A. Wijewickrema as C.I., Pasyala, Mr. C. Iddawela as A.F.O., Godakat wela, Mr. H. H. Samarakoon as C.I., Wariyapola, Mr. W. Weeraratne as C.I., Ambalantota and Mr. T. Ganarajah as A.F.O., Headquarters.

A scheme for subsidising the planting of coconuts on citronella lands in Matara and Hambanota districts was initiated by Government during the year. In November, 1959, work in connection with this scheme was handed over to this division to be carried out under the present organisation with additional staff. Work done under this scheme during the period under review is given in section (*ii*) of this report.

The main activities of the division except for the special work connected with the outbreak of the Coconut Caterpillar pest in Kurunegala district and the Citronella Subsidy Scheme, have been similar to those enumerated in last year's report. New planting, replanting, soil and moisture conservation, control of pests and diseases, value of fertilizers their application and after care of seedlings were the chief subjects on which advice and demonstrations were given by the field staff. In addition to these, the field officers inspected small holdings which obtained fertilizer under the subsidy scheme through C.A.P. and S. Societies and also arranged for free transport of seedlings from C.R.I. Nurseries.

The work done during the year included :—

(1) Small holdings less than 50 acres :

(*a*) No. visited for general advisory work	..	7416
(*b*) Extent pegged for Soil Conservation work	..	15317 chains
(*c*) Extent lined for planting ..	..	2202½ acres

(2) Estates more than 50 acres in extent :

(*a*) No. visited for general advisory work	..	385
(*b*) Extent pegged for Soil Conservation work	..	4699 chains
(*c*) Extent lined for planting ..	..	520 acres

(3) Inspections under the fertilizer Subsidy Scheme :

(*a*) No. of Small-holdings visited ..	..	1120
(*b*) No. of Manure Applications distributed	..	4649

3633—E

(4) Follow-up Service :

(*a*) No. of units visited for advice on after-care of seedlings	552

(5) Work in selected Villages :

(*a*) Extent pegged for Soil Conservation ..	5300 chains
(*b*) Lined for planting	892 acres
(*c*) No. of C.R.I. Seedlings planted	61290

(6) Meetings :

(*a*) No. of Meetings attended by Field Staff ..	325
(*b*) No. of talks delivered	225

(7) Pests and Diseases:

No. of properties visited for :—

(*a*) Black beetle	869
(*b*) Red weevil	169
(*c*) Coconut caterpillar	299
(*d*) Termite damage	430
(*e*) Grey blight	195
(*f*) Other pests and diseases	388
	2350

Coconut Caterpillar Pest.—A serious outbreak of this pest was reported from Nikadalupotha area in the Kurunegala district, where a number of small-holdings and estates were affected. The field staff assisted the Crop Protection Division to carry out an intensive spraying campaign and other measures in an effort to control the spread of the pest. They also assisted that division in recording population counts.

SECTION II

Planting Coconuts on Citronella Lands

In addition to the duties of his substantive post, the Chief Advisory Officer was in charge of this work. In December, 1959, the following additional staff was appointed to assist him.

Mr. W. V. Fernando of the Advisory Division as District Coconut Instructor; Messrs. J. G. de Silva, J. B. Herath and S. C. M. Eric Silva as Coconut Instructors; S. Liyanage, D. M. K. Bandara and C. L. L. Anthony as Clerk/Typists; and Messrs. C. W. Dissanayake, K. A. Ariyadasa, H. D. Wijeratne, A. P. Kumarasinghe, D. W. K. S. Gunawardena, T. Gunadasa, W. K. Mettapala, J. M. Sugathadasa Fernando as Field Attendants.

The Coconut Instructors and Field Attendants were given a short course of practical training prior to being posted in the ranges in Matara and Hambantota districts.

Applications, on prescribed forms, for assistance under the above Scheme were called from owners of citronella lands under 20 acres in extent. The total number of applications received up to 31st December was 5,889.

C. A. WICKRAMASURIYA,
Chief Advisory Officer,
Coconut Research Institute.

REPORT OF THE PLANTING OFFICER

1. *Nurseries.*—Seednuts : 1,984,675 seednuts were planted in the nurseries during the year.

The distribution of seednuts in the nurseries is as follows :—

Name of nursery	*Jany./June, 1959*	*July/Dec. 1959*	*Total*
Rathmalagara nursery ..	250,950	100,000	350,950
Eraminigolla nursery ..	31,700	35,000	66,700
Carmel nursery ..	202,000	126,300	328,300
Walpita nursery ..	81,300	108,000	189,300
St. Anne's nursery ..	50,000	—	50,000
Hettipola nursery ..	40,000	27,000	67,000
Handapangala nursery ..	67,500	—	67,500
Mylambavely nursery ..	100,000	—	100,000
Kalawewa nursery ..	100,000	—	100,000
Dematawela nursery ..	90,200	31,000	121,200
Wilpotha nursery ..	182,925	80,500	263,425
Kilinochchi nursery ..	76,500	—	76,500
Alampil nursery ..	68,000	—	68,000
Koggala nursery ..	79,800	56,000	135,800
Grand Total ..	1,420,875	563,800	1,984,675
Mapalana Nursery (under Citronella Subsidy Scheme) ..			175,000

2. *Seedlings.*—The demand for seedlings exceeded the available supply and orders for 1,296,768 seedlings were accepted for the year, 1959 for both planting seasons.

The distribution of seedlings from the nurseries is as follows :—

Name of nursery	*Total No. of seedlings issued in May/June*	*Total No. of seedlings issued in Oct./Nov.*	*Total No. of seedlings issued for both seasons*
Rathmalagara nursery ..	86,158	171,279	257,437
Hettipola nursery ..	38,050	34,160	72,210
Walpita nursery ..	73,619	62,190	135,809
Carmel nursery ..	48,095	123,789	171,884
Wilpotha nursery ..	25,064	108,025	133,089
Eraminigolla nursery ..	19,751	21,008	40,759
Koggala nursery ..	26,897	35,587	62,484
Dematawela nursery ..	28,550	80,180	108,730
St. Anne's nursery ..	100	51,497	51,597
Kilinochchi nursery ..	1,000	52,100	53,100
Mylambavely nursery ..	1,000	46,470	47,470
Alampil nursery ..	—	49,950	49,950
Handapangala nursery ..	124	49,400	49,524
Kalawewa nursery ..	—	62,725	62,725
Grand Total ..	348,408	948,360	1,296,768

Inspections.—The nurseries were inspected by Planting Officer, Assistant Planting Officer and Senior Field Assistant as follows :—

Nurseries	*No. of visits for the year*		
	P.O.	*A.P.O.*	*S.F.A.*
Rathmalagara — Hettipola ..	4	6	10
Wilpotha — St. Anne's ..	5	6	10
Kalawewa — Karawaddana Mylambavely	4	6	7
Kilinochchi — Alampil ..	4	5	5
Koggala, Dematawela and Handapangala ..	6	5	5
Walpita — Eraminigolla ..	6	6	10

P. D. L. FERNANDO,
Planting Officer,
Coconut Research Institute, Lunuwila.

REPORT OF THE WELFARE OFFICER

The staff position was as follows :—

	Senior	*Inter-mediate*	*Assistant*	*Minor*
At the end of 1958 ..	8	9	90	59
New appointments in 1959 ..	—	1	15	21
	8	10	105	80
Less resignations and retirements in 1959 ..	1	1	3	8
Deaths ..	—	—	—	1
	7	9	102	71
Promotions ..	—	2	—	1
Confirmations ..	—	—	15	8
Position as at 31-12-59 ..	9	7	102	71

Promotion of 2 officers from the Intermediate Grade to the Senior Staff Grade should make the total of the Senior Staff Grade to read as 9 and Intermediate Grade as 7. The Minor Staff Officer's promotion is within the same grade and thereby makes no difference. Thus, the cadre of the entire staff at the *end of* 1959 *was* 189. With the implementation of the new rules and regulations since 1st January, 1957 the promotion of Minor Staff Officers to the Assistant Staff has decreased as the minimum educational qualifications laid down for the higher grade is being applied.

Labour Force.—According to the Provident Fund Register who are members of the Employees Provident Fund the labour force as at 31-12-59 was 515 distributed as follows :—On monthly pay 27, on daily pay 488. Tractor Drivers who were employed on daily pay in terms of the Wages Board Ordinance were placed on monthly salary as in Government Service. The Wages Board basic wage was revised during the year and the Coconut Research Board in addition to the above gave a General Allowance of 10 Cts. per day plus a cup of tea or 5 Cts. in lieu of it. A Service Allowance of 15 Cts. per day for 5 years continuous service and 25 Cts. per day for 10 years continuous service with the Institute were also granted during the year. Labourers who drew a wage of Rs. 3/- per day prior to the enforcement of these rates were given only the service allowance. The labourers were encouraged to make applications for monthly paid appointments in Labour grades of the Institute.

Housing.—Welfare service was extended to all employees as far as possible without distinction between any category of workers. Eight labour cottages have been constructed and allocated to labourers during the course of the year. With the expansion of the cadre of the Institute the number of applicants awaiting allocation of quarters have considerably increased. The Hostel was fully occupied by unmarried officers during the year.

Financial Aid.—All applications from employees for Provident Fund, Gratuity, Medical Aid, Transport Loans, Distress Loans, Workmen's Compensation Claims, Allocation, Furnishing and Maintenance of Quarters and Buildings and generally the establishment work of the Institute have been dealt with during the year. A sum of Rs. 18,186.25 has been granted as loans for the purchase of means of transport while the total distress loans granted was Rs. 234/-. A sum of Rs. 100/- per head to the monthly paid employees and Rs. 50/- per head to the daily paid employees was granted as a Festival Advance during the year. The total amounts involved were Rs. 13,700/- and Rs. 17,335/- respectively.

Industrial accidents have been on the increase — snake bites have become a common occurrence and the amount of compensation paid for a temporary disablement case by the Insurance Company under the Workmen's Compensation Ordinance has been found hardly sufficient to meet the incidental expenses. The payment of these expenses by the Institute is under consideration.

The Employees Provident Fund Act has been made operative and the Institute has been declared a covered employment with effect from 1st June, 1959. 515 employees have been enrolled as members of the Fund since then. The employees contributed a sum of Rs. 4,029.98 while the Boards contribution was Rs. 4,161.98 during this period. For June and July the Board contributed 10 per cent *viz.*, 4 per cent of employees gross wages and the Board's contribution of 6 per cent. The workers of this category includes Drivers, Cleaners, Watchers, Cattle Keepers, Kanganies and Labourers employed under the Coconut Growing, Engineering, Building and Transport Trade.

The staff contribution to the Provident Fund was Rs. 77,639.55 to which the Board added a sum of Rs. 76,924.88 during the year. Interest is payable at 4½ per cent.

The C.R.I. Co-operative Welfare Society Ltd., catered to the economic needs of the employees; the stores of the Society made available to members food and curry stuffs and other essential requirements at competitive rates while the canteen was in progress to supply lunch and tea. Thrift and savings were also part of the Society's business during the year. The Board's annual grant is Rs. 1,500/-.

Medical Aid.—The amount lying to the credit of the members on 1st January 1959 was Rs. 21,387.93 to which the members contributed at the rate of Rs. 10/- per month in the case of Senior and Intermediate staff and Rs. 6/- per month in the case of Assistant and Minor staff. The Board contributed an equal amount at the end of each month. A sum of Rs. 11,389.61 was paid to members on medical aid claims approved at 7 meetings held during the year. Special concessions have also been obtained to members from consultant doctors in the panel.

Recreation.—The maximum encouragement and assistance have been given for recreational activities. Facilities for indoor and outdoor games have been provided during the year as far as possible. The " E " and " D " Division cricket teams of the C.R.I. Recreation Club participated in the Government Service cricket tournament. In the " D " Division our cricketers came up to the quarter finals defeating the Department of Meteorology and the Port Cargo Corporation. At the quarter finals the C.R.I. team lost by a small margin. The " E " Division was eliminated in the first round. A sum of Rs. 260/- as expenses incurred in connection with these cricket matches was paid by the Board. The C.R.I. Recreation Club held its annual Christmas Party on 19th December 1959. The Party was organised mainly for the benefit of the officers' and labourers' children and over 250 gifts and food bags were distributed among them. A sports meet and a variety entertainment were among the important features of the party. The Boards annual grant is Rs. 500/-.

Industrial Relations.—It is observed that in the field of Industrial relations employees of the Coconut Research Institute have advanced in the development of Trade Unionism as a means for securing their legitimate rights. The formation of a Staff Association by the Senior and Intermediate staff of the Institute has strengthened the trade union movement of the Institute still further. The Coconut Research Board decided to recognise Trade Unions established by its employees in accordance with the practice adopted in Government Departments. Democracy, while conceding certain rights, imposes responsibilities. It is inconceivable that in a democratic system all the benefits can be accepted and obligations evaded. Fair play and justice in unison declare that a right must always carry with it corresponding obligations and it is hoped that this spirit will remain to maintain employer-employees relationship of the Institute in future. Complaints regarding minor labour disputes have been enquired into and amicably settled during the year.

F. H. B. FELIX SILVA,
Welfare Officer,
Coconut Research Institute of Ceylon.

REPORT ON THE ESTATES

BANDIRIPPUWA ESTATE

Acreage and Census.

Acreage B/E (1) and (2)

	A.	R.	P.
Research Section	52	2	31
Buildings, Streams and Roads	17	0	00
Estate Section including Pasture Plots S/c's and Botanist's Expt.	295	1	26
Waste Land and Paddy Field	0	3	14
	365	3	31

Census of Palms as at February, 1959 is as follows :—

Particulars	*Research section*	*Estate Section*				*Total*
		Past.Pl.	*S/c Res. Cv.*	*N.P.K./GR*	*Estate*	
Full Bearing ..	1084	629	755	560	5008	8036
Partial Bearing ..	378	920	1829	107	4289	7523
Duds ..	80	953	2009	38	2449	5229
In Flower ..	136	4	18	8	144	310
With Stem ..	162	27	9	12	158	368
Established Plants ..	41	13	—	9	51	114
Supplies ..	31	—	—	1	5	37
Vacancies ..	9	120	251	39	402	821
Total ..	1921	2666	4871	774	12506	22738
Left out for the playing field ..						462
Unplantable vacancies and palms uprooted for buildings, etc. ..						635
Underplanted area ..						23835
Established plants ..	343	—	—	—	135	478
Supplies ..	96	—	—	—	22	118
	439	—	—	—	157	596
Grand Total ..						24431

On the above census 140 palms were uprooted for the year for buildings and thinning out in the underplantation. The 11 year old plantation of 220 palms has 114 palms bearing, 55 palms in flower and 48 palms with stem. The census shows 821 actual vacancies on the whole estate including the new acquisition, but it is not a good proposition to supply them since the whole plantation is more than 67 years old and that underplanting is taken up annually on the basis of Research requirements.

Rainfall.—This compares with the previous two years as follows :—

Average 1934/50	*Months*	1958 *Inches*	1958 *Wet days*	1959 *Inches*	1959 *Wet days*
2.20	January ..	1.15	2	0.93	1
2.17	February ..	1.34	2	0.59	3
5.38	March ..	8.40	8	2.28	1
8.40	April ..	13.69	18	8.88	14
10.31	May ..	26.20	22	10.76	24
7.42	June ..	5.23	23	5.96	18
2.82	July ..	1.15	4	9.72	17
3.45	August ..	3.39	13	3.40	13
4.28	September ..	1.21	7	4.90	13
12.56	October ..	7.57	17	11.04	18
12.92	November ..	5.29	16	11.49	13
4.81	December ..	1.64	6	1.13	5
76.72	Total ..	76.46	138	71.08	140

There was very little rain in the first 3 months of the year as well as in December. The drought effect would be reflected in 1960 crops.

Field Notes

Weeding.—It was possible to maintain the whole estate in good condition free of weeds and heavy growth on the estate.

Drains.—The drain system in the new acquisition had to be corrected. In this field 1422 fathoms of new drains were cut on the contour system and 2799 fathoms of old drains were closed for the yeart It was necessitated to adopt soil conservation measures in this area.

Roads and Bridges.—All estate roads were maintained in proper order. New roads had to be opened up in the new lands acquired in 1958.

Fences.—After the acquisition of the neighbouring lands the boundary fence was put anew.

Pest and Diseases.—The incidence of beetle attack on young palms was very much less as frequent control measures were adopted, by examining young palms daily.

Husk Pits.—227 husk pits have been done in Nos. 5 and 6 blocks in the alternate rows.

Crops.—These compares as follows :—

Pick	1955	1956	1957	1958	1959	*5 Years Average*
B/E (1) 1.	95,108	51,187	74,720	43,996	74,787	67,959
2.	122,594	76,300	95,564	65,862	122,447	96,553
3.	123,367	106,571	105,526	107,669	97,380	108,103
4.	126,399	107,980	101,281	112,139	89,864	107,533
5.	85,536	76,448	85,069	68,850	63,412	75,863
6.	60,676	55,398	49,779	45,825	29,892	48,314
Total	613,680	473,884	511,939	444,341	477,782	504,325
Less Res.	86,128	67,253	83,030	73,464	86,362	79,247
Est. Sec.	527,552	406,631	428,909	370,877	391,420	425,078

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Pick	1955	1956	1957	1958	1959	5 *Years Average*
B/E (2) 1.	—	—	—	—	78,036	—
2.	—	—	—	—	94,414	—
3.	—	—	—	—	98,406	—
4.	—	—	—	54,163	88,332	—
5.	—	—	—	48,462	66,884	—
6.	—	—	—	51,541	46,466	—
Total	—	—	—	154,166	472,538	—

The total crop realised for 1959 on both estates was 950,320 nuts from 15,559 bearing palms equivalent to 247 acres. Thus the nuts per palm were 61.1 nuts and 3847.4 nuts per acre.

The disposal of crops is as follows :—

	nuts	
Sold on Contract	132,705	
Sold to Planting Division	85,070	
Sold to Research	16,699	
Research Nurseries	1,897	
Allowance to Staff	26,114	
Cured	676,145	
Empties	11,690	1.2%
Total	950,320	

676,145 nuts cured into copra obtained 464 candies 419 lbs. on an out-turn of 1,455 nuts to a candy. The nuts per candy of copra has been fairly high as a result of continuous drought in the first three months and selected nuts have been sold to the Planting Division.

Manuring.—The following palms have been manured for 1959 :—

B/E (1)	No. 5 Block	100 palms	15 lbs.	4½ lbs. Sulphate of Ammonia 6 lbs. Saphos Phosphate 4½ lbs. Muriate of Potash
	No. 5 Block	509 palms		
	No. 4 Block	200 palms	10 lbs.	3 lbs. Sulphate of Ammonia 4 lbs. Saphos Phosphate 3 lbs. Muriate of Potash
B/E (2)	" A "	2841 palms		
	" B "	1610 palms		4½ lbs. Sulphate of Ammonia 6 lbs. Saphos Phosphate 4½ lbs. Muriate of Potash
	" C "	2047 palms		
		7307 palms		

All the palms were manured by cutting circular trenches round the palm and each was closed with a supply of husks except B/E (2) " A " Block which is sandy soil. In addition to the manuring 159 young plants received ½ the dose of the adult palm.

General.—It was possible to complete the programme of work for the year although there was a scarcity of labour, which did not seriously effect the work. The income and expenditure details for the year will be shown under separate column.

D. F. WITHANA,
Superintendent, Bandirippuwa Estate.

RATMALAGARA ESTATE

Rainfall.—The rainfall of 1959 compared with that of 1958 is as follows :—

	1958		1959	
	Days	*Inches*	*Days*	*Inches*
January ..	3	1.25	1	1.86
February ..	4	.95	1	1.11
March ..	11	6.61	1	2.47
April ..	17	10.78	10	8.86
May ..	19	12.86	19	12.09
June ..	15	5.34	16	4.39
July ..	8	1.13	11	4.35
August ..	12	1.36	5	2.74
September ..	4	.78	16	4.31
October ..	14	6.00	15	10.53
November ..	21	8.38	20	9.74
December ..	7	6.17	6	1.92
Total ..	135	58.61	121	60.06

The total rainfall for the year was 60.06 inches thus showing an increase of 1.45 inches above that of 1958.

Crops.—The crops for the year have been extremely good. The Research Divisions' crop was 261,262 nuts and Estate Division and Pasture plots 391,400 nuts thus making a total of 652,662 nuts for the year 1959 against 555,648 nuts for 1958. This shows an all-round increase of 97,024 nuts.

The crops were disposed of as follows :—

Research Divisions		
Cured into Copra	240,488	
Sold to Research	8,594	
Sold on Contract	6,752	
Rejections	5,428	261,262 nuts
Cured into Copra	190,052	
Sold on Contract	107,043	
Sold to Planting Divisions	81,000	
Issued to Staff	8,052	
Rejections	5,253	391,400 nuts
Grand Total		652,662 nuts

Copra.—43,540 nuts cured into copra (Estate and Research) produced 269 candies and 518 pounds of copra of grades 1, 2 and 3 showing an average out-turn of 1,595 nuts to a candy (inclusive of Dwarf Nuts). The out-turn for 6th crop 1959 was 1,394 nuts per candy Estate Section and 1,841 nuts per candy Research Section.

Field Works.—This work was carried out according to programme.

Manuring.—This was carried out according to programme.

Labour.—There was no trouble with labour.

Buildings.—These are in order. Four junior staff bungalows and one minor staff bungalow were colour-washed during the year. Electricity has been supplied to the minor staff bungalows. A set of twin cottages was built for labour on the estate block.

The Planting Division has opened up a nursery in the 4 acre bare land adjoining the Rubber Bleck.

The tapping of the Rubber Block was carried out this year too.

H. J. F. PEIRIS,
Superintendent, Ratmalagara Estate.