

CEYLON COCONUT QUARTERLY

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ANNUAL REPORT OF THE COCONUT RESEARCH INSTITUTE FOR 1963

The present report is the 35th 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 1963, the Coconut Research Board consisted of the following:—

Ex-Officio Members

Director of Agriculture, Mr. A.V. Richards, M.Sc. (Calif.), B.Sc. (Lond.), Dip.Agric. (Cantab.)
A.I.C.T.L. (Trinidad).

Treasury Representative: Mr. G.M. Sparkes.

Coconut Rehabilitation Commissioner: Mr. B. Mahadeva.

Chairman, Low Country Products' Association: Mr. Francis Amarasuriya.

Director, Coconut Research Institute: 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. Wijebahu Wijesinghe, M.P.

Mr. W.I. Hugh Fernando, M.P.

Nominated by the Planters' Association of Ceylon.

Mr. C.T. Van Geysel, J.P.

Mr. B. Warusavitana.

Nominated by the Low Country Products' Association.

Senator Thomas Amarasuriya, O.B.E. (Chairman, Coconut Research Board).

Mr. C.A.M. de Silva.

Nominated by the Honourable Minister to represent the Small-holders.

Mr. A.F. Samarasinghe.

Mr. L.W.A. Fernando.

During the period 1963 Mr. W.I. Hugh Fernando, M.P. was elected Speaker of the House of Representatives. The place of Mr. Hugh Fernando on the Coconut Research Board was taken by Mr. S.D.R. Jayaratna, M.P., Senator Thomas Amarasuriya the Chairman, Coconut Research Board resigned from

the Board when he was elected President of the Senate and his place was taken by Mr. C. Selwyn Samarawcera who was nominated by the Low Country Products' Association.

With the resignation of Mr. G.M. Sparkes, from the public service, the post of the Treasury Representative on the Board remained vacant.

Mr. C.A.M. de Silva was unanimously elected Chairman of the Coconut Research Board.

Meetings.—Four meetings of the Coconut Research Board were held during the year on 16th March, 15th June, 14th September and 19th December. Three Special Meetings of the Coconut Research Board were held on September 26th, November 22nd and December 4th.

Committees

Administrative Committee (Personnel at 1st January 1963):

- (1) Chairman of the Board.
- (2) Mr. G.M. Sparkes.
- (3) Mr. B. Warusavitana.
- (4) Mr. C.A.M. de Silva.
- (5) Mr. B. Mahadeva.
- (6) Mr. A.V. Richards.
- (7) Mr. W.I. Hugh Fernando.
- (8) Director, Coconut Research Institute.

The 42nd, 43rd, 44th and 45th meetings of the Administrative Committee were held on 25th January, 26th April, 26th July and 25th October 1963, respectively.

Estate and Experimental Committee (Personnel at 1st January 1963):

- (1) Mr. Francis Amarasuriya.
- (2) Mr. A.V. Richards.
- (3) Mr. B. Warusavitana.
- (4) Mr. C.T. Van Geyzel, J.P.
- (5) Chairman of the Board.
- (6) Mr. L.W.A. Fernando.
- (7) Mr. Wijebahu Wijesinghe, M.P.
- (8) Director, Coconut Research Institute.

Three Co-opted Members:

- (1) Mr. X. Jobin.
- (2) Mr. M.M. Kumarakulasingham.
- (3) Mr. R.H. de Mel.

The 43rd, 44th, 45th and 46th meetings of the Estate and Experimental Committee were held on 16th February, 15th May, 17th August and 16th November, 1963 respectively.

Extension Committee (Personnel at 1st January 1963):

- (1) Mr. C.T. Van Geyzel, J.P.
- (2) Mr. Francis Amarasuriya.
- (3) Mr. C.A.M. de Silva.

- (4) Mr. B. Mahadeva.
- (5) Mr. A.F. Samarasinghe.
- (6) Mr. L.W.A. Fernando.
- (7) Director, Coconut Research Institute.

The 35th, 36th and 37th meetings of the Extension Committee were held on 9th February, 10th August and 8th November, 1963 respectively.

Editorial Committee (Personnel at 1st January 1963):

- (1) Mr. Francis Amarasuriya.
- (2) Director, Coconut Research Institute.
- (3) Dr. D.V. Liyanage.
- (4) Mr. Wijebahu Wijesinghe, M.P.
- (5) Mr. A.F. Samarasinghe later Mr. L.W.A. Fernando.

C.A.M. DE SILVA,
Chairman, Coconut Research Board.

REPORT OF THE DIRECTOR

1. STAFF

Staff of the Coconut Research Institute at the end of 1963 was as follows:—

Administrative 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).

Soil Chemistry Division

Soil Chemist—Dr. D.A. Nethsinghe, D.Phil. (Oxon.), B.Sc. (Ceylon), A.R.I.C.
Research Assistant—Mr. T.S. Balakrishnamurthi, B.Sc. (Ceylon). (On overseas Study leave).

Chemistry Division

Chemist—Dr. W.R.N. Nathanael, Ph.D. (Lond.), M.Sc. (Lond.), F.R.I.C.
Research Assistant—Vacant.

Botany Division

Botanist—Dr. D.V. Liyanage, Ph.D. (Manch.), B.Sc. (Lond.).
Research Assistant—Mr. M.A.P. Manthirratne, B.Sc. (Lond.).

Agrostology Division

Agrostologist—Dr. K. Santhirasegaram, Ph.D. (Adelaide), B.Sc. (Ceylon).
Research Assistant—Mrs. N. Rajaratnam, 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 Division

Crop Protection Officer—Mr. U.B.M. Ekanayake, B.Sc. (Ceylon).

Biometry Division

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

Dr. K. Santhirasegaram who was away in Australia on post-graduate study returned to Ceylon, having obtained the Ph.D. degree of the University of Adelaide.

Dr. W.R.N. Nathanael, Chemist was elected a Fellow of the Royal Institute of Chemistry.

Mr. T. Balakrishnamurthi proceeded on post-graduate study leave to the University of Aberdeen, Scotland.

2. MEETINGS

The Director attended the following meetings besides those of the Coconut Research Board and its Committees:—

- (i) Annual General Meeting of the Planters' Association of Ceylon.
- (ii) Meetings of the District Planters' Associations of Chilaw/Negombo and Kurunegala Planters' Associations.
- (iii) Central Board of Agriculture.
- (iv) Animal Husbandry Sub-Committee of Central Board of Agriculture.
- (v) Committee appointed by Hon. Minister of Agriculture on Food and Milk Production on Coconut Estates.
- (vi) Seminar on Coir at Small Industries Corporation, Velona, Katubedde, Moratuwa.

3. RESEARCH CONFERENCES

The following subjects were discussed at Research Conferences held during the year:—

- (i) "Problems of Extension Work on Coconuts" led by Mr. C.A. Wickramasuriya, Chief Advisory Officer.
- (ii) "Problems of Replanting of Senile Coconut Palms" led by Dr. D.V. Liyanage, Mr. R.H. de Mel, Co-opted Member of the Estates and Experimental Committee was present and participated in the Discussions.
- (iii) "Some Recent Soil and Land Use Surveys of Coconut Development Schemes in Ceylon" led by Mr. K.S.O. Perera, O.I.C., Soil Survey Unit.

4. VISITORS

The Visitors during the year included the following:—

- Dr. L. Horton, Assistant Director, Tropical Products Institute, London.
Mr. J. Legrand, Commercial Attache, French Embassy.
Mr. D. Rhind, Adviser in Agricultural Research—Department of Technical Co-operation, London.
Mr. W.V.D. Peiris, Coconut Improvement Officer, F.A.O.
Dr. W.D. Raymond, Tropical Products Institute, London.
Mr. A.H. Green, Plantations Group, Unilever Ltd.—spent 3 days at the Institute.
Dr. Karl Maramorosch, Boyce Thompson Institute, New York.
Members of the Animal Husbandry Sub-Committee of the Central Board of Agriculture.
The Chinese Agricultural Delegation.
Miss Lyndon Moore, Agricultural Economics Research Institute, University of Oxford.
Dr. H.S. Hopf, Scientific Secretary of the Tropical Pesticide Research Committee.
Mr. H.A. Hassan, Director, Botanical Gardens, Assovan, Egypt.
Mr. Kuo Ying, Counsellor of the Embassy of the People's Republic of China in Ceylon.

5. TRAINEES

Mr. D.E. Nwosisi, Manager, Eastern Nigeria Development Corporation Coconut Estate.

Messrs. Hassan Bin Abdulla and Othman Bin Mohamed from the Department of Agriculture, Malaya.

Mr. Frederic Lewis, Nominee of the Government of Cuba.

Mr. Atiqur Rahaman, Manager, Industrial Estates, East Pakistan Small Industries Corporation, studied copra processing and coconut cultivation work.

6. FIELD DAYS

Two Field Days were held at Ratmalagara Estate and the Isolated Seed Garden on 7th January 1963 for the members of the Low Country Products' Association and on 18th July 1963 for the members of the Kurunegala Planters' Association.

7. PUBLICATIONS

The Director contributed articles on "Coconuts in 1962" and "Activities of the Coconut Research Institute in 1962" to the Annual Report of the Planters' Association of Ceylon.

An article by the Director entitled "Diversification of the Coconut Economy" was contributed to the "Times of Ceylon" Agricultural and Engineering Supplement.

8. 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:—

Chemistry

(i) *Desiccated Coconut*:—Consequent on certain complaints received by the Ceylon Coconut Board from overseas buyers, regarding the problem of oil exudation from certain shipments of Ceylon Desiccated Coconut packed in paper bags, some *ad hoc* experiments have been conducted to establish the factors responsible for this phenomenon.

On the basis of chemical, physical and microscopical examination of parallel samples of Ceylon and Philippine Desiccated Coconut, the tentative conclusion has been that oil exudation results from some sort of cell-wall degradation or breakdown. It is probable that this is associated with certain critical temperature combinations and/or limits for sterilization and drying. The problem continues to be investigated.

In preference to the hydraulic press method, a more satisfactory technique using thick quality (No. 3) filter paper sandwiched between metal plates has been evolved for routine testing of oil exudation. This method is now being used regularly in the quality testing laboratory of the Ceylon Coconut Board.

(ii) *Grated Coconut Meat*:—The grated meat from the fresh coconut kernel is used in the Ceylon household for culinary purposes. Further, it has been estimated that the annual *per capita* consumption of coconuts is 140. This would mean that the annual domestic consumption (for cooking and other uses in the household) would be in the region of 1,400 million nuts.

For cooking purposes, it is customary to press out manually the "milk" from the grated meat using a certain amount of hot water. With a view to obtaining an estimate of the efficiency of this extraction—(particularly as regards oil and protein), a simple experiment simulating the household method was carried out. The samples of grated meat obtained during three successive manual pressings were then analysed chemically.

The results have shown that there is a colossal waste of valuable oil and protein in the "pol-kudu", that is discarded as waste. In terms of weights—on the basis that 1,200 nuts give 560 lbs. (a candy) of copra, (6% moisture) with an oil content of 68.0% (dry basis) it has been computed that the loss of oil represents 21.3% of the oil per nut. The corresponding total weight loss on 1,400 million nuts consumed locally would thus amount to 39,000 tons per annum. In other words, the economic loss to the industry (without taking into account the protein) would be in the region of 43.5 millions. If the Central Bank figure of 990 million nuts of annual domestic consumption is adopted, then the corresponding economic loss would be 30.8 million. (Calculated on the basis that the value of a ton of oil is Rs. 1,100/-).

(iii) *Vinegar*:—(a) The Vinegar Generator installed at the new factory Nainamadama which was started off in June 1962, continued to operate very satisfactorily during the year. The factory was inspected at regular intervals and the acid strength of the finished vinegar was found to be consistently over 5.5%. The maize cobs originally used in the packing chamber were found to last the guaranteed period of one year without any form of degradation or breakdown.

(b) A satisfactory method was evolved for the preparation of caramel (of high tinctorial efficiency), for colouring vinegar. A bottle of this caramel has been found adequate to colour 20 gallons of vinegar to a dark wine-tint.

This method has been demonstrated to some vinegar-makers and it is now being applied at the Nainamadama factory for colouring their "Generator" Brand Vinegar.

(c) An experiment was successfully carried out to test the efficacy of common salt in retarding the growth of mycodermal film in bottled vinegar. It was found that a minimum concentration of 2.0% salt dissolved in the vinegar would completely arrest the formation of any mycodermal suspensions.

As an effective substitute for sterilization, common salt at a concentration of 2% is now being used at the Nainamadama Factory.

Botany

Work on hybridisation and selection, progeny trials and planting techniques were continued during the year.

The three progeny trials at Marandawila, Walpita and Bandirippuwa were maintained during the year.

Nuts of crosses done during the previous year, viz. dialled, testing male transmitters, study of segregation of certain characters, etc., were harvested and some of them planted in the nursery. Altogether 375 seedlings were planted at Pottukulama Sub-Station in November 1963.

A programme of work was undertaken to study whether a uniformly high-yielding king-coconut palm without periodicity in bearing, and possibly early bearing, could be developed by crossing selected palms within and between forms.

Crossing of *typica* × *typica* and *typica* × *pumilla* where the male parent is a prepotent was continued at six stations during the year.

A technique to increase the quantity of pollen collected from an inflorescence was devised, based on a method developed by Jamaican workers. The pollen bank was well patronised by 8 private estates and 3,856 samples of pollen issued to them.

Preliminary studies on culturing embryos were undertaken.

1,880,644 selected seed nuts were supplied to the Planting Division during the year.

Soil Chemistry

Seven long-term field experiments on manurial problems were continued in 1963—in addition to the observation trials on magnesium deficiency and leaf scorch problems.

The results of field experiments on bearing palms at Bandirippuwa and Ratmalagara give support to our current recommendation on NPK manuring (in 1960 we recommended an increase in the level of NPK manuring to about double the rates previously recommended).

The experiment comparing organic with inorganic fertilizers on a light sandy loam at Marandawila Estate, Bingiriya has shown, that organic fertilizers offer no advantage over the cheaper inorganic fertilizers.

In the experiment on methods of fertilizer placement at Walahapitiya Estate, Nattandiya, there was little difference between the surface application of fertilizers in a circular strip 3 feet wide 3 feet away from the palm, and the considerably more expensive traditional circular trenches. Broadcast applications proved to be less effective.

A second field trial on adult palms using radioactive phosphorus confirmed that placement in the entire area round the palm up to a distance of about 6 feet from the bole was more efficient than placement in a 3 feet wide circular strip 3 feet away from the palm, or placement in the centre of the squares.

Chemical analysis of leaflet samples from palms affected by "Leaf Scorch" in the Southern Province has shown that these palms are deficient in Boron and Magnesium. The possible association of the problem with nutrient deficiencies cannot yet be overruled, and further trials on this aspect are in progress.

Agrostology

Soil Fertility:—All coconut soils so far studied showed acute deficiencies of N.P.K. except those from Bandirippuwa where phosphate gave positive response only, at the early stages. However, soils sampled from the newly acquired sections are showing phosphate response as to be expected from the mineral composition of the soils.

In experiments carried out to study minor nutrient status of the Gonapinuwela soils where coconuts are showing peculiar symptoms, boron applied as sodium borate deca hydrate at 3 lbs./acre gave significantly high yields of *Medicago sativa*. However this deficiency of B has also been noted with other coconut soils (c.f. cinnamon sand at Horrekelle and lateritic gravel at Mattegoda) where the coconuts are not affected as in the South. The *M. sativa* plants growing in the Gonapinuwela soils developed symptoms which could not be explained on the basis of nutritional deficiencies; and examination of the root system showed decay of the tips and lesion scattered over the entire system. The presence of a parasitic nematode *Hemicycliophora longicaudata* in the roots has been reported by the Crop Protection Division.

Pasture under Coconuts:—Observations on the effect of *Brachiaria brizantha* and *B. milliformis* on coconuts and ancillary experiments on the performance and suitability of these species have shown that:

- (a) The pasture species would compete with coconuts for soil moisture and nutrients. It is suspected that competition for soil moisture would be more severe than for nutrients particularly under low rainfall conditions.
- (b) Both species yield to the same extent under similar conditions.
- (c) *B. milliformis* responds more to nitrogen manuring than *B. brizantha*.
- (d) *B. milliformis* is dominant over *B. brizantha* in the light microclimate under coconuts and the level of nitrogen manuring in these experiments.
- (e) The herbage yield of *B. milliformis* in particular is less during the N/E monsoon compared to the S/W monsoon. This appears to be associated with early maturity during the former season due to shorter day length at that time.

Crop Protection

The Parasite Breeding Station at Mylambavely, Batticaloa was opened in April 1963 and Mr. Edwin Dharmaraju, the Colombo Plan Entomologist, left in May on the completion of his assignment in Ceylon.

Over five million parasites of the Coconut Caterpillar were produced and over two million were released to fifty estates.

Life cycle studies were carried out on *Microbracon brevicornis* and *Persierola nephantides* and field studies on the pest-parasite complex carried out. Until now no field recoveries of *Microbracon brevicornis* have been made and the factors responsible for this are under study.

The Microbial insecticide Baithane L—69, based on *Bacillus thuringiensis* was found to be effective against the larvae of *Nephantis serinopa*.

A number of insecticides have been tested in the Laboratory against the Red Weevil, *Rynchophorus ferrugineus* and telodrin was found to be the most effective against the larvae and pupae of this pest.

During 1963, much emphasis was laid on the study of the "Leaf Scorch" problem in the Gonapinuwela area. Studies on its mode of spread in the field and the symptomatology are in progress. Two weak parasitic fungi, *Pestalotiopsis palmarum* (Cke) Petrak and Sydow., have been isolated from the leaves of affected palms; but are not likely to be the primary causes of the condition; Histopathological studies have revealed that there is a blackening of the cortical cells and a blockage of the xylem vessels of the roots. A nematode, *Hemicyclophora longicaudata*, Loos (Criconematidae)* has been found to be associated with roots of affected palms. *H. longicaudata*, Loos is found to occur in large numbers in the soil of the Gonapinuwela area. It has not been possible to ascertain, as yet, whether this is the primary cause of Leaf Scorch, and investigations on this aspect are in progress, in addition to studies on the micro-organisms associated with the roots and soil and the environmental conditions necessary for the spread of "leaf-scorch".

Mycological studies on Bud-rot and Nut-fall of coconut were conducted.

* It has been renamed *Caloosia Longicandata*, Loos.

Biometry

The Biometrician besides assisting the Research Divisions in their statistical work as well as the designing of experiments, carried out the following items of research:—

- (a) A study was made of the patterns of the within year variations of coconuts crops vis-a-vis the patterns of variations of the crop components.
- (b) Nut water nutrients data were re-examined in relation to applied fertiliser dosages as well as yields and some new trends were observed.

Soil Survey

The Soil Survey of Puttalam North area, mainly comprising the Vanatavillu Middle Class Scheme which was commenced in 1962 was continued in 1963.

Soils have been classified into three series, consisting of red, yellow, and bleached yellow series, the latter lying in the Valley of the Villus.

A Soil Survey of lands along the Padawiya-Pulmoddai Road was carried out. Three soil types were observed—gravelly soils on the ridges, a deep alluvium and a clay hydromorphic association. Only the second type was recommended as being suitable for coconut cultivation.

Advisory and Extension Work

Besides the normal advisory work and inspections under the Fertilizer Subsidy Scheme, 354,469 seedlings covering an acreage of 4,764 acres, and 118 tons of fertilizer and aldrex were issued in connection with the Citronella Subsidy Scheme.

Nurseries:—2,096,096 seednuts were planted in the 14 Planting Division Nurseries and 454,610 seednuts for the Citronella Subsidy Scheme in the 2 Nurseries at Medamulana and Mapalana.

M.L.M. SALGADO,
Director, Coconut Research Institute.

REPORT OF THE CHEMIST

1. RECOVERY OF COCONUT OIL DURING EXPELLER PRESSING

Monthly records kept at an oil mill in the Kurunegala District have shown that on an average a candy (560 lbs.) of copra (on expeller pressing) may be expected to yield 336 lbs. of oil (60.0%) and 191 lbs. of poonac (34.1%). In other words, the gross operational losses on every candy would amount to 33 lbs. or 5.9 per cent of the weight of copra taken. In milling practice, it is generally estimated that 6.5 candies of copra would give a ton of oil and 0.5 ton of poonac, which are not widely different from the out-turns that have been recorded at the above mill.

Analyses of samples of comminuted copra (before and after drying) as prepared for expeller pressing showed that at least 2 per cent of the losses are due to dryage during the preparation of desi-copra. Besides "copra dust", of course a certain amount of sediment poonac and oil are also recovered from the filter presses, which are normally reported as losses. Records are being kept at this mill in order to obtain quantitative estimates of these recoveries.

Expeller Efficiency

Samples of poonac were drawn from the three expellers (all of Indian manufacture), installed at this mill, and these were analysed with the following results:—

Sample	% Moisture	% OIL	
		Wet basis	Dry basis
Expeller No. 1 ..	5.02	15.34	16.15
Expeller No. 2 ..	5.06	17.82	18.76
Expeller No. 3 ..	6.15	15.88	16.92
Mean	5.41	16.35	17.28

The residual oil contents in all three samples should be reckoned high for good expeller poonac.

Regarding expeller efficiency—on the basis that a candy of copra [6.0% moisture and 68.3% oil (dry basis)] contains 359.52 lbs. of oil, the actual oil recovered per candy (viz. 336 lbs.) would represent 93.5% of the potential oil contained in the copra.

2. DESICCATED COCONUT

(a) Consequent on certain complaints received by the Ceylon Coconut Board from overseas buyers, regarding the problem of oil exudation from certain shipments of Ceylon Desiccated Coconut packed in paper bags, some *ad hoc* experiments have been conducted to establish the factor or factors responsible for this phenomenon.

CHEMICAL EXAMINATION OF CEYLON AND PHILIPPINE DESICCATED COCONUT

(Samples supplied by the Ceylon Coconut Board on 27.4.63)

TABLE I (a)

1	2	3	4		5	6		7		8	
Sample	% Passing through B.S. 10 mesh test sieve	% Moisture	% OIL		Free Fatty acidity on Pressed oil (% Lauric)	% Total Sugars (as Sucrose)		% Protein		% Total Mineral Matter	
			Wet basis	Dry basis		Wet basis	Dry basis	Wet basis	Dry basis	Wet basis	Dry basis
CEYLON (C ₁)	69.2	3.6	67.7	70.3	0.14	5.8	6.0	6.0	6.7	1.4	1.6
PHILIPPINE (P ₁)	89.5	4.6	66.7	70.0	0.21	4.9	5.2	6.2	6.7	1.8	1.9

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TABLE I (b)

1	2																					
Sample	MINERAL ELEMENTS																					
	% Moisture	On Original DCN (mg. per 100 g.)										On Oil-free Meal (Per cent)										
		K		P		Ca		Mg		N		Moisture %	K		P		Ca		Mg		N	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
CEYLON (C ₁)	3.6	389	437	152	170	27	30	121	136	953	1070	10.9	1.31	1.47	0.51	0.57	0.09	0.10	0.41	0.46	3.21	3.61
PHILIPPINE (P ₁)	4.6	531	565	164	174	19	20	89	95	1000	1070	6.1	1.77	1.88	0.54	0.58	0.06	0.07	0.30	0.32	3.34	3.55

On the basis of chemical, physical and microscopical examination of parallel samples of Ceylon and Philippine Desiccated Coconut, the tentative conclusion has been that oil exudation results from some sort of cell-wall degradation or breakdown. It is probable that this is associated with certain critical temperature combinations and/or limits for sterilization and drying. In Ceylon, the pared kernel is sterilized for 1½ minutes at a temperature of 210°F, whereas in the Philippines the corresponding sterilization temperature is only 150°F for an immersion time of 10 minutes.

The results of chemical examination of two samples of desiccated coconut used in this study are charted in Tables I (a) and I (b). Using a hydraulic press some preliminary oil exudation tests were also carried out on the two samples, and the results are summarised in Table II.

TABLE II

<i>Sample</i>	<i>Oil exuded (as % of weight taken) 400 lbs./sq. inch for 5 mins.</i>	<i>Oil exuded (as % of weight taken) 800 lbs./sq. inch for 5 mins.</i>	<i>TOTAL</i>
Ceylon ordinary (fine) ..	30.18 (% F.f.a. = 0.42)	6.47 (% F.f.a. = 1.03)	36.65
Philippine ordinary (fine) ..	27.15 (% F.f.a. = 0.21)	4.68 (% F.f.a. = 0.84)	31.83

The figures though not conclusive would appear to be in conformity with the theory that the higher exudation of oil from Ceylon D.C., is to be linked with some sort of cell-wall breakdown or weakening during sterilization and or drying. The experiments are being continued.

(b) As the hydraulic press method was found unsuitable for testing over low pressure ranges, this method was subsequently abandoned. Instead, a more sensitive and satisfactory plate-method has been evolved for testing oil exudation from desiccated coconut. The method consists in spreading out evenly an accurately weighed quantity (5 grms.) of desiccated coconut between two Whatman No. 3, thick, absorbent quality, 15 cm. filter papers with cellophane backing. In order to ensure uniformity in particle size, only that fraction of the sample that passes through a B.S. (10 mesh) sieve is weighed out initially for the test. The filter papers (with the sample) are then sandwiched in the horizontal position between two heavy metal plates (approximately 7" square) and subjected to incremental pressures by loading the top plate with standard weights. The weight of the top plate is of course taken into account in computing the applied pressure. After subjecting the sample to a specific pressure for exactly *one* hour, the desiccated coconut is carefully scraped off and the filter papers weighed. The increase in weight expressed as a percentage of the dry weight of desiccated coconut taken represents the oil exudation at each specific pressure.

The observation has been made that the moisture content of the samples is one of the factors that could vitiate the results. Apart from dehydrating all samples for test to bone-dryness in a vacuum desiccator, it has also been found that incremental pressures for the lower range 10-5-40 constitute a more sensitive index for the comparison of sample differences than the higher range 20-10-60 which was used earlier in these tests. The results of 5 bone-dry samples tested in this manner over the lower pressure range are charted in Table III (a).

TABLE III (a)

Oil Exudation from Desiccated Coconut (Pressed between 15 cm. filter papers)

1	2	3						
WEIGHT (lbs./27.4 sq")	PRESSURE (lbs./sq" for 1 hour)	SAMPLE (oil exuded as % of bone-dry weight)						
		I (CU)	II (CW)	III (CP)	IV (CT)	V (C _i)	Mean	C.V. (%)
Plate only = 10 (P)	0.36	13.86	14.00	14.65	16.55	17.37	15.29	9.26
P + 5 = 15	0.55	11.68	10.27	8.35	11.07	7.68	9.81	15.77
P + 10 = 20	0.73	8.27	7.49	6.00	6.68	4.70	6.63	18.54
P + 15 = 25	0.91	5.69	5.77	4.67	4.48	3.00	4.72	21.32
P + 20 = 30	1.09	4.81	4.06	3.80	3.84	2.13	3.73	23.53
P + 25 = 35	1.28	3.09	2.82	2.44	3.08	1.74	2.63	19.23
P + 30 = 40	1.46	2.55	2.88	2.40	2.44	1.25	2.30	24.06
Total Oil Exuded (%)		49.95	47.29	42.31	48.14	37.87	45.11	9.79

The figures in column 3 show that the coefficient of variation between the five samples (when the load is 10 lbs. for 1 hour) is 9.3%. For the same five bone-dry samples the following figures have been recorded for an initial load of 20 lbs., when applied for an hour. The data indicate the relative sensitivities of the samples to the lower and higher pressures respectively.

Samples (subjected to a load of 20 lbs.)	Oil Exuded (as % of dry wt.)	
CU	16.73	} Coefficient of Variation for CU, CW, CP and CT = 1.51%, whereas for the same four samples at the lower pressure it works out to 7.27%.
CW	16.31	
CP	16.06	
CT	16.69	
C ₂	20.26	
Coefficient of Variation (%)		8.98

It will be seen that the inclusion of sample (C) blurs the variation factor, as it is exceptionally high from the point of view of oil exudation.

As these experiments are being continued the figures in Table III (b) have been computed to show the variations over the different pressure ranges for comparison with future samples.

This plate-method of testing oil exudation is being recommended for use in the routine examination of desiccated coconut. It is being currently employed in the D.C., quality testing laboratory of the Ceylon Coconut Board.

TABLE III (b)

Oil Exudation from Desiccated Coconut—(Pressed between 15 cm. filter papers)

1	2						
WEIGHT (lbs./27.4 sq")	SAMPLE (oil exuded as % of bone-dry weight)						
	I (CU)	II (CW)	III (CP)	IV (CT)	V (C ₁)	Mean	C.V. (%)
(A) Plate only (P) = 10	13.86	14.00	14.65	16.55	17.37	15.29	9.26
(B) P } P + 5 } 1 hour each	25.54	24.27	23.00	27.62	25.05	25.10	6.08
(C) P } P + 5 } P + 10 } 1 hour each	33.81	31.76	29.00	34.30	29.75	31.72	6.66
(D) C — plus (P + 15) — 1 hour	39.50	37.53	33.67	38.78	32.75	36.45	7.49
(E) D — plus (P + 20) — 1 hour	44.31	41.59	37.47	42.62	34.88	40.17	8.65
(F) E — plus (P + 25) — 1 hour	47.40	44.41	39.91	45.70	36.62	42.81	9.27
(G) F — plus (P + 30) — 1 hour	49.95	47.29	42.31	48.14	37.87	45.11	9.79

3. GRATED COCONUT MEAT

The grated meat from the fresh coconut kernel is used in the Ceylon household for culinary purposes. Further, it has been estimated (Central Bank of Ceylon) that the nut equivalent of the annual domestic consumption of coconuts is in the region of 990 millions.

For cooking purposes, it is customary to press out manually the "milk" from the grated meat using a certain amount of hot water. With a view to obtaining an estimate of the efficiency of this extraction—(particularly as regards oil and protein), a simple experiment simulating the household method was carried out. The samples of grated meat obtained during three successive manual pressings were then analysed chemically. The complete results obtained in the study are charted in Tables IV (a) to IV (e).

The results clearly show that there is a colossal waste of valuable oil and protein in the "pol-kudu" that is discarded as waste. In terms of weights—on the basis that 1,200 nuts give 560 lbs. (a candy) of copra (6% moisture) with an oil content of 68.0% (dry basis), it has been computed that the loss of oil represents 23.1% of the oil per nut. The corresponding total weight loss on 990 million nuts consumed locally would thus amount to approximately 30,407 tons per annum. The economic loss to the industry (without taking into account the protein) would be in the region of Rs. 33.5 millions. [Calculated on the basis that the value of a ton of coconut oil is Rs. 1,100].

The problem of averting these losses would hinge on the possible preparation of some form of emulsified coconut oil as a suitable substitute for coconut milk. Such a product would of course have to be sufficiently cheap for regular household use.

4. ESTIMATION OF CRUDE FIBRE

A.G. Norman (*J. Agric. Sci.*, 1935, 25, pp. 529-40) has shown that crude fibre is a variable mixture of cellulose and lignin, neither of which is a constant fraction of the quantity present in the original sample. During the acid digestion—starch is hydrolysed, but cellulose and lignin are very slightly changed. During the digestion with alkali, cellulose is slightly changed, lignin is attacked to a considerable but variable extent, and the proteins are almost completely removed. Norman thinks that any empirical method should include the whole of the lignin, and has suggested as a possible alternative, acid hydrolysis with a correction for the proteins.

As it is proposed to carry out a series of crude-fibre estimations on desiccated coconut and other products of the coconut kernel, a few preliminary experiments were carried out to test the reproducibility of results obtained with the above empirical method.

Norman's suggestion about acid hydrolysis with a correction for proteins was tried out, but was found to give inconsistent values. A sample of desiccated coconut with the analytical composition given below, was subjected to different treatments and then examined for crude fibre with the results charted in Table V.

Composition of D.C. Sample (ICP/H)

% Moisture	—	3.89
% Oil (wet basis)	—	67.24
% Oil (dry basis)	—	69.96
% Dry oil-free meal	—	30.04

**CHEMICAL EXAMINATION OF GRATED COCONUT MEAT AFTER SUCCESSIVE
MANUAL PRESSINGS USING HOT WATER**

(Original grated sample prepared from five dead-ripe **FALLEN NUTS**)

TABLE IV (a)

(Moisture, Oil, Sugars, Protein and Total Mineral Matter)

1	2	3			4			5			6			7
Sample	% Moisture	% Oil			% Total Sugars (as Sucrose)			% Protein			Total Mineral Matter %			Dry Weight Inter-relationships (Successive Pressings)
		Wet basis	Dry basis	As % of tot. in fresh meat	Wet basis	Dry basis	As % of tot. in fresh meat	Wet basis	Dry basis	As % of tot. in fresh meat	Wet basis	Dry basis	As % of tot. in fresh meat	
GK (fresh) ..	44.7	36.1	65.4	100.0	3.9	7.1	100.0	4.4	8.0	100.0	1.9	3.4	100.0	100.0
GK (calculated on air-dry basis)	5.7	61.7	65.4	100.0	6.7	7.1	100.0	7.5	8.0	100.0	3.2	3.4	100.0	100.0
GK I	5.7	56.2	59.6	46.3	6.3	6.7	47.9	7.4	7.9	50.0	4.5	4.8	71.8	50.8
GK II	5.7	50.4	53.4	30.1	5.4	5.7	29.6	6.5	6.9	31.9	3.5	3.7	40.3	36.9
GK III	5.7	46.7	49.5	23.9	3.8	4.0	17.7	5.6	5.9	23.2	1.3	1.4	13.0	31.6

GK — Original freshly grated meat.
 GK I — Grated meat after **FIRST** manual expression with hot water.
 GK II — Grated meat after **SECOND** manual expression with hot water.
 GK III — Grated meat after **THIRD** manual expression with hot water.

Note:—Samples GK I, GK II and GK III were air-dried before analyses.

**CHEMICAL EXAMINATION OF GRATED COCONUT MEAT AFTER SUCCESSIVE
MANUAL PRESSINGS USING HOT WATER**

(Original grated sample prepared from five dead-ripe **FALLEN NUTS**)

TABLE IV (b)

MINERAL ELEMENTS—On oil-free meal (Per cent)

1	2	3			4			5			6			7			8
		<i>K</i>			<i>P</i>			<i>Ca</i>			<i>Mg</i>			<i>N</i>			
		<i>Wet</i>	<i>Dry</i>	<i>As % of tot. in Fresh Nut</i>	<i>Wet</i>	<i>Dry</i>	<i>As % of tot. in Fresh Nut</i>	<i>Wet</i>	<i>Dry</i>	<i>As % of tot. in Fresh Nut</i>	<i>Wet</i>	<i>Dry</i>	<i>As % of tot. in Fresh Nut</i>	<i>Wet</i>	<i>Dry</i>	<i>As % of tot. in Fresh Nut</i>	
IGK	4.8	1.56	1.64	100.0	0.59	0.62	100.0	0.07	0.07	100.0	0.41	0.43	100.0	3.53	3.71	100.0	100.0
IGK I	4.8	1.15	1.21	43.7	0.50	0.52	50.0	0.07	0.07	58.6	0.37	0.39	53.7	2.96	3.11	49.6	59.2
IGK II	4.8	1.00	1.05	31.8	0.35	0.37	29.0	0.06	0.06	42.9	0.34	0.36	41.6	2.27	2.38	31.8	49.7
IGK III	4.8	0.57	0.60	16.9	0.24	0.25	19.4	0.05	0.05	32.9	0.27	0.28	30.0	1.78	1.87	23.3	46.2

- IGK — Original freshly grated meat.
- IGK I — Grated meat after **FIRST** manual expression with hot water.
- IGK II — Grated meat after **SECOND** manual expression with hot water.
- IGK III — Grated meat after **THIRD** manual expression with hot water.

**CHEMICAL EXAMINATION OF GRATED COCONUT MEAT AFTER SUCCESSIVE
MANUAL PRESSINGS USING HOT WATER**

(Original grated sample prepared from five dead-ripe FALLEN NUTS)

TABLE IV (c)

MINERAL ELEMENTS—Calculated on respective samples of Grated Meat (Mg. per 100 g.)

1	2	3		4		5		6		7	
<i>Sample</i>	<i>% Moisture</i>	<i>K</i>		<i>P</i>		<i>Ca</i>		<i>Mg</i>		<i>N</i>	
		<i>Wet</i>	<i>Dry</i>	<i>Wet</i>	<i>Dry</i>	<i>Wet</i>	<i>Dry</i>	<i>Wet</i>	<i>Dry</i>	<i>Wet</i>	<i>Dry</i>
I GK (fresh)	44.7	314	568	118	213	13	24	82	149	710	1284
I GK (calculated on air-dry basis)	5.7	536	568	201	213	23	24	141	149	1211	1284
I GK I	5.7	461	489	198	210	26	28	149	158	1184	1256
I GK II	5.7	461	489	162	172	26	28	158	168	1046	1109
I GK III	5.7	287	304	117	124	24	25	133	141	890	944

- I GK — Original freshly grated meat.
- I GK I — Grated meat after FIRST manual expression with hot water.
- I GK II — Grated meat after SECOND manual expression with hot water.
- I GK III — Grated meat after THIRD manual expression with hot water.

**CHEMICAL EXAMINATION OF GRATED COCONUT MEAT AFTER SUCCESSIVE
MANUAL PRESSINGS USING HOT WATER**

(Original grated sample prepared from five dead-ripe FALLEN NUTS)

TABLE IV (d)

(Weight Characteristics of Components of De-husked Nuts used for Experiment)

1	2	3	4	5
<i>Nut No.</i>	<i>Weight of Nut (grms.)</i>	<i>Weight of Grated Meat (grms.)</i>	<i>Weight of Nut-Water (grms.)</i>	<i>Weight of Shell (by difference) (grms.)</i>
1	1065	457	288	320
2	872	439	168	265
3	1036	417	308	311
4	712	390	114	208
5	734	321	185	228
Mean	884	405	213	266

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TABLE IV (e)

(Moisture and Dry Matter in Grated Meat during Successive Pressings)

1	2	3		4	5		6
<i>Sample</i>	<i>% Moisture in the samples as prepared for the Experiment</i>	<i>Wet and Dry Weights of the portion used for determination of the losses in Dry Matter during successive Pressings</i>		<i>Wet Weights of Portion recalculated on 44.7% moisture basis</i>	<i>Wet and Dry Weights obtainable from 1000 grms. of fresh meat (44.7%) (moisture)</i>		<i>Dry Weights as % of original from 1000 grms.</i>
		<i>Wet Weight</i>	<i>Dry Weight</i>		<i>Wet Weight</i>	<i>Dry Weight</i>	
GK (fresh) ..	44.7	832	460	832	1000	553	100.0
GK I ..	57.9	555	234	423	508	281	50.8
GK II ..	66.1	502	170	307	369	204	36.9
GK III ..	66.9	442	146	264	317	175	31.6

TABLE V

Crude Fibre Estimations on Desiccated Coconut (Sample ICP/H)

1	2	3	4	5	6						
					No.	No. of Extractions (Pet. Ether)	No. of Disintegrations	Acid Digestion	Alkali Digestion	% FIBRE (Original D.C.)	
										Wet basis	Dry basis
1	one	nil	yes	yes	12.53	13.04					
2	one	nil	yes	yes	12.61	13.12					
3	two	one	yes	yes	3.76	3.91					
4	two	one	yes	yes	3.98	4.14					
5	three	two	yes	yes	3.61	3.76					
6	three	two	yes	yes	3.27	3.40					
7 On oil-free meal obtained from routine oil determination					3.75	3.90					

The figures clearly show that the particle size of the material is a critical factor in the values obtained for crude fibre. With good duplicate agreement the unground material obviously gives *spuriously* high figures. Between the samples ground once and twice, the values are not so widely divergent, though definitely lower with increased diminution of particle size.

In the proposed series of fibre estimations the procedure to be followed would be to use the dry oil-free material after passing through a pre-determined standard mesh test sieve.

5. VINEGAR

(a) The Vinegar Generator installed at the new factory at Nainamadama which was started off in June 1962 continued to operate very satisfactorily during the year. The factory was inspected at regular intervals and the acid strength of the finished vinegar was found to be consistently over 5.5%. The maize cobs originally used in the packing chamber were found to last the guaranteed period of one year without any form of degradation or breakdown.

(b) A satisfactory method was evolved for the preparation of caramel (of high tinctorial efficiency), for colouring vinegar. A bottle of this caramel has been found adequate to colour 20 gallons of vinegar to a dark wine-tint.

This method has been demonstrated to some vinegar-makers and it is now being applied at the new Nainamadama factory for colouring their "Generator Brand" Vinegar.

(c) An experiment was successfully carried out to test the efficacy of common salt in retarding the growth of mycodermal film in bottled vinegar. It was found that a minimum concentration of 2.0% salt dissolved in the vinegar would completely arrest the formation of any mycodermal suspensions.

As an effective substitute for sterilization, common salt at a concentration of 2% is now being used at the Nainamadama factory.

6. POT CULTURE EXPERIMENT

(a) A fifth Sand Pot Culture Experiment on 288 seedlings was laid down during the year.

It is proposed to carry out *preliminary tests* on the relative merits and demerits of using leaf-punch samples (side by side with the entire laminae) for diagnostic analyses. It is proposed to restrict leaf punch analyses in this experiment to K and N only.

(b) Work on this experiment was focussed principally on the analyses of plant samples from previous Pot Culture Experiments.

7. MISCELLANEOUS WORK

(a) 32 samples of copra received from the Botanist were analysed for moisture and oil contents during the year.

(b) Analyses and reports were made during the year on various samples of copra, desiccated coconut, poonac, sediment poonac and acetifying toddy.

(c) A sample of farmyard manure received from Marawila was analysed and reported on for its manurial value in respect of nitrogen, phosphorus, potassium, calcium and magnesium.

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REPORT OF THE BOTANIST

1. PROGENY TRIALS

The three progeny trials at Marandawila, Walpita and Bandirippuwa were maintained during the year. The Walpita trial takes the form of two Cubic Lattices (A and B), and unselected, open-pollinated progenies of 125 unselected seed parents are tested in each Lattice. The analysis of variance of yield of nuts and weight of husked-nuts for two years of Lattice A (age of palms—12 and 13 years) showed that the differences between treatments in yield of nuts were not significant, but the differences in weight of husked-nuts were significant ($P < 0.05$). The adjusted mean weight of husked-nuts per palm per year varied between 102.2 lb. and 41.8 lb. with a population mean of 71.9 lb., and that indicates the relative variation in breeding values between the seed parents. From this analysis it was possible to classify the 125 seed parents according to their breeding values, and use some of them for further breeding work.

The offspring of the two best seed-parents 55 and 237 have given a mean yield of copra more than 40 per cent of the population mean, and further the coefficients of variation within progenies have been relatively low. These two palms could be classified as prepotent provisionally—provisionally as the progenies are only 13 years old and have not reached the optimum bearing age yet.

Pollen from palms 55 and 237 were collected regularly for controlled pollination work and 25 of the best palms of the Marandawila Trial, classified according to their breeding values were selected for pollination work.

2. HYBRIDISATION BETWEEN VARIETIES AND FORMS

The programme of work on breeding and selection of coconut palms was continued during the year. Nuts of crosses done during the previous year, *viz.* diallel, testing male transmitters, study of segregation of certain characters, etc., were harvested and some of them have been already planted in the nursery. 453 nuts have been harvested from one diallel cross involving 8 *typica* palms: two of the palms have given relatively few nuts when used as the female parent, but the same palms when used as the pollen parent have given a sufficiently large number of nuts. 536 nuts were collected from the crosses to test male transmitters: the pollen parents being 6 selected palms from the Isolated Seed Garden. Two types of cross *typica* × *typica* and *pumila* × *typica* were done. Altogether 375 seedlings were planted at Pothukulama in November, 1963.

The king-coconut palms (var. *aurantiaca*, form *thembilli*) grown in Ceylon show a marked periodicity in bearing, which character is presumably associated with the predominantly inbreeding system of the palm, similar to the dwarf (*nana*) variety. A programme of work was undertaken to study whether a uniformly high-yielding king-coconut palm without periodicity in bearing, and if possible early-bearing, could be developed by crossing selected palms within and between forms.

A number of progenies of various crosses planted since 1950 are under observation and some of their yield data for 1963 are given below. The 22 progenies of *typica* × *pumila* have given a mean yield

of 166 nuts and a husked-nut weight of 297.9 lb. per palm, and 7 progenies of *pumila* × *typica* have given 162 nuts and a husked-nut weight of 312.4 lb. per palm. 10 progenies of *typica* × *typica* have given 182 nuts and a husked-nut weight of 322.0 lb. per palm. Although these F₁ palms are only 13 years old, their yields are unusually high. Since the number of progenies of each cross is relatively small conclusive results cannot be drawn from them. Plantings done subsequently, particularly the experimental block planted at Pothukulama in 1962 should give a better picture of the relative differences in yield between some of the above types of palms.

Crossing of *typica* × *typica* and *typica* × *pumila* where the male parent is a prepotent was continued at six stations during the year. 25,171 nuts were harvested from crosses done in 1962. 16,028 seedlings of the above crosses were issued to the industry.

Pollen Bank:—A technique to increase the quantity of pollen collected from an inflorescence was devised, based on a modification of a method developed by Jamaican workers. Anthers of coconut flowers were separated from the perianth lobes and were oven dried at 40°C for 4 to 5 hours. Thereafter pollen was separated from the dehisced anthers by sieving. Pollen grains showed a germination of about 60 per cent, against 80 per cent for the control *i.e.*, pollen collected from spikelets in the laboratory under atmospheric conditions. The drop in germination is compensated by the large increase in pollen collected. It was possible to collect 9.0 gm. of pollen from a prepotent palm using this new technique, whereas previously the average collection from the same palm was 1.0 gm. of pollen. The pollen bank was well patronised by 8 private estates and 3,856 samples of pollen have been issued to them, each sample being sufficient to pollinate three inflorescences once.

The influence of pollen parent on endosperm weight:—An experiment was carried out from 1961 to 1963 to study the effect, if any, of the pollen parent on some nut characters like weight and volume of husked-nut and particularly thickness and weight of endosperm. The data of this experiment will be published in due course.

3. EMBRYO CULTURE

Preliminary studies on culturing coconut embryos were undertaken and when a successful technique has been developed, it is proposed to study whether the embryos of certain genetical combinations leading to heterosis develop faster than those not exhibiting such a phenomenon and related problems. Coconut embryos were dissected from the endosperm, surface sterilized with ethyl alcohol and grown on White's nutrient medium, supplemented with coconut water. A few embryos were successfully established in culture, but their growth retarded after 4 weeks. Absence of a culture room affected the progress of these studies.

4. CYTOLOGY

The somatic chromosome number of 14 pairs of twins of coconut seedlings were determined largely to find out whether haploidy is associated with twins. All the plants examined had the usual chromosome number $2n = 32$, and haploids were not detected. Repeated attempts to induce polyploidy in coconuts either by colchicine or alternate heat and cold treatments have not been successful. A pasture grass grown under coconuts and commonly referred to as *Brachiaria brizantha* has a chromosome complement of $2n = 36$, whereas the published figure for the species is $2n = 54$.

5. PLANTING TECHNIQUES

Hedge planting:—The observation trials of a new system of close planting for selective thinning are being continued and it is yet too premature to analyse the yield data as the palms are relatively young. About 5 acres at the Seed Garden were planted in May 1963 with a planting distance of 32 feet between rows and 12 feet within the row.

Depth of planting:—The field trial where four depths of planting a coconut seedling—6, 12, 18 and 24 inches—are compared has completed 7 years. The design is randomised block lay-out with 9 palms per plot and 5 replications. The seedlings were manured regularly from the date of transplantation. At the end of the year, palms in flower for each treatment were as follows: 6 inches depth—82.2 per cent, 12 inches depth—64.4 per cent, 18 inches depth—82.2 per cent and 24 inches depth—80.0 per cent. The differences between treatments were not significant. Thus, planting seedlings at the four depths indicated above has not made any difference with respect to their flowering-age, although it is commonly believed that deep planting delays flowering.

Size of seed hole:—This experiment planted in November, 1955, has shown that the size of seed-hole cut to transplant a coconut seedling has no effect on the initial flowering of the palms (*vide*. Annual Report for 1961). The yield data collected in 1962 and 1963 showed that the difference between the four treatments with respect to yield of nuts and husked-nut weights were not significant. The relative yield data are indicated below yield; per palm includes non-bearing palms as well. The soil in the block is mostly light gravel with a sandy loam in a smaller area. It is apparent that under the conditions of the experiment, the size of seed hole prepared to transplant a coconut seedling is immaterial, provided the plants are manured regularly and the land is cultivated.

Treatment	1962		1963	
	No. of nuts	Yield per palm Wt. of husked nuts (lb.)	No. of nuts	Yield per palm Wt. of husked nuts (lb.)
1 × 1 × 1ft. seed hole ..	17	31.8	23	39.0
3 × 3 × 3ft. seed hole ..	23	36.4	28	41.4
Cruciform type	23	41.2	28	45.4
Post-hole borer type ..	17	31.3	24	41.3

6. SEED SUPPLY SCHEME

1,880,604 selected seed-nuts from selected palms were supplied to the Planting Division during the year. Six new estates were examined and four of them were selected as suitable for seed collection. 49,897 palms have been selected for seed collection by the end of the year.

7. MISCELLANEOUS

Field Day:—Field days were held at the Isolated Seed Garden and at Rathmalagara Estate on two separate days for members of the L.C.P.A. and Kurungala P.A.

Publications:—The following paper was submitted for publication in the Ceylon Coconut Quarterly. Methods of under planting in senile coconut plantations by D.V. Liyanage.

Staff:—Mr. M.A.P. Manthirratne, Snr. Technical Assistant was promoted Research Assistant from 16th March, 1963.

D.V. LIYANAGE,
Botanist, Coconut Research Institute.

REPORT OF THE SOIL CHEMIST

SUMMARY

Seven long-term field experiments on manurial problems were continued in 1963—in addition to the observation trials on magnesium deficiency and leaf scorch problems. Pre-treatment records were maintained during the year for two new experiments—one on nitrogen quality, and the other on the problem of round-the-year immature nut fall.

The results of field experiments on bearing palms at Bandirippuwa and Ratmalagara give further support to our current recommendations on N.P.K. manuring (in 1960 we recommended an increase in the levels of N.P.K. manuring to about double the rates previously recommended).

The experiment comparing organic with inorganic fertilizers on a light sandy loam at Marandawila Estate, Bingiriya has shown that organic fertilizers offer no advantage over the cheaper inorganic fertilizers. We still receive occasional queries as to whether it would not be more advantageous to use organic sources of nitrogen and phosphorus in our fertilizer mixtures. This experiment confirms our view that it would be economically disadvantages to do so.

In the experiment on methods of fertilizer placement at Walahapitiya Estate, Nattandiya, there was little difference between the surface application of fertilizers in a circular strip 3 feet wide and 3 feet away from the palm and the considerably more expensive traditional circular trenches. Broadcast applications proved to be less effective.

A second field trial on adult palms using radioactive phosphorus confirmed that placement in the entire area round the palm up to a distance of about 6 feet from the bole was more efficient than placement in a 3 feet wide circular strip 3 feet away from the palm, or placement in the centres of squares.

Chemical analysis of leaflet samples from palms affected by "leaf scorch" in the southern province has shown that these palms are deficient in boron and magnesium. The possible association of the problem of leaf scorch with nutrient deficiencies cannot still be over-ruled, and further trials on this aspect are in progress.

Laboratory studies have indicated that except on sandy soils, dolomite can be applied to palms at the same time as the usual N.P.K. fertilizer mixtures without loss of nitrogen provided that the fertilizers are well incorporated into the soil.

A. FIELD EXPERIMENTS

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

(See C.R.I. Annual Report 1949 and 1951 for details of treatment and design).

The 28th year of this experiment was completed in 1963. The yields for 1963 are the highest recorded since 1955. The main effects of N, P and K for 1963 are given in Table I. Potash continues to show a highly significant effect, while phosphate has given a significant response for the second year in succession.

Potash at 2.25 lbs. K₂O/palm biennially (4½ lbs. muriate of potash) gave an increase of 102 lbs. copra per acre over the lower level of 1.5 lbs. K₂O. The response to phosphate at 1 lb. P₂O₅/palm biennially was 181 lbs. copra/acre over the control. None of the interactions showed significance. It is interesting to note that although these palms are now well over 60 years old, they still continue to give high yields—over 4,400 nuts/acre when fertilizers are applied.

TABLE I
Yield data (main effects) for 1963—3⁸ N.P.K. Experiment, Bandirippuwa
(66 palms/acre)

Treatment	Lbs. Copra per acre	Nuts/ acre	% Copra		Difference per acre		Copra out-turn nuts/ candy	Diffe- rence in nuts/ candy
			Copra	Nuts	Copra lbs.	Nuts		
N ₀ (0.0 lbs. N)	2,033	4,087	100	100	—	—	1,126	—
N ₁ (0.5 lbs. N)	2,071	4,277	102	105	+ 38	+190	1,156	+30
N ₂ (1.0 lbs. N)	1,988	4,205	98	103	- 45	+118	1,185	+59
P ₀ (0.0 lbs. P ₂ O ₅)	1,909	3,885	100	100	—	—	1,140	—
P ₁ (1.0 lbs. P ₂ O ₅)	2,090	4,305	109	111	+181*	+420**	1,154	+14
P ₂ (2.0 lbs. P ₂ O ₅)	2,093	4,380	110	113	+184*	+495**	1,172	+32
K ₁ (0.75 lbs. K ₂ O)	1,770	3,839	100	100	—	—	1,215	—
K ₂ (1.5 lbs. K ₂ O)	2,110	4,295	119	112	+340***	+456***	1,140	-75
K ₃ (2.25 lbs. K ₂ O)	2,212	4,435	125	116	+442***	+596***	1,123	-92

Significant difference at P. 05 = 154 lbs. copra/acre and 278 nuts/acre.

* — Significant at P. 05.

** — Significant at P. 01.

*** — Significant at P. 001.

2. Manurial × Cultivation Experiment (Ratmalagara Estate)

The 20th year of this experiment was concluded in June 1963. Here too the yields for the year 1962-63 are the highest recorded since 1955. Both phosphate and potash showed significant effects (Table II)—phosphate at 1.0 lbs. P₂O₅ per palm biennially giving nearly 800 lbs. copra per acre more than the control plots. With phosphate applications a yield of over 4,200 nuts per acre was obtained. None of the interactions showed statistical significance.

TABLE II

Yield data for 1962-1963, Manurial \times Cultivation Experiment, Ratmalagara
(60 palms/acre)

Treatment	Lbs. Copra per acre	Nuts/ acre	% Copra Nuts		Difference per acre		Copra out-turn Nuts/ candy	Diffe- rence in nuts/ candy
			Copra	Nuts	Copra lbs.	Nuts		
P ₀ (0.0 lbs. P ₂ O ₅)	1,404	2,634			—	—	1,051	—
P (1.0 lbs. P ₂ O ₅)	2,198	4,244			+794***	+610***	1,107	+56
C ₀ (no ploughing)	1,749	3,391			—	—	1,085	—
C (ploughing)	1,853	3,590			+104	+199	1,085	0
Significant difference P. 05 = 142 lbs. copra/acre and 269 nuts/acre.								
K ₀ (0.0 lbs. K ₂ O)	1,673	3,339			—	—	1,117	—
K ₁ (1.0 lbs. K ₂ O)	1,843	3,565			+170	+226	1,083	-34
K ₂ (2.0 lbs. K ₂ O)	1,886	3,555			+213*	+216	1,058	-59

Significant difference at P. 05 = 174 lbs. copra/acre and 330 nuts/acre.

* — Significant at P. 05.

*** — Significant at P. 001.

3. 3 \times 3 \times 3 N.P.K. Experiment on Young Palms (Ratmalagara Estate)

(See C.R.I. Annual Report 1959 for details of treatment and design).

This experiment was planted in 1948. During the early period (up to the flowering stage) only nitrogen and phosphorus gave significant responses. The effect of potash reached significance at bearing stage. The yield data for the main effects of N, P and K given in Table III (a) once again show that all three major nutrients have produced highly significant increases in crops. The analysis of variance has also indicated a highly significant NP interaction (P. 001), while the NK and PK interactions were also found to be significant at the 5% probability level.

The NP, NK and PK interactions are seen in the two-way tables —Table III (b). The response to potash which is linear increases with increasing levels of nitrogen—the combination giving highest yields being K₂N₂ (3 lbs. each of muriate of potash and ammonium sulphate per palm annually). At lower levels of potash, the higher nitrogen dosage (N₂) depresses yields. This confirms the earlier results obtained in the 3³ N.P.K. experiment at Bandirippuwa.

There is also a positive NP interaction—the combination N₂P₂ (3 lbs. ammonium sulphate, 3 lbs. Saphos phosphate) giving the highest yields.

The combinations N₂P₂K₂ (equivalent to 9 lbs. C.R.I. mixture "A") has given 4,778 nuts per acre, whereas the control plots have given only 2,474 nuts per acre, and the combination N₁P₁K₁ (4½ lbs. C.R.I. mixture "A") gave 3,768 nuts per acre.

TABLE III (a)

Yield data for 1963—3³ N.P.K. Experiment on Young Palms, Ratmalagara Estate
(55 palms/acre)

Treatment	Lbs. Copra per acre	%	Difference in lbs. Copra/ acre	Nuts/ acre	%	Difference in nuts/ acre	Copra out-turn Nuts/ candy	Difference in nuts/ candy
N ₀	1,523	100	—	2,768	100	—	1,018	—
N ₁	1,860	122	+ 337**	3,358	121	+ 590	1,011	- 7
N ₂	1,827	120	+ 304***	3,456	125	+ 688	1,059	+ 41
P ₀	1,188	100	—	2,147	100	—	1,012	—
P ₁	2,022	170	+ 834***	3,666	171	+ 1,519	1,015	+ 3
P ₂	2,000	168	+ 812***	3,769	176	+ 1,622	1,055	+ 43
K ₀	1,582	100	—	3,042	100	—	1,077	—
K ₁	1,695	107	+ 113	3,099	102	+ 57	1,024	- 53
K ₂	1,932	122	+ 350***	3,442	113	+ 343	997	- 80

Significant difference at P. 05 = 132.6 lbs. copra/acre.

*** Significant at P. 001.

TABLE III (b)

lbs. Copra per acre

	N ₀	N ₁	N ₂
P ₀	1,246	1,705	1,617
P ₁	1,231	2,220	2,127
P ₂	1,085	2,140	2,256
	N ₀	N ₁	N ₂
K ₀	1,493	1,692	1,561
K ₁	1,423	1,874	1,787
K ₂	1,650	2,013	2,132
	P ₀	P ₁	P ₂
K ₀	1,105	1,773	1,868
K ₁	1,072	1,975	2,038
K ₂	1,385	2,317	2,094

TABLE III (c)

lbs. Copra per acre

	N_0K_0	N_0K_1	N_0K_2
P_0	1,355	1,152	1,230
P_1	1,366	1,655	2,093
P_2	1,759	1,464	1,627

	N_1K_0	N_1K_1	N_1K_2
P_0	952	1,163	1,580
P_1	2,103	2,172	2,387
P_2	2,022	2,287	2,072

	N_2K_0	N_2K_1	N_2K_2
P_0	1,008	902	1,345
P_1	1,852	2,098	2,471
P_2	1,823	2,362	2,582

4. Manurial Experiment on Organics vs. Inorganics and frequency of manuring (Co-operative Experiment at Marandawila Group, Bingiriya).

(See C.R.I. Annual Report 1959 for details of treatment and design).

The 5th year of this experiment was concluded in June 1963. Table IV gives the yield data (adjusted by co-variance analysis) for the different treatments during the year 1962-1963. This year too all treatments were found to be significantly better than the control (no manure). But none of the other treatment differences showed statistical significance. For the 5th year in succession it has been shown that organic manures offer no advantage over the cheaper inorganic fertilizer even on the sandy loam soil.

Biennial application of fertilizers in full circles round the palm has been found to be as effective as annual application in half circles. It is possible that any advantages of annual application was not realised as only half the root system was utilised for the uptake of fertilizers applied each year. The experimental treatments will therefore be altered to full circle application of fertilizers both annually and biennially.

TABLE IV

Yield data for 1963, Experiment on Organics vs. Inorganics, Marandawila Estate
(Copra yield adjusted by co-variance analysis) (60 palms/acre)

Treatment	lbs. Copra/acre	%	Difference in lbs. Copra/acre	Out-turn nuts/candy
Control	2,317	100	—	1,103
Inorganics annually ..	2,758	119	441	1,057
Inorganics in 2 years ..	2,752	119	435	992
Organics annually ..	2,758	119	441	1,003
Organics in 2 years ..	2,760	119	443	1,037
Cattle manure with supplements	2,850	123	533	1,012

5. 4 × 4 × 4 N.P.K. Experiment on adult palms (Bandirippuwa Estate)

(See C.R.I. Annual Report 1960 for details of treatment and design).

This experiment has now completed three years. The fourth annual manuring was done in November 1963. The copra yields for the 2nd year (1962) showed a significant positive response to nitrogen. In the third year significant positive responses were obtained for both nitrogen and potash. The yield data for 1963 (adjusted by co-variance analysis) is given in Table V. The phosphate response showed no significance, nor did any of the interactions. Both nitrogen and potash have given the highest yields at the higher levels of application (7½ lbs. sulphate of ammonia and 3 lbs. muriate of potash per palm respectively).

TABLE V

Yield data for 1963—4th N.P.K. Experiment on adult palms, Bandirippuwa
(Copra yield adjusted by co-variance analysis) (66 palms/acre)

Treatment	lbs. Copra/acre	%	Difference in lbs. Copra/acre	Nuts/acre	Copra out-turn in nuts/candy
N ₀ (0.0 lbs. N)	1,824	100	—	3,873	1,176
N ₁ (0.5 lbs. N)	2,013	110	+ 189**	4,116	1,188
N ₂ (1.0 lbs. N)	2,089	115	+ 265**	4,451	1,192
N ₃ (1.5 lbs. N)	2,111	116	+ 287**	4,679	1,214
P ₀ (0.0 lbs. P ₂ O ₅)	1,986	100	—	4,213	1,191
P ₁ (0.5 lbs. P ₂ O ₅)	1,939	98	- 47	4,399	1,172
P ₂ (1.0 lbs. P ₂ O ₅)	1,961	99	- 25	1,467	1,198
P ₃ (1.5 lbs. P ₂ O ₅)	2,149	108	+ 163	4,342	1,212
K ₀ (0.0 lbs. K ₂ O)	1,829	100	—	4,085	1,210
K ₁ (0.5 lbs. K ₂ O)	2,015	110	+ 186**	4,224	1,190
K ₂ (1.0 lbs. K ₂ O)	2,070	113	+ 241**	4,398	1,217
K ₃ (1.5 lbs. K ₂ O)	2,122	116	+ 293**	4,413	1,158

**Significant at P. 01.

Significant difference P. 05 = 138 lbs. Copra/acre.

It is interesting to note that in the old 3rd N.P.K. trial at Bandirippuwa the potash response showed significance from the third year onwards, while the effect of nitrogen was statistically significant only in the second year.

6. **Methods of placement and liming experiment on adult palms (Co-operative experiment at Walahapitiya Estate, Nattandiya).**

(See C.R.I. Annual Report 1961 for details of treatment and design).

The third annual manuring was done in October 1963. During the course of the year the plots receiving lime were given a further applications of lime at the rate of 15 cwts. per acre, so that these have now been treated with a total of 45 cwts. lime per acre. The lime has reduced the acidity of the top soil (0-9") in these plots from pH 4.2 to pH 6.8. But the sub-soil (9-18") still remains quite acid at pH 4.3. Liming produced no significant effects on yields at the end of the second year of this experiment. Further applications of lime will be done to reduce the acidity of the sub-soil as well.

Broadcast application of fertilizers was less efficient than placement round the palm. Surface application of fertilisers in a circular strip 3 feet wide and 3 feet away from the palm showed little difference to the considerably more expensive traditional circular trench system of placement. The yield data (adjusted by co-variance analysis) for 1963 is shown in Table VI. It is still premature to draw any definite conclusions.

TABLE VI

Yield data for 1963—Experiment on fertilizer placement and liming, Walahapitiya Estate
(Yields adjusted by co-variance analysis) (50 palms/acre)

Treatment	lbs. Copra/acre	%	Difference lbs. Copra/acre
O (no fertilisers)	1,406	100	—
B (broadcast)	1,428	101	22
C (Circular trenches)	1,570	111	164***
S (Spread on surface in circular strip)	1,528	109	118***
Significant difference P. 05 = 52 lbs. Copra/acre.			
***Significant at P. 001.			
L ₀ (no lime)	1,474	100	—
L ₁ (lime)	1,490	101	16
O (no fertilizers)	1,406	100	—
F ₁ (3½ lbs. N.P.K. mixture)	1,498	106	92
F ₂ (7 lbs. N.P.K. mixture)	1,518	108	112

7. **4 × 4 × 4 N. P. K. Experiment on young palms, Potlukulama Estate**

(See C.R.I. Annual Report 1961 for details of treatment and design).

This experiment which was planted in December 1960 completed its second manurial year in 1963. As from 1963, the annual fertilizer dosage was applied in two split doses in June and December. At the end of 1963, four palms had flowered. To facilitate weed control, particularly illuk, a mixed leguminous cover crop consisting of pueraria, centrosema and calapogonium was sown in 1962. By the end of 1963 the cover crop was well established.

With the quick and healthy growth of the palms, red weevil has become a problem. Four palms were lost in 1963 through red weevil attack.

A number of palms were attacked by the fungus disease, *Helminthosporium*. There was no association of the disease with any particular manurial treatment.

Measurements of heights and girths of palms, and counts of total leaf number and new leaf production were kept at six-monthly intervals. Statistical analysis of these records showed that both nitrogen and potash had a positive significant effect in leaf production. Nitrogen had a significant effect in increasing the height and girth of palms. But, unlike in the experiment on young palms at Ratmalagara, phosphate has not had a response yet, although available phosphate in the soil is low. Whether this is due to poor availability of saphos phosphate under these soil conditions, or whether the chemical method of assessing available soil phosphate did not give a correct picture of the actual situation, has to be investigated.

8. Observation trials on yellowing palms, Walgama Estate, Rukmale and Mattegoda Estate, Polgasowita.

(See also C.R.I. Annual Reports for 1960, 1961 and 1962).

These trials which were commenced in 1957 completed their sixth year in 1963. All yellow palms which had been subject to applications of magnesium sulphate or dolomite have now been restored to a healthy green colour. As in the previous year, magnesium caused a marked increase in nut yields. At Walgama Estate affected palms receiving N.P.K. fertilizer only gave 20 nuts/palm in 1963, whereas those treated with magnesium as well gave 46 nuts/palm. Green palms which showed no visual symptoms of magnesium deficiency gave 46 nuts/palm when treated with N.P.K. fertilizers only. The addition of magnesium increased these yields to 62 nuts/palm.

Magnesium deficiency is likely to limit nut production even before any visual symptoms of deficiency occur. We therefore recommend the application of dolomitic limestone as a long-term preventive measure against magnesium deficiency in certain areas even though no visual symptoms have been observed.

9. Leaf Scorch problem, Gonapinuwela area

(See also C.R.I. Annual Reports for 1961 and 1962).

During 1963, the studies on nutritional aspects of the problem of "Leaf Scorch" was confined to soil applications of boron since only the group of palms treated with borax showed no signs of further deterioration. Moreover, leaf analysis had indicated that palms in this area are deficient in boron. But no conclusions can be drawn yet as to whether the problem is of nutritional origin.

Another interesting observation was that the group of palms which had been previously subject to spraying with copper, iron and manganese sulphates showed temporary improvement. Whether this was due to copper acting as a fungicide is a matter for further investigation, particularly since the Commonwealth Mycological Institute has reported that visual symptoms observed in connection with this problem are probably caused by weakly parasitic and saprophytic fungi attacking the weakened leaves.

In 1963, about 250 diseased palms and 250 healthy palms were selected at Kirimetiya Estate for treatment with various combinations of major and minor elements, and also lime. The objects of this experiment are to determine (a) whether by the application of any particular nutrient combination diseased palms can be restored to normal health, and (b) whether healthy palms can be made less susceptible to disease by the application of any particular nutrient treatment.

B. LABORATORY INVESTIGATIONS

1. Radio-Isotopes (P^{32}) project—Fertilizer placement trials

(See also C.R.I. Annual Reports for 1960, 1961 and 1962).

A second field trial on placement using radioactive phosphorus was carried out on adult bearing palms (over 40 years old) grown on a sandy loam soil at Marandawila Estate, Bingiriya. The palms had been subject to regular broadcast application of fertilizers for the past eight years. The following methods of placement were compared:—(a) Basin round palms extending to a distance of 5 feet 8 inches from the bole of the palm, (b) traditional 3 feet wide circular trench, 3 feet away from the base of the palm, and (c) circles of 5 feet 6 inches radius in squares between palms (distance between palms was about 26 feet \times 28 feet).

The area in which radioactive phosphorus was applied (96 square feet) were similar for all three methods of placement. This ensured the elimination of any complications which may result due to isotopic exchange. Depth of application was 4 inches, or less if there was any danger of root damage when removing the surface soil. The experimental units were single palms, and each placement was replicated five times.

To minimise errors due to individual palm variability and soil heterogeneity, the following precautions were taken. Each replicate of the three different treatments were grouped together so as to form a block—palms receiving the different treatments being as close together as possible within each block. The experimental palms were separated from each other by guard palms. Palms of similar bearing capacity and growth were selected for treatment comparisons within each block.

Each experimental palm was treated with a solution of 66 grammes dibasic ammonium phosphate labelled with 5 millicuries P^{32} in 10 litres water. This solution was uniformly sprinkled in the entire area of placement. In the case of placement (c) at the centres of squares, the full phosphate dosage was given to each of the four circles in the squares surrounding the experimental palm since the fertilizer applied to each square would be equally accessible to four palms.

Leaflets were sampled from the sixth frond of each experimental palm at intervals of one week, four weeks and thirteen weeks after the P^{32} application. The leaflet samples were dry ashed and the phosphate precipitated and redissolved to eliminate interfering sources of radioactivity. P^{32} was determined by the liquid counting technique, and total phosphate by the colorimetric vanado-molybdate method.

The experimental results are summarised in Table I (b). The efficiency of the different methods of placement is judged by the amount of radioactivity taken up by the palms (measured in terms of specific activities). In the first week, there was no noticeable, difference between the placement. After four weeks, there is a clear trend in favour of placement in the entire area round the palm up to a distance of 5 feet 8 inches from the bole (placement A), while after thirteen weeks the superiority of placement (A) has increased to about 100% over placements (B) and (C). The variation between palms do not permit any distinction to be made between placements (B) and (C). These results confirm those obtained in the first experiment. (C.R.I. ANNUAL REPORT 1962).

TABLE I B

Radio Isotopes Project—(P³²) Marandawila Estate, Placement trial on adult coconut palms

(Soil type Loamy sand, Fertilizers broadcast annually for last 8 years). Specific activities (counts per minute/mg. P) in 6th frond leaflet

	REPLICATE NOS.															Mean		
	1			2			3			4			5					
Time after P ³² Application (Weeks)	1	4	13	1	4	13	1	4	13	1	4	13	1	4	13	1	4	13
Method of Placement																		
A. Basin (5' 8" radius from bole outwards)	20.5	156	415	5.2	34.8	127	15.8	111	376	16.3	84.9	198	6.0	60.1	173	12.7	89.4	258
B. Traditional Circular Trench (3' wide 3' away from bole)	7.2	51.2	121	3.3	23.6	103	16.1	87.7	216	30.0	79.9	150	1.1	13.8	54.6	11.5	51.2	129
C. Centres of Squares	25.6	134	317	3.70	44.8	120	5.8	42.6	199	1.2	11.2	29.7	3.1	22.8	60.2	7.9	51.1	145

This study indicates that contrary to popular belief the density of absorbing roots is much higher in the area immediately surrounding the palm up to a distance of about 6 feet from the bole even under conditions which would be considered ideal for the development of a wide spread root system (light, well drained sandy loam soil and regular broadcast application of fertilizers). The extent to which more efficient placement would help to reduce costs of production is a matter for further investigation.

2. Chemical analysis of leaflets from "Leaf Scorch" problem palms

Table II B (a) gives the means and ranges of chemical analysis of leaflets sampled from the first and sixth fully opened fronds of ten healthy and ten diseased palms at Kirimetiya Estate, Elpitiya. All samples were taken from healthy green fronds. We are grateful to the Institute de Recherches pour les Huiles et Oleagineux, Paris, for this chemical analysis.

Examination of the individual palm analysis using the rank-sum test of Wilcoxon revealed that the leaflets sampled from frond 1 of diseased palms had a lower content of magnesium and boron, and a higher content of nitrogen and phosphorus. In frond 6, the only difference observed was a lower content of manganese and magnesium in samples from diseased palms. The differences observed are however not large.

Table II B (b) gives the mean chemical analysis of leaflets sampled from the 1st and 6th fronds of ten individual palms at Bandirippuwa Estate. It is seen that these have a generally higher content of magnesium and boron than the leaflets of both healthy and diseased palms at Kirimetiya Estate.

Magnesium deficiency is known to occur widely in coconut palms grown on the lateritic soils of the heavy rainfall areas of the Southern and Western province, and under acute conditions is associated with an intense yellowing of leaves. In the Western province there are coconut estates which have been suffering from acute magnesium deficiency for over ten years, but the palms did not die, or exhibit any of the other symptoms of "Leaf Scorch". Although leaf analysis has shown diseased palms at Kirimetiya Estate to be more deficient in magnesium than the healthy areas, the palms exhibited no visual symptoms characteristic of magnesium deficiency (in other coconut lands in the Gonapinuwala area, both the usual symptoms of both magnesium deficiency and "Leaf Scorch" has been observed to occur simultaneously).

Leaf analysis has shown that palms in the Western province (Mattegoda and Walgama Estates, where magnesium deficiency occurred) have a low boron content (less than 10 ppm. B)—but they showed no symptoms of leaf scorch.

It appears therefore that although leaf analysis has indicated diseased palms to be deficient in magnesium and boron, the problem of leaf scorch cannot be the direct result of any nutrient deficiency. The possibility that nutrient deficiency has weakened the palms and made them susceptible to attack by some parasitic organisms (e.g. nematode, fungus) cannot be over-ruled. Field investigations on these lines are in progress.

TABLE II B

(a) Chemical analysis of leaflets sampled from palms affected by "leaf scorch" and healthy palms at Kirimetiya Estate

Means of samples taken from ten individual palms

		%						ppm								
		N	P	K	Ca	Mg	S	Na	B	Mn	Al	Fe	Cu	Zn	Mo	
Fron 1	Healthy	Mean	1.40	0.136	2.155	0.231	0.178	0.135	0.226	12	87	5.8	56	10	42	0.21
		Range	1.29-1.50	0.124-0.153	1.532-2.357	0.184-0.291	0.142-0.213	0.126-0.150	0.173-0.281	8.38-15.47	55-115	1.0-14.0	51-61	5.42-11.97	27-85	0.18-0.30
			1.50	0.153	2.357	0.291	0.213	0.150	0.281	15.47	115	14.0	61	11.97	85	0.30
	Diseased	Mean	1.61†	0.152†	2.235	0.226	0.151*	0.146	0.217	11*	85	14	56	9	51	0.60
		Range	1.31-2.12	0.130-0.167	1.633-2.769	0.170-0.297	0.117-0.190	0.129-0.183	0.131-0.277	9.10-11.63	59-126	1.5-52.0	45-70	7.05-10.76	30-100	0.20-2.00
			2.12	0.167	2.769	0.297	0.190	0.183	0.277	11.63	126	52.0	70	10.76	100	2.00
Fron 6	Healthy	Mean	2.13	0.151	1.907	0.273	0.205	0.183	0.344	9	118	24	67	8	29	0.22
		Range	1.92-2.24	1.34-1.73	1.011-2.34	0.201-0.449	0.155-0.280	0.157-0.213	0.234-0.451	7.92-10.93	69-180	5.0-65.0	62-75	7.05-9.93	23.0-40.0	0.20-0.30
			2.24	1.73	2.34	0.449	0.280	0.213	0.451	10.93	180	65.0	75	9.93	40.0	0.30
	Diseased	Mean	1.95	0.152	2.069	0.247	0.174*	0.173	0.292	10	85*	9	62	7	36	0.45
		Range	1.87-2.28	1.33-1.69	1.458-2.574	0.174-0.350	0.127-0.254	0.144-0.206	0.137-0.427	8.57-10.69	52-139	1.2-24.0	47-71	5.69-9.06	12.0-70.0	0.20-1.90
			2.28	1.69	2.574	0.350	0.254	0.206	0.427	10.69	139	24.0	71	9.06	70.0	1.90

†Significantly higher than samples from healthy palms.

*Significantly lower than samples from healthy palms.

TABLE II B

(b) Mean of samples taken from ten individual palms at Bandirippuwa Estate

		%						ppm							
		<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>	<i>S</i>	<i>Na</i>	<i>B</i>	<i>Mn</i>	<i>Al</i>	<i>Fe</i>	<i>Cu</i>	<i>Zn</i>	<i>Mo</i>
<i>Fron</i> d 1	Mean	1.71	0.155	2.164	0.165	0.218	—	—	16	28	21	85	—	—	—
	Range	1.41-1.91	0.127-0.192	1.34-2.80	0.131-0.229	0.176-0.288	—	—	14.2-19.9	15.44	7.31	54-139	—	—	—
<i>Fron</i> d 6	Mean	2.35	0.166	1.22	0.230	0.277	—	—	13.5	—	33	—	—	—	—
	Range	2.21-2.64	0.149-0.192	0.58-2.10	0.144-0.374	0.166-0.411	—	—	11.1-17.6	—	25-57	—	—	—	—

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3. A study on the effect of frond age on leaf composition

Leaflets were sampled from the 1st, 6th and 14th fully opened fronds of ten healthy adult palms randomly selected from a block at Bandirippuwa Estate. The chemical analysis of these samples for the five major elements.—N, P, K, Ca and Mg are given in Table III B. Frond 1 had a consistently lower N content, while K decreased with increasing age of frond. Ca and Mg increased with frond age, but P showed no significant variation.

TABLE III B

Chemical composition of leaflets in fronds of different age

		(% mean on samples from ten palms)				
		N	P	K	Ca	Mg
<i>Frond No. 1</i>						
Mean ..	..	1.715	0.155	2.164	0.165	0.218
Std. Dev.	..	0.148	0.019	0.512	0.034	0.036
<i>Frond No. 6</i>						
Mean ..	..	2.353	0.166	1.216	0.230	0.277
Std. Dev.	..	0.133	0.013	0.502	0.082	0.069
<i>Frond No. 14</i>						
Mean ..	..	2.303	0.154	0.868	0.325	0.282
Std. Dev.	..	0.190	0.0176	0.460	0.052	0.075

4. Studies on the effects of crushed dolomite on fertilizer and soil nitrogen

As a safety measure against possible nitrogen losses, the application of dolomite to coconut palms is done separately, at a later date after the usual N.P.K. fertilizer mixtures containing sulphate of ammonia has been applied. This practice involves extra expenditure. A simple laboratory experiment was therefore carried out to obtain some quantitative estimate of nitrogen losses when dolomite is mixed with fertilizers both in the presence and absence of soil.

On mixing crushed dolomite with CRI general coconut fertilizer mixture (containing equal proportions of ammonium sulphate, saphos phosphate and muriate of potash), the loss of nitrogen was negligible even after seven days provided that the mixture was kept dry. When exposed to the atmosphere under laboratory conditions, the mixture had absorbed about 6% moisture and lost 22% nitrogen after 7 days. The loss of nitrogen after one day was 8%. Under conditions of storage where the atmosphere was moisture saturated, the loss of nitrogen after one week was 60%, with a moisture absorption of 12%.

The addition of dolomite to a damp mixture of a clay soil and N.P.K. fertiliser in proportions similar to field applications did not cause any noticeable loss of nitrogen even after 6 weeks. Under similar conditions, about 10% N was lost from a sandy soil, and 6% N lost from a sandy loam. Dolomite raised the soil pH from about 4.2 to 7 in the loam and clay soils, and from 5.5 to 7.4 in the sand.

In the clay soil, dolomite application had little effect on nitrification, but in the sand and sandy loam, nitrate N increased from 10 to 90 ppm. and 2 to 200 ppm. respectively.

The results show that except on sandy soils, dolomite can be applied at the same time as the usual N.P.K. mixture provided that the fertilizers are well incorporated into the soil.

The effects of enhanced nitrification (resulting from lime application to acid soils) on the nitrogen response in coconut yields is a matter which merits further investigation.

C. MISCELLANEOUS

1. Premanurial records on yields were maintained on individual adult palms on a block of about 30 acres at Mawatte estate, Dankotuwa, with a view to laying down a new field experiment to test the relative efficiency of different forms of nitrogenous fertilisers (urea, ammonium sulphate, nitrochalk).
2. Individual palm records on mature nuts, female flowers and immature fallen nuts were maintained on a block of about 1,000 palms on an estate at Bingiriya where round the year immature nutfall had been reported. We propose to carry out a simple field trial on this block to see whether the immature fall of nuts is associated with any nutrient deficiency.
3. (i) The following papers were presented at the Annual Sessions (1963) of the Ceylon Association for the Advancement of Science, by members of the division:—
 - (a) "Estimation of calcium and magnesium in coconut leaflets by the EDTA method"—by M.A.T. de Silva.
 - (b) "Maintaining fertility on coconut land"—by D.A. Nethsinghe.
- (ii) Dr. D.A. Nethsinghe presented a paper on "Conserving Fertility on Coconut Lands" at a Symposium on the "Management of Resources for Conservation and Production" held by the Soil Conservation Society of Ceylon.
- (iii) An article on "Manuring of Young Palms" by D.A. Nethsinghe was published in the Ceylon Coconut Planters' Review, Vol. III, No. 2.

D. PERSONNEL

Mr. T.S. Balakrishnamurthi, Research Assistant, left for U.K. on overseas study leave under a Colombo Plan scholarship in September 1963. He is reading for a post-graduate degree in Soil Science at the University of Aberdeen.

Mr. Ivan Soysa, Field Assistant, resigned from his post in October 1963.

Mr. Stanley Fernando, Laboratory and Field Attendant was promoted to the post of Field Assistant in December 1963.

D.A. NETHSINGHE,
Soil Chemist, Coconut Research Institute.

REPORT OF THE AGROSTOLOGIST

1. INTRODUCTION

The Agrostologist returned from overseas study leave and resumed duties in July. During his stay in Australia, the Australian Government, the Waite Agricultural Research Institute, the CSIRO Division of Tropical Pastures, Queensland, and various Government Departments, Associations and Clubs extended to him very warm welcome and friendship which made his stay pleasant, profitable and successful. To all of them he expresses his most sincere thanks.

The old phytosolarium is still out of commission and as a result work on soil fertility has been greatly reduced. It is with great reluctance we record here the fact that manuscripts submitted to the Director as far back as 1958 are yet to be published. It is also felt necessary to point out that as the section on pasture trials would reveal, much information is being lost due to lack of facilities to carry out chemical analysis.

The cadre on 31.12.63 was as follows:—

<i>Agrostologist:—</i>	K. Santhirasegaram, B.Sc. (Cey.), Ph.D. (Adl.)
<i>Research Assistant:—</i>	D.T. Rajaratnam, (Mrs.) B.Sc. (Cey.)
<i>Technical Assistants:—</i>	G.C.M. Goonesekera, Dip.Agric. (Pera.) D.E.F. Fernandez. Vacant
<i>S.F.A.:—</i>	D.C. Ellewela
<i>L.F. Assistants:—</i>	K.C. Muttuchchamy Y.G. Fernando, (Miss) W.S.C. Perera W.H.J. Fernando A.G.K. Silva
<i>L.F. Attendants:—</i>	K.A.D.W. Jinadasa K.P.C. Fernando R.M. Dayaratne A.A. Fernando A. Dassanayake J.M.J. Jayamanne W.P.T. Perera S.A. Ratnayake P.J.E. Fernando D. Amarasinghe
<i>Tractor Driver:—</i>	M.I. Marikkar

2. SOIL FERTILITY STUDIES

(a) Follow up studies at Horakelly and Ratmalagara

These experiments reported in detail in the 1962 Annual Report have been completed and will be published.

(b) Keenekelle Soils

Preliminary studies in these have been completed. The soil is deficient in N, P and K. The results are being written up for publication.

(c) Pothukulama Soils

Studies on these too have been completed and the results are being written up for publication.

(d) Goniapinuwela Soils

Detail studies on this have been commenced. The first two experiments have been on micro-nutrients to furnish information to the Soil Chemist for his detailed field studies of the cause of the symptoms exhibited by coconuts in this area.

Experiment I

This was a 2^5 factorial experiment of Fe, Cu, Zn, Mn, B and Mg with two replicates and planted to *Medicago sativa*.

At the early stages the plants responded to applications of Cu and B; but at the later stages these responses were less marked and led to significant depression in yield. At this stage however the plants showed symptoms which could not be explained in the light of past experience. In view of the fact that the coconuts were also showing unusual symptoms the possibility of the test plants also being affected by organisms were considered and the shoots and roots examined. The root system was found to decay at the tips and black lesions were found along the system. They were further examined by the Crop Protection Officer who reported the presence of a parasitic nematode *Hemicycliophora longicaudata* (Loos) in the roots.

Experiment II

This was a 4×2 factorial of 4 levels of B (0, 3, 6 and 12 lbs. Sodium borate/acre) and Ca as CaCO_3 10 cwts./acre with 4 replicates of all treatments and planted to *M. Sativa*.

At all harvests Ca increased yields significant at the 0.1% level, and growth from the second harvest onwards in absence of Ca was almost nil; and for the purpose of evaluating response to B, only the CaCO_3 treatments were considered. The yield/plant (gms. dry wt.) at the various stages of growth (for the 4 levels of B) are presented in Table I.

TABLE I

Age in days	B_0	B_3	B_6	B_{12}
39	0.07	0.22	0.20	0.12
48	0.13	0.36	0.50	0.34
58	0.57	1.07	1.03	0.84
90	0.41	1.69	1.47	1.31
112	0.16	0.63	0.60	0.52
Total	1.34	3.97	3.80	3.13
Mean	0.26	0.79	0.76	0.62

B increased yields significantly (0.1%) at the first level of application (3 lbs./acre). Thereafter there had been no significant responses, though a consistently increasing depression with increase in the rate of application was obvious.

There was no serious effect due to the nematode in this experiment though the soils for both experiments were drawn from the same sample. While the first experiment was commenced soon after the soils were sampled this experiment was planted six months later during which time the soil remained air dry. This drying may have killed the nematodes. *H. longicaudata* is a noncyst forming type (Ekanayake).

It is pertinent at this point to discuss the results of these experiments in relation to the leaf scorch symptoms in the South. This soil is deficient in boron, but boron deficiency had been detected in other soils (cinnamon sand at Horakelly and lateritic gravel at Mattegoda) employing similar techniques and same test plant, but the coconuts in those areas do not show symptoms similar to that exhibited at Gonapinuwela. At Horakelly incipient deficiency of Cu and marked response to added S have been recorded. It therefore appears highly unlikely that scorching of the coconut leaves at Gonapinuwela is caused by a deficiency of Cu, B and or S. It may be that due to some other primary cause, these or some other nutrient(s) is made unavailable either by non absorption or subsequent precipitation within the plant. As for the primary cause the root systems both with the coconuts and lucerne suggest the nematode to be a causative organism. The recent report of Rhind would well find support in these observations and merit some detailed studies. That secretions of an organism could upset nutrient availability one may site the inbalance of K and Mg caused by *Fusarium* infection of the bole of oil palms in West Africa (Hasselo personal communication). The prevalence of these symptoms in and around husk heaps could well mean that the soil conditions beneath the heaps favour the existence of effective population of the causative organisms.

(e) *Bandirippuwa Soils.*

The soils of the main estate were studied earlier by Paltridge and Santhirasegaram where response to P was rather unusual and Salgado had explained this as due to heavy application of bone meal at an earlier date. It was therefore decided to study the soils from the newly acquired areas with a view to assess the phosphate status.

3. PASTURE STUDIES

(i) *Comparison of 3 grasses (P₁) B/E:*

This has now been concluded in its original form. Each plot is now divided into 6 sub-plots of 6 palms each. Two sub-plots (random) in each plot receive nitrogen as follows:—

- (i) $\frac{1}{2}$ original level of N application ($\frac{1}{2}$ cwt. $(\text{NH}_4)_2\text{SO}_4$ /acre/Season).
- (ii) Original level of N application (1 cwt. $(\text{NH}_4)_2\text{SO}_4$ /acre/Season).
- (iii) Double original level of N application (2 cwts. $(\text{NH}_4)_2\text{SO}_4$ /acre/Season).

Palm manuring is being carried out annually in accordance with the estate practice.

This is to study the competition for N between coconuts and the various grasses and also the yield of the grasses at the three levels of N application.

(ii) *Cultivation \times type of manuring (P₂) B/E*

This experiment is now concluded. A detailed account of the results obtained have been reported in 1962. The plots are however used for the layout of experiments to study the growth and yield of *B. miliiformis* under various frequencies of N application (P_{15}) and different frequencies and height of defoliation (P_{16}).

(iii) *Cultivation experiment (P₄) R/E*

The 1963 data further supported the findings reported in 1962. The experiment is being continued.

(iv) *Intensity of grazing trial (P₅) R/E*

The data on nut yield further supported the findings presented in 1962. There was still no definite trend due to the level of grazing. Due to *M. miliiformis* replacing *B. brizantha* in one of the plots and the large difference between replicates in the yield of herbage it was decided that no further information could be derived from the experiment in its original size. It was therefore decided to reduce it while maintaining the essentiality as follows:—

- (i) Weeds only— $\frac{1}{2}$ acre.
- (ii) *B. brizantha* ungrazed— $\frac{1}{2}$ acre.
- (iii) *B. brizantha* grazed 2 beasts/acre— $\frac{1}{2}$ acre.
- (iv) *B. brizantha* grazed 16 beasts/acre— $\frac{1}{2}$ acre.
- (v) Same as (iii), total fertilizer doubled.
- (vi) Same as (iv), total fertilizer doubled.

The rest of the area is split into smaller plots to study the effect of doubling the level of manuring of N, P and K as a factorial (P_{21}).

(v) *Type of grazing Experiment (P₆) R/E*

This experiment is being continued and the 1963 data support the findings reported in 1962.

(vi) *Pasture \times Manurial experiment (P₇) B/E*

The system of grazing in this experiment has been changed from the October/November season when all pasture plots are grazed simultaneously with varying number and size of animals, depending

on the amount of herbage available so that grazing could be completed at the same time in all plots. The earlier system of grazing where animals were moved from replicate to replicate was followed with a view to obtain some information of animal performance. Since no worthwhile information was obtained over the three years, the new system was adopted. All plots were sampled for herbage yields prior to commencement of grazing.

Coconut yields

The yield of nuts and copra/acre for 1963 were adjusted with the 1959 pre-experimental data and analysed. Significant effects were recorded for nitrogen and potash while there was some advantage due to phosphates. Pasture species also had significant effects. There was no interaction among nutrients and between nutrients and pastures.

Nitrogen

Nitrogen increased number of nuts/acre particularly between N_2 and N_4 ($P > 0.5$) while yield of copra/acre was not significant to the same extent. (Table II).

TABLE II

Number of nuts and copra (lb.)/acre and copra (oz.)/nut at the 3 levels of N

	<i>N of nuts</i>	<i>Copra (lbs.)</i>	<i>Copra (oz.)/nut</i>
N_1	2827.52	1457.24	8.40
N_2	2958.78	1547.58	8.35
N_4	3312.64	1680.56	7.00
L.S.D. ($P > 0.5$)*	309.76	179.46	

*Highest value for any comparison.

Similar findings have been reported by *Eden et al* (1963) for nitrogen. In the experiment reported by *Eden et al* (Loc. cit) the levels of N applied were 0, 0.5 and 1.0 lb. per palm every two years, while the levels of N applied in this experiment are 0.72, 1.44 and 2.88 lbs. over the same period. While *Eden et al* too have had response to N occasionally particularly at the early years of their experiment and that the data of this experiment now considered is only for 1963, the levels of application of N are however such that these results throw some doubt on their conclusions that benefit from nitrogen manuring was small or non existent. It is of particular interest to point out that while fertilizer application was biennial in the experiment quoted by *Eden et al*, in the present experiment nitrogen is applied broadcast biannually. It may well be that this nutrient would have greater effects on yield with frequent applications.

Potash

Marked response was obtained from both number of nuts and Copre/acre. (Table III).

TABLE III

Number of nuts and copra (lbs.) per acre for the two levels of K

	<i>No. of nuts</i>	<i>Copra (lbs.)</i>
K ₁	2870.40	1466.46
K ₂	3195.52	1657.13
L.S.D. (P > 0.5)	261.08	143.03

Pastures

The estate control (weeds) plots yielded highest number of nuts and copra per acre. Between the two pastures, *B. brizantha* had a more severe effect than *B. miliiformis* particularly on the yield of copra. (Table IV).

TABLE IV

Number of nuts and copra (lbs.) per acre for the 3 types of vegetation

	<i>No. of nuts</i>	<i>Copra (lbs.)</i>
Estate control	3368.42	1747.87
<i>B. brizantha</i>	2628.48	1322.68
<i>B. miliiformis</i>	3101.44	1614.84
L.S.D. (P > 0.05)*	350.87	114.91

*Highest value for any comparison.

In another experiment (P₁) reported in 1962 it was shown that in the same area these two pastures had a very slight beneficial effect on number of nuts per acre compared to the weed control. It must be pointed out that in that experiment (P₁) the palms received manure around the base in addition to the broadcast fertilization and that the amount of weed growth was very much more compared to this experiment. The systematic delay in grazing of the replicates which would have had deleterious effects on soil moisture may be a further contributory factor in the present experiment. The new grazing system may eliminate this and a more realistic picture would emerge in time.

Herbage Yields

The sampling made prior to grazing in November were analysed. The yield of herbage was significantly low in the weed controls compared to the pastures, while there was no appreciable difference between the two pasture grasses. Only nitrogen had any significant effect on the yield of herbage which increased linearly with increase in the amount of N, particularly in the pasture plots. There was no obvious trend in the control plots (Table V) and there was no significant interaction either.

TABLE V

Dry matter yield (lbs./acre) of herbage at the 3 levels of N applied

	N_1	N_2	N_4	Mean
Estate control	989	933	1,003	975
<i>B. brizantha</i>	1,303	1,637	2,256	1,732
<i>B. miliiformis</i>	1,459	1,772	2,262	1,831
Mean	1,250	1,447	1,840	+ 260 / + 322

+ L.S.D. ($P > 0.05$) of respective means.

(vii) Rate of N experiment (P_{12}) B/E

Modification of P_1 .

(viii) Interspecific Competition for N (P_{13}) R/E

In this experiment *B. brizantha* and *B. miliiformis* were planted alone and in mixture of equal proportions at 3 levels of N(0, 2 and 4 cwts. $(NH_4)_2SO_4$ /acre/year) to study the yield and proportion of the two species.

The data collected in November/December during which time the swards have not developed fully showed that *B. miliiformis* yielded more than *B. brizantha* and responded better to N application. It was also the dominant species.

(ix) Yield and Row spacing (P_{14}) B/E

In this experiment Guinea grass (*Panicum maximum*) was planted in rows 1, 2, 4 and 8' apart with plants 1' apart along the rows, with and without application of N. The experiment is in the establishment stage.

(x) Rate and Frequency of N application (P_{15}) B/E

The growth and yield of *B. miliiformis* is being studied at the following rates and frequencies of N application.

- Rates:—
- N_0 no application.
 - N_1 1 cwt. $(NH_4)_2SO_4$ /acre/2 years (4 seasons).
 - N_2 2 cwts. $(NH_4)_2SO_4$ /acre/2 years (4 seasons).
 - N_4 4 cwts. $(NH_4)_2SO_4$ /acre/2 years (4 seasons).

- Frequencies:—
- F_1 Total N twice each season.
 - F_2 Total N once each season.
 - F_3 Total N once in two seasons.
 - F_4 Total N once in four seasons.

The first application of N was made on 15.10.63 and pasture sampled at monthly intervals depending on the availability of herbage.

(xi) *Interspecific competition between grasses at varying proportion of plants (P₁₇) R/E*

In this experiment *B. brizantha* and *B. miliiformis* were planted alone and in mixtures. The mixtures varied in the amounts of the two species as follows:—

T₁— *B. brizantha* only in rows 2' apart (100b : 0 m.).

T₂— *B. brizantha* 3 rows alternate with 1 row of *B. miliiformis* (75b : 25m.).

T₃— *B. brizantha* 1 row alternate with 1 row of *B. miliiformis* (50b : 50m.).

T₄— *B. brizantha* 1 row alternate with 3 rows of *B. miliiformis* (25b : 75m.).

T₅— *B. miliiformis* only in rows 2' apart (0b : 100m.).

All treatments receive annual application of P and K and biannual application of N.

(xii) *Interspecific competition between grass and legume (P₁₈ R/E)*

Guinea grass (*P. maximum*) and Centro. (*Centrosema pubescens*) are being grown alone and in mixture at two levels of N to study the effect of one species on the growth and yield of the other.

Experiments with *B. brizantha* and *B. miliiformis* are being conducted in pots to study the following:—

Frequency and height of defoliation—Here, individual plants of *B. miliiformis* are being grown in pots and subjected to different frequencies and height of defoliation at a range of nitrogen treatments to follow in detail the growth behaviour and yield of this species.

Effect of day light—Field observations indicated that *B. miliiformis* responds to the small variation in day length between the May-June and October-November seasons. In a preliminary experiment where plants were exposed to 10, 12, 14 and 15 hours light period, flowering occurred after 3 and 5 weeks in 10 and 12 hours respectively. Those exposed to 14 and 15 hours did not flower even after 8 weeks of exposure. The inflorescence appeared after a minimum of 9 leaves in the main tillers and 6 in the secondary tillers. More critical experiments are being planned.

There appears to be considerable doubt as to the identification of the various species of *Brachiaria*. Available plant material are being collected and grown in pots. Those differing in various characters are then being studied by the Botanist for cytological identification and by the Botanical Gardens, Peradeniya in conjunction with Kew Gardens U.K. for physical identification. What has been spelt *B. milliformis* or *B. miliformis* hitherto should read *B. miliiformis*.

A few species of grasses and legumes have been introduced and grown in pots for seed production. It is intended to grow these in different localities to test their suitability.

4. CATTLE

The herd strength as at 31st December, 1963 was as follows:—

TABLE VI

			<i>Bulls</i>	<i>Cows</i>	<i>Steers</i>	<i>Heifers</i>	<i>Total</i>
B/E	..	..	3	50	69	54	176
R/E	..	..	2	29	10	41	82
Total	..	..	5	79	79	95	258

A total 49,739.0 and 31,050.5 pints of milk were produced at B/E and R/E respectively during the year; while at B/E after supplying the staff the balance was sold to the Milk Board who rejected 1,445.0 pints, the bulk of the production at R/E was converted to ghee. There do not appear to be much demand for this commodity and sales have been poor, with the result stock was building up.

Cow No. R. 13 a black Sinhala has produced 2,454 pints in its fourth lactation over 335 days. This is an improvement on the record of 2,102 pints set by cow No. R. 12 in 1962.

There had been 48 and 27 births at B/E and R/E respectively. There had been very heavy loss at B/E (12 deaths) mostly among calves due to worms due to negligence, a situation which is now corrected.

K. SANTHIRASEGARAM,
Agrostologist, Coconut Research Institute.

REPORT OF THE CROP PROTECTION OFFICER

A. PESTS

1. The Coconut Caterpillar *Nephantis serinopa* Meyr.

The Parasite Breeding Station at Mylambavelly was opened in April. Mr. Edwin Dharmaraju, M.Sc. (Ag.), F.R.E.S., Colombo Plan Entomologist, left the island in May after the completion of his assignment in Ceylon. Mr. Dharmaraju worked for a period of over two years on the biological control of the Coconut Caterpillar in Ceylon. His report will be published as a Technical Bulletin. We wish to express our thanks to Mr. Dharmaraju for the many ways in which he helped the writer in continuing the work he had begun, which help he has continued to extend to us even after he left the island.

The following parasites of the Coconut Caterpillar—*Nephantis serinopa* Meyr., were under laboratory rearing:—

<i>Parasite</i>	<i>Host material used</i>
Larval parasites:	
<i>Microbracon brevicornis</i> W. ..	<i>Corcyra cephalonica</i> larvae
<i>Perisierola nephantidis</i> M. ..	<i>Corcyra cephalonica</i> larvae
<i>Stomatomyia bezziana</i> Bar. ..	<i>Nephantis serinopa</i> larvae
Prepupal parasite:	
<i>Elasmus nephantidis</i> R. ..	"Pre-pupae" of <i>Nephantis serinopa</i> .
Pupal parasites:	
<i>Tetrastichus israeli</i> M and K } ..	<i>C. cephalonica</i> and <i>Prodenia litura</i> pupae
<i>Trichospilus pupivora</i> F. }	

Cultures of *C. cephalonica* and *P. litura* were maintained in the laboratory while *N. serinopa* were collected from the field.

Considerable difficulty was met with in the breeding of *M. brevicornis* W. due to the excessive production of males, which was however rectified to some extent by changing the host material. There was a break in the cultures of *M. brevicornis* W. and *P. nephantidis* M. during November and December and fresh material was obtained from the Parasite Breeding Station, Ambajipeta, Coconut Research Station, Kayangulam and the Commonwealth Institute of Biological Control, Bangalore.

Over five million parasites were produced and over two million were released in fifty-six estates in four provinces as detailed in Table I.

TABLE I

Production and Release of Parasites

Name of Parasite	Total output at Mylambavelly and Lunuwila	No. of parasites released into different provinces				Total parasites released
		E.P.	N.P.	S.P.	N.W.P.	
<i>Microbracon brevicornis</i> W.	1,942,440	59,400	23,000	113,200	511,200	1,241,400
<i>Perisierola nephantidis</i> M.	756,190	37,700	7,200	33,000	74,600	152,500
<i>Stomatomyia bezziana</i> Bar.	6,404	450	—	—	—	450
<i>Elasmus nephantidis</i> R.	14,740	2,370	—	—	—	2,370
<i>Tetrastichus israeli</i> M and K.	1,337,850	312,750	4,250	16,150	113,350	446,500
<i>Trichospilus pupivora</i> F.	1,315,450	356,550	7,000	32,950	196,350	592,850
	5,373,074	1,303,820	41,450	195,300	895,500	2,436,070

Life cycle studies were carried out on *M. brevicornis* W. and *P. nephantidis* M.

Field studies on the pest-parasite complex were carried out and the data from four estates were analysed.

The Microbial insecticide, Bakthane L. 69, based on *Bacillus thuringiensis* Berliner., was found to be effective against the larvae of *N. serinopa* Meyr.

The larvae of *P. litura* reared in the laboratory were found to be infected with a microsporidian which appears to belong to the genus *Nosema*; and the pupae were found to be infected with *Aspergillus flavus* Link. We are thankful to the Department of Invertebrate Pathology, University of California, for the identification.

2. The Red Weevil *Rhynchophorus ferrugineus* F.

The Red Weevil has become a serious pest of coconut in this country and its control has become a matter of vital importance. The main handicap in its control is the difficulty of detecting the pest in the early states of infestation. This, together with the negligence of cultivators, particularly small-holders, has led to its spread.

It was found that the application of insecticides after detection alone is not sufficient, and a programme of research embracing other aspects of control was therefore initiated. In addition to the direct application of insecticides, this entails the development of effective preventive measures, methods of early detection, the use of attractants, repellents and insect traps, a search for parasites and predators and the development of more efficient methods of injecting chemicals into the palms.

It was found that the adoption of the preventive measures recommended reduces the populations of the pest to easily controllable levels.

An insect trap, was developed and has to be tested out further.

Laboratory insecticidal trials were in progress. Seven insecticides were tested against the larvae and the results are given in Table II.

TABLE II
Time Exposure LD 50 for Insecticides

<i>Insecticide</i>	<i>LD 50 Time in hours</i>	<i>Relative efficacy %</i>
Telodrin	25.2	140
Dimecron	36.2	124
Gammalin	39.6	119
Metasystox	58.6	100
Systox	61.1	98
Rogor	99.7	74
Ekatin	285.0	34

Telodrin appears to be the most effective insecticide against the larvae. The relative efficacies of the insecticides as compared with Meta-systox (Metasystox being taken as a standard) are also given.

It is found that after the application of insecticides the larvae continue to feed within the palm for a time. An attempt was made, in the laboratory trials, to assess the morbidity by recording the weight of frass put out by the feeding larvae every 24 hours.

From an examination of this data it appeared that in the first 24 hours Systox and Meta-systox and to a certain extent Gammalin increased the appetite of the larvae; Telodrin, Dimecron and to a lesser extent Ekatin lowered the appetite while Rogor did not have any effect at all.

The results of the trials against the pupae showed that Telodrin was the most effective while Gammalin, though not significant, had some effect.

The results of the insecticidal trials against the adults are given in Table III.

TABLE III
Time Exposure LD 50 Insecticides

<i>Insecticides</i>	<i>LD 50 Time in hours</i>		
	<i>Total Adults</i>	<i>Female</i>	<i>Males</i>
Systox ..	68	81*	49.2
Dimecron ..	85	69.6	99.5
Gammalin ..	86	84.1	83.9
Metasystox ..	92	111.5	71.2
Rogor ..	94	60.4	117.2
Telodrin ..	100*	105.0*	90.0*
Ekatin ..	154	371.1	128.4

*Approximate values

From the laboratory trials, Telodrin appears to be the most effective insecticide against the larvae and pupae of the Red Weevil. Further trials in the field will be conducted in 1964; and the results of the work reported here will be published in greater detail elsewhere.

3. The Coconut Scale, *Aspidiotus destructor* Sign.

The Coconut Scale, is now controlled by the spraying of insecticides; which is an expensive method of control and the possibility of biological control was therefore considered. In Ceylon, the naturally occurring predator *Chilochorus nigrilis* controls the pest to some extent. The actual degree of control is, however, not known. The predator *Cryptognatha nodiceps*, was imported from Fiji and we are thankful to Mr. B.A. O'Connar, Senior Entomologist, Department of Agriculture, Fiji, for supplying us with the material. No field releases were carried out and attempts were made to rear the predator in the laboratory without success, due to the difficulty of establishing the host in the laboratory. Techniques of breeding the host in the laboratory were developed.

Data on the bionomics of the Coconut Scale in this country is scarce and it is advisable to study the pest for a period to assess the seasonal pattern of its occurrence, the degree of control obtained by *C. nigrilis* etc., before *C. nodiceps* is introduced. Such a programme of research over a period of about three years is contemplated.

4. The Nettle Grub, *Parasa lepida*

Report of Nettle Grub infestation were received from the Chilaw District. It was seen that the natural control obtained by parasites and predators was small while an appreciable percentage of larvae were destroyed by a disease.

5. Termites

A preliminary survey was conducted to find out the distribution of the species of termites attacking coconut and to estimate the degree of damage caused.

6. Other insect pests of coconut

The following insects were found to attack coconut:—

Diocalandra frumenti F. (Curculionidae), the "Little Coconut Weevil", was found to attack trunks of coconut palms.

Sophrops eurystoma Burm (Melolonthidae) was seen to attack the leaves of coconut seedlings.

Phythognathus dionysius F., *Pseudohlaps dispar* (Hust) and *Leucopholis coneophora* Burm were seen to attack the roots of adult coconut palms.

Immature nuts were attacked by *Cyclodes omma* Vander H; Mealy bugs *Pseudoceccus* sp., were associated with mature nuts, and *Amorphoidea* sp. was associated with the inflorescences. We are thankful to the Director, Commonwealth Institute of Entomology, London, for identifying the insects. A paper on the above mentioned insects to be read at an C.R.I. Research Conference was prepared.

7. Crop Protection Unit

225 acres in 25 estates were sprayed against the Coconut Scale using Kerosene oil emulsion.

B. DISEASES

1. "Leaf Scorch" of Coconut in the Southern Province

A study of the symptoms has shown that the most characteristic visual symptoms of the disease is the scorching or withering of the tips of leaflets of the lower leaves. The withering extends along the leaflets towards the mid-ribs of leaves, and progresses from the lower leaves to the upper leaves. The youngest leaves are the last to show the symptoms, and even in palms in the advanced condition of the disease, the youngest leaves remain green and apparently healthy. The leaves of affected palms are reduced in number as the disease progresses. The scorched leaves tend to remain on the palm for a longer time than is usual and when they fall, the abscission is such that prominent leaf scars are left on the trunks. The withering is accompanied by tapering of the trunk and a reduction in yield. The nuts of affected palms are narrower and longer than those of unaffected palms. It appears that there is a reduction of yield before the symptoms are visible, and that the symptoms are visible only after the disease has progressed to some extent in the palms. So that apparently healthy palms may in fact be diseased.

There are also other disorders of palms, in this area, such as yellowing due to magnesium deficiency, yellowing due to neglect and water logging, Leaf Blight, and a type of scorching due to the sea spray. All these disorders are found in the Gonapinuwela area and should not be confused with "Leaf Scorch".

The mode of spread of "Leaf Scorch" is being studied on four blocks in different estates in the Gonapinuwela area. Table IV indicates the progress of the disease within these blocks.

TABLE IV

Block	Total No. of palms in Block	No. of palms diseased in April 1963	No. of palms diseased in December 1963
Block A	390	24	53
Block B	97	10	17
Block C	100	1	12
Block D	149	23	35

In each block the condition of each palm was observed once in every 30 days. The data was analysed to determine whether there is "neighbour infection" from affected to unaffected palms and no definite conclusions can be made as yet.

Isolations of micro-organisms from the leaves of affected palms constantly gave *Pestalotiopsis palmarum* (Cke) Stey from the edge of the lesions adjoining healthy tissues, and *Botrydiplodia palmarum* (Cke) Petrak and Sydow, and *Echidnodes cocos* Sydow, from the scorched area. These are weak parasitic fungi and appear to be organisms which invade the leaves once the leaves are weakened by the disease. We are thankful to the Director, Commonwealth Mycological Institute for the identification.

However, the preliminary analysis of fungicidal trials in progress indicates that certain fungicides improve the condition of the leaves of affected palms. Copper oxide and Dispersible Sulphur significantly reduced the number of leaves showing the symptoms of "Leaf Scorch" of palms sprayed with these fungicides. It is not possible to say, as yet, whether this reduction is due to a direct fungicidal action or to some other cause.

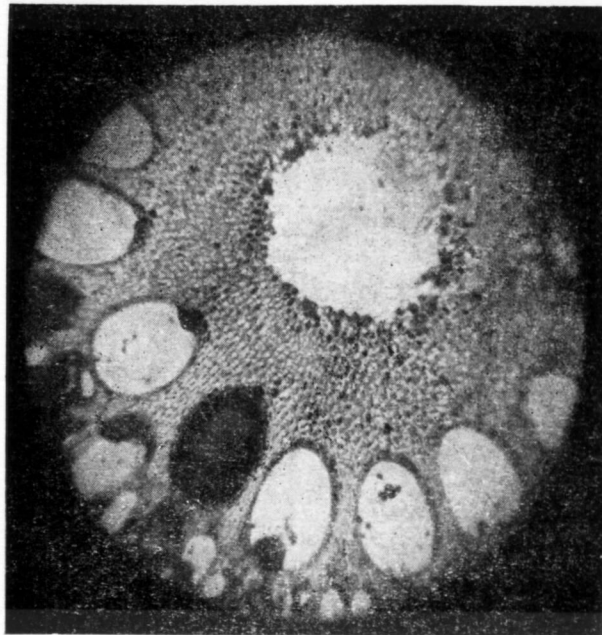
It was observed that the roots of affected palms were considerably decayed; numbers of secondary roots in affected palms appear to be less than those in unaffected palms.

A nematode *Hemicycliophora longicandata* Loos, 1948 (Criconematinae)* has been found to be constantly associated with the roots of, and the soil near, affected palms. A number of soil and root samples have been examined for nematodes using a modified Baermann funnel technique. Briefly, 15 g. of chopped roots were macerated in a "Ken-mix" blender for 30 seconds in 100 cc. of water and the macerated material was kept in a 60 mesh sieve, on which was placed a nematode filter. The sieve was then placed on a glass funnel and water poured to a known level. After 24 hours the first 20 cc. of the liquid in the stem of the funnel was drained, mixed and five 1 cc. aliquots were examined in a counting chamber under the microscope. A count of the parasitic and saprophytic nematodes were taken. The soil was similarly processed (without blending) *H. longicandata* Loos, was the only parasitic nematode recovered.

H. longicandata Loos, is found extensively in the Gonapinuwela area. It has not been possible to recover this species from other areas from which there other parasitic species, *Tylenchorhynchus nudus* Allen, 1955, *Rotylenchulus reniformis* Lonford and Oliverira and a species of *Helicotylenchus* have been recovered. We are thankful to Dr. J.B. Goody, Rothamstead Experimental Station, for identifying the nematodes.

Attempts to induce the symptoms of "Leaf Scorch" by inoculating the soil with suspensions of the nematode have so far not been successful.

A nematocide trial is in progress in the Gonapinuwela area but it is too early to comment on this.



Cross section of root xylem vessel blocked.

*It has been renamed *Caloosia longicandata* Loos.

Roots stained with acid-fuchsin lactophenol showed that the nematode is lodged in the cortical region and in the vascular tissues. Histological studies of the roots indicate that there is a blockage of the xylem vessels and a blackening of the cortical tissue. The exact cause responsible for the blockage of the xylem vessels is not yet known. The blockage could reduce the amount of water and nutrients taken up by affected palms.

Two fungi, *Fusarium sambicineum* f.b. Wr. and another probably of the genus *Cylindrocarpon* have been isolated from the roots. We are thankful to the Director, Commonwealth Mycological Institute for the identification.

The Agrostologist, C.R.I. handed over pots planted with *Medicago sativa* in soil from Gonapinuwela, which showed unusual symptoms. The pots were those used in a trace element experiment with the Gonapinuwela soil. The roots and soil were processed and examined for nematodes. *H. longicandata* Loos, was found to occur in the roots and soil. The roots showed considerable decay and the unusual symptoms present may be attributed to the presence of the nematode.

2. An unidentified condition of coconut

An unidentified condition of coconut was reported from the Chilaw District and the Melsiripura area. The cause of the disorder is not known. The symptoms are described below:—

The oldest leaves turn yellow, then brown and finally deep brown or bronze. The yellowing extends to the younger leaves as the condition progresses. The discolouration may extend to the mid-rib and leaf petiole. The mid-ribs of some of the younger leaves break either at the tips or nearer the petiole. The bud is the last to be affected. The leaves droop, before they finally drop, exposing the bud region.

Some of the affected palms also show symptoms of bleeding. The roots are in a bad state of decay and the root tips are black in colour.

There is a considerable reduction in yield as the disorder progresses.

3. Bud-rot

Mycological studies on *Phytophthora palmivora* Butl. were carried out. Attempts to induce the symptoms of bud-rot by inoculating seedlings, with *P. palmivora* Butl. were not successful.

C. MISCELLANEOUS

A paper entitled "A check list of parasites, Hyper-parasites, Predators and Pathogens of the Coconut Caterpillar, *Nephantis serinopa* Meyrick recorded in Ceylon and in India and their distribution in these countries by Mr. Edwin Dharmaraju, Colombo Plan Entomologist, was published in the Ceylon Coconut Quarterly, Vol. XIII, Nos. 3/4.

The following papers were prepared for publication:—

1. "Preventive measures in the control of the Red Weevil Pest".
2. "Microbial Control of the Coconut Caterpillar".
3. "A note on *Sophrops eurystoma* Burm., a pest of Coconut in Ceylon".
4. "A note on a species of *Amorphoidea* associated with inflorescences of *Cocos nucifera* L."

The following leaflets were prepared:—

1. The Control of the Red Weevil—Leaflet No. 37.
2. The Coconut Caterpillar and its control—Leaflet No. 34.

A paper entitled "Some of the lesser known insects found to be associated with coconut in Ceylon" was prepared to be presented at a C.R.I. Research Conference.

D. PERSONNEL

Mr. C.P. Wickremaratne took over duties as Technical Assistant in June 1963. I took over duties as Crop Protection Officer in February 1963.

U.B.M. EKANAYAKE,
Crop Protection Officer, Coconut Research Institute.

REPORT OF THE BIOMETRICIAN

1. STATISTICAL SERVICE

This Division continued to assist all the Research Divisions of the Institute in their design of experiments, statistical analyses and interpretation of data.

As is customary, details of work done for the various divisions are excluded in this report, except for any special features of biometrical interest.

One such noteworthy feature during the year, is a new type of a spacing trial this division prepared for the Botanist. This design was based on the multi-factor response surface concept. In plantation crops spacing of trees consists of two dimensions, column-wise and row-wise, giving rise to square or rectangular planting. Thus if the columns or rows are oriented in a fixed direction (say) North-South, there should be a certain optimum column \times row spacing, which gives either the maximum yield per acre or the maximum income per acre whichever is desired.

The attainment of such optimum conditions is best done by characterising the responses to different combinations of the column and row spacings by means of a response surface. Just as the relation on $y = f(x_1)$ between y and the levels of a single factor x_1 , may be represented by a curve, so the relation between y and two factors x_1 and x_2 may be represented by a surface called the Response Surface.

If one expects the yield per unit area to increase with plant density upto a point and then decrease (i.e. diminishing returns), then the response surface will be reasonably well characterised by a polynomial equation of the type:

$$y = a + b_1x_1 + b_2x_2 + b_3x_1^2 + b_4x_2^2 + b_6x_1x_2$$

The design provides for a few replicates of a strip-plot design. Each replicate is divided into strips in one direction to be allotted to one set of treatments—(say) column spacings—and into another set of strips at right angles to the first to be allotted to another set of treatments—(say) row spacings. The allotment of the treatments to the strips at each stage has of course to be made at random.

The optimum spacing is determined from the response equation.

2. BIOMETRICAL STUDIES

(a) Calibration studies

A field trial was commenced at Ratmalagara Research Station with a view to studying various morphological characters of the palm from the point of view of their suitability as calibrating variates for coconut experiments.

Every coconut bunch in each tree is tagged and followed up from the time of the opening of the inflorescence, through setting and nutfall to final maturity. Other records such as leaf counts, trunk measurements at different heights are done once in every two months.

Useful information on crop variations will be available from these records. These data will be used in future crop-weather studies.

(b) *Seasonal variations of coconut crops*

A study was made of the seasonal (i.e. pick by pick) fluctuations of copra yields as conditioned by the contributory fluctuations of the crop components viz: the number of bunches, number of female flowers per bunch, percentage setting, immature nutfall, incidence of barren nuts and nut size. It is now possible to associate a percentage increase or decrease of a particular bimonthly pick over the mean for the 6 picks, with certain percentages increases or decreases of the crop components (Table I). For instance one may be in a position to say that the first crop for the year (i.e. January/February) is normally 26.7% below the average for the six picks and that this 26.7% fall in the crop is occasioned by 8.3% drop from average in the number of bunches, 0.9% drop in the number of female flowers per bunch, 22.6% drop in the percentage setting, 2.9% increase in immature nutfall, 0.4% decrease in the incidence of barren nuts (empties) and 7.9% increase in nut size. Table I shows the position with regard to the other picks.

TABLE I

Percentage increase or decrease in crop in relation to percentage increases or decreases in their crop components

<i>Crop</i>	<i>Bunches</i>	<i>Female flower per bunch</i>	<i>% setting</i>	<i>Immature nutfall</i>	<i>Empty nuts</i>	<i>Weight per nut</i>	<i>Final crop wt. of copra</i>
1st crop (Jan./Feb.)	.. -8.3	- 0.9	-22.6	-2.9	+0.4	+7.9	-26.7
2nd crop (March/April)	.. +1.2	+ 3.8	+ 5.3	+0.2	+0.7	+5.0	+14.0
3rd crop (May/June)	.. +4.0	+ 4.6	+25.6	+2.2	-0.1	+2.2	+42.1
4th crop (July/August)	.. -0.1	+ 9.6	+14.7	+1.7	-0.2	-4.3	+21.2
5th crop (Sept./Oct.)	.. +3.3	- 7.0	- 5.1	+0.2	-0.4	-8.6	-19.5
6th crop (Nov./Dec.)	.. -0.0	-10.0	-17.8	-1.3	-0.4	-1.4	-31.1

An interim estimate shows that as far as the seasonal fluctuations of crops within the year are concerned, the variation in the percentage setting is the predominant factor controlling the crop fluctuations—accounting for about 50% of the total fluctuations; the variation in the number of female flowers per bunch accounts for about 20%; the nut size and number of bunches come next in importance; variations in immature nutfall and barren nuts do not account for more than 2-3% of the crop variations.

(c) *Biennial bearing tendency in coconut*

Subsequent to the analysis of coconut yield data done in the previous year, wherein it was observed that the biennial bearing tendency is a significant feature in coconut, a further analysis was carried out to determine for coconut experiments a minimum plot size which will ensure a reasonable reduction of biennial disturbances that make interpretation of data awkward.

It is observed that the plot size of six palms will be a reasonable minimum. The biennial effect though not completely eliminated at this plot size, is however kept at a tolerable level.

(d) *Economics of Fertilizer Use*

“With the widespread increase in the use of fertilizers and anticipation of changing price situations the question becomes: what is the economic optimum (a) in rate of application and (b) in combination of nutrients? This question can be answered only with (a) the principles of profit maximisation and cost minimisation of production economics and (b) the response functions of agronomy”.

However as the services of agricultural economists were not available, such economic analyses of the results of fertilizer experiments has not been done for any agricultural crop in Ceylon.

This division has been recently interested with such economic analyses for coconut data.

Based on the modern concepts of “response surfaces”, “isoquants”, “isoclines” and “Minimum recommended dosages”, etc. the data of the N.P.K. Fertilizer experiment at Bandirippuwa Estate were analysed.

The N—K response surface for coconut in respect of Bandirippuwa soil type is characterised by the following equation:—

$$y = 1377.9300 + 0.0655 N - 0.0067 N^2 + 10.3182 K - 0.0618K^2 + 0.0210 NK$$

Where y is the expected yield in pounds copra per acre; N and K are the levels of added fertilizer given as pounds of Sulphate of Ammonia (20.6% N) per acre and pounds of Muriate of Potash (50.0% K₂O) per acre respectively.

Based on this response equation the following economic fertilizer dosages were evaluated:—

- (i) The optimum nutrient combinations to secure given targets of production.
- (ii) The combinations of nutrients that will maximise profit when capital is limited.
- (iii) The minimum recommended dosage when capital is limited.
- (iv) The optimum (or profit maximising) nutrient combinations for varying prices of crop and costs of nutrients.

This analysis, apart from illustrating the principles behind the economics of fertilizer application, has highlighted certain points of general interest to soil scientists, fertilizer experts and the practical planter.

It is observed (1) that the optimum fertilizer dosage increases as the (crop) market improves, and (2) that the ratio of nutrients in the mixture also changes with the market and also the level of application. This shows that any attempt to brand a particular mixture as "High yielding mixture" or "coconut mixture" etc. based on a fixed ratio of nutrients, is economically not sound.

Another economic aspect on which fresh light is thrown by this analysis is in regard to manuring when capital is limited. When capital is limited, land-owners adopt one of two popular systems viz: (1) the whole estate is manured but at a lower rate per palm depending on the amount of money available or (2) the manuring is done at the usual (optimum) rate per palm but only over a fraction of the estate depending on the amount of money available.

The analysis shows that after all both these practices are economically unacceptable. For the quantum of capital available, one has to evaluate the economic ratio and level of nutrients applicable over the whole estate.

These economic nutrient dosages applicable to the whole estate under conditions of limited capital are subject to a certain lower limit which is called the minimum recommended rate of fertilizer application. The maximum rate and the optimum rate are well known as the rates of fertilizer application which give the maximum production and maximum absolute profit respectively. The minimum recommended rate is on the other hand the level of fertilizer which gives the maximum relative profit or the maximum return per unit of investment in fertilizer.

Thus when capital is limited, one is compelled to apply rates lower than the optimum. As we come down from the optimum rate, the absolute profit is lowered but (strange as it may sound) the average return per unit investment really increases to reach a maximum at the minimum recommended rate, thus ensuring in fact the most efficient use of fertilizer per rupee invested.

Therefore under conditions of limited capital, one could manure the whole estate at the highest rate permitted by the capital as long as the rate is not below the minimum recommended rate. But if the capital available is insufficient to apply at least the minimum recommended rate over the whole estate, then it will be more economic to apply the minimum recommended rate over a fraction of the estate depending on the capital available.

3. AGRI-METEOROLOGY

(a) Meteorological Stations

The meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Ambakelle Seed Garden were maintained satisfactorily.

The recording of the meteorological station was taken over from Mr. A.T. Fernando and handed over to Mr. Ebert Silva, Superintendent, Ratmalagara Estate.

(b) Rainfall 1963 and Crop Prospects 1964—(i) Rainfall

TABLE II

Rainfall and its distribution in important coconut areas of Ceylon

STATION	TOTAL RAINFALL			EFFECTIVE RAINFALL			DISTRIBUTION INDICES		
	1963	1962	Av. 53-62	1963	1962	Av. 53-62	1963	1962	Av. 53-62
Lunuwila (B/E)	101.20	78.4	79.4	96.00	67.9	74.7	(i)2.61	1.84	1.82
							(ii)3.46	2.70	2.81
Madampe (R/E)	77.28	53.3	64.6	72.38	51.4	62.7	(i)1.60	1.30	1.71
							(ii)1.89	1.96	2.43
Chilaw	85.76	55.0	62.0	79.11	49.6	58.6	(i)1.85	1.47	1.50
							(ii)2.32	1.98	2.14
Puttalam	64.70	56.7	47.8	62.04	56.7	45.6	(i)1.32	1.48	1.26
							(ii)1.50	1.74	1.58
Kurunegala	90.06	82.0	85.8	86.01	71.9	79.0	(i)1.95	1.99	1.93
							(ii)2.42	3.09	2.83

(ii) *Crop Prospects*

The Coastal belt from Lunuwila to Puttalam registered record rainfall. Lunuwila recorded the highest rainfall since 1930 and Madampe the highest since 1939. The effective rainfall in all these areas is also above the average.

As far as the distribution is concerned, it was about average in most areas except Bandirippuwa and Chilaw which were better.

Therefore in most coconut growing areas, crop prospects for 1964 are pretty bright although it may not keep up with the level of production in 1962.

4. PRODUCTION AND EXPORTS

(a) *Production*

The estimated production of coconuts in Ceylon for the year 1963 is 2,704 million nuts, which is 9.7% lower than the previous year which incidentally recorded the highest production ever. The production in 1963 is however 5.3% higher than the average over the last 5 years.

A fall in yields as compared to the year 1962 was expected as the rainfall was not so favourable. This was in fact indicated in "crop prospects" in my annual report for 1962.

(b) *Exports*

The total quantity (in nut equivalent) of the major coconut products exported in 1963 is 1,216 million nuts—this being 20.9% lower than in 1962. There is however an increase of 2.8% over the last 5 year average.

The average value of exports per 1,000 nuts in 1963 is Rs. 164.24. This is 11.1% higher than in 1962 and 6.4% lower than the last 5 year average.

Thus if attention is concentrated on the production and export data of only 1963 against the background of 1962 which registered an all-time record crop, one may not feel too happy about the Industry's performance. In fact a certain amount of anxiety has been evident among those closely associated with the industry. But such an anxiety is unwarranted because the drop in production is a temporary phenomenon due to unfavourable weather and further the comparison has been with the record crop of 1962. A more rigorous study of production *trends* eliminating the phenomenal short-term fluctuations (due to the weather) which coconut yields are characteristically subject to, makes it abundantly clear that the industry is steadily progressing. And if one takes into account the fact that the coconut industry is predominantly a small holders' industry, its achievement is something to be proud of, and credit has to be given to those agencies which work devotedly for the industry—such as the Coconut Research Institute, the Coconut Rehabilitation Department and the Ceylon Coconut Board.

5. PUBLICATIONS

(a) *Published*

- (1) "Statistical control of variability in coconut experiments" by V. Abeywardena (Emp. J. of Expt. Agric. No. 126).
- (2) "Some suggestions for minimizing errors from mishaps in field experiments with perennials" by V. Abeywardena (Ceylon Coconut Quarterly, Vol. 13, Nos. 3 and 4).
- (3) "Studies on biennial bearing tendency in coconut 1. The measurement of bienniality in coconut" by V. Abeywardena (Ceylon Coconut Quarterly, Vol. 13, Nos. 3 and 4).
- (4) "Economics of Fertilizer Use" by V. Abeywardena (a paper read at the symposium on "The role of fertilizers in agricultural production" held during the annual sessions of the Ceylon Association for the Advancement of Science on 21st November 1963).

(b) *Submitted for Publication*

- (1) "Seasonal variation of coconut crops" by V. Abeywardena and J.K.T. Fernando (Ceylon Coconut Quarterly).
- (2) "Some further aspects of nut water analysis as a diagnostic approach" by M.L.M. Salgado and V. Abeywardena (Ceylon Coconut Quarterly).
- (3) "Studies on biennial bearing tendency in coconut 2. A minimum plot size for coconut" by V. Abeywardena (Ceylon Coconut Quarterly).

6. PERSONNEL

There were no changes in the staff of the Division during the year. The cadre as at end of 1963 is as follows:—

Biometrician	— 1
Research Assistant (Statistics)	— 1
Field Assistant	— 1
Field Attendants	— 3

V. ABEYWARDENA,
Biometrician, Coconut Research Institute.

REPORT OF THE SOIL SURVEY UNIT

The Soil Survey of Puttalam North—Part I

The area surveyed was in the Kalpitiya one inch sheet, of lands to the North of the 6th mile post upto Ellavankulama on the Old Mannar Road.

Geomorphology

The landform consisted of a rolling mantle plain to the East of the road, and a comparatively lowlying coastal plain to the West which passed into the lowland South of the 7th mile post designated as the Aruvi Series.

A salient feature of the lagoon shore was the presence of a raised beach covered with an overburden of red soils, and on the lower terrace was bedded sandstone and corraline limestone, as at Kalladichena, indicating a shore line of emergence.

The theory of the shoreline of emergence in this area could also explain the presence of the villus or lakes, remnants of a primordial drainage, which could have formed as a result of uplift of the base-level of erosion.

It could also be postulated that due to the general up-lift of the land, the primordial drainage would have altered its course with an accompanying down cutting of the base level, forming the highly eroded depressions called vembus. Deep V shaped ravines lead into the Moongil Aru and the Kalaru, pointing to the immaturity of the vembus compared to the maturity of the mentioned rivers, which have already reached their base levels of erosion.

Geology

The Miocene

The area constitutes the Southern limits of the Miocene limestone series, continuous with the Miocene of the North-Western coast and Jaffna Peninsula. It has been observed in the geological survey of this area, that there is a marked difference in the lithology of the Miocene series, consisting of pure limestones and marls grading into hard limestones in the South, while in the North the hard limestones are interbedded with siliceous limestone and calcareous sandstones, the boundary of the division being the Karativu-Periya Naga villu road, c.f. Report on the raw material investigations in Puttalam North, Herath, Pattiarachi and Fernando.

Since there is a slight dip of the strata in the North-West direction, the lithology of the Northern series may be due to shallow water sedimentation of the Miocene sea, which could have transgressed in the North-West direction.

The Pleistocene

From a study of deep wells in the area it has been observed that the Pleistocene consists of quartzose gravels, followed by ferruginous gravels cemented by a matrix of clay followed by an over burden of

soils, consisting of red, yellow and bleached yellow series, the last named lying in the valley of the villus. If the primordial drainage was in the line of the villus, then it follows that the yellow and bleached yellow loams departed from the original red due to the greater period of submergence under fluvial waters. This explains the massiveness of the yellow loam gravels which have the lithogenetic character of a fluctuating water table.

A hypothesis for the origin of the Pleistocene is the postulate of a torrential fluvialite, sedimentation over the Miocene which laid down the gravels and finer sediments brought down from the land mass bordering the former Miocene sea. This was the first drainage phase.

The second drainage phase was probably laid down in the line of the modern villus, which brought about soil differentiation due to the bleaching of the original uniform red due to a fluctuating water table. The geomorphic evidence for the second drainage phase is the existence of the present line of villus as already stated. Mineralogical evidence for the two cycle theory of drainage is the fundamental difference in the heavy mineral suites of the smaller ferruginous gravels underlying all the soil types, laid down in the first cycle, and the larger gravels underlying the yellow loams. The heavy mineral percentage in the smaller gravels was higher and there was a preponderance of zircons.

Mineralogy

The correlation of strata

The earlier theory that the soils of this region were derived from the Miocene limestone was discarded on mineralogical grounds by studies conducted at the Department of Geological Surveys.

Subsequent work carried out in the Soil Survey laboratory of the Institute has proved the similarity of the heavy mineral suite in all the soil types, thus proving the common origin of the Red, Yellow and Bleached Yellow loams. The common heavy minerals were Ilmenite, Zircon and Rutile. The quartz grains especially in the red loams were coated with Haematite.

Mineralogical evidence for impermeability

It would be seen under the section on Hydrology, that the yellow loams were more impermeable than the red loams. Mineralogical evidence supports this contention as the study of coarse sand fractions in the yellow loams demonstrate that these grains are coarser, more angular and contains an abundance of feldspars. Thus more water had percolated into the yellow loam profile than into the red loams where the grains were smaller, more rounded, and were devoid of feldspars.

Morphology of the minerals

The original aeolian sedimentation theory has to be abandoned because the grains do not show those characteristics of wind deposits such as excessive roundness and sphericity, pitting, cross laminations in multiple directions, and other characteristics of such sediments. However the morphology points to a fluvialite sedimentation from the land mass bordering the extinct Miocene sea.

Mineralogical Analysis of Vanathivillu Red Soils

<i>Sample No.</i>	<i>% of fine sand</i>	<i>Weight of heavy minerals</i>	<i>% of heavy minerals</i>
1	6.3840	1.5365	5.1460
2	7.2372	1.9101	7.6404
3	8.6572	1.8934	7.5736
4	7.0792	1.5397	5.1588
5	6.9692	1.5015	6.0060
6	7.2232	1.8500	7.4000
7	7.9148	1.9115	5.6460
8	6.1848	.8930	3.5720
9	9.4214	1.5951	6.3804
10	8.2948	1.5173	6.0692
11	8.3124	1.4630	5.7520
12	10.7696	1.4782	5.9128
13	8.8464	1.3456	5.3824
14	4.6656	1.5900	6.3600

Analysis of Yellow and White Soils

<i>Sample No.</i>	<i>% of fine sand</i>	<i>Weight of heavy minerals</i>	<i>% of heavy minerals</i>
1	1.8748	1.3757	5.5028
2	8.6760	1.4628	5.8512
3			
4	5.9928	1.8236	7.3044
5	6.6160	1.5632	6.2528
6	11.0760	1.3514	5.4056
7	13.2044	1.2944	5.1776
8	9.8320	1.3614	5.4456
9	14.1700	1.7389	6.9556
10	11.0812	1.4444	5.7776
11	8.9636	1.5555	6.2220
12	—	1.7544	7.0176 B.y.
13	—	1.6716	7.7064 B.y.

THE SOIL SURVEY OF PUTTALAM NORTH

PART II

Climate and Vegetation

The rainfall in Puttalam area is *low* 44.2%, with a *fair* distribution 11.51%. The peak of the drought is at July-August, and the first rainy season is from September-December. The lesser drought is from the beginning of January to Mid March and this is followed by the latter rains upto the middle of May, c.f. graph. The humidity is 74%, and the temperature is moderate 81.1F, with a diurnal range of 11.8.

The following is a table of the wind direction and the mean cloud proportion:

			Mean wind Vel.	Cloud proportion %
January	..	..	136 N 34 E	6.9
February	..	..	139 N 29½E	6.6
March	..	..	131 S 75 W	6.6
April	..	..	137 S 45½W	7.0
May	..	..	263 S 43 W	7.2
June	..	..	341 S 46 W	7.4
July	..	..	328 S 45 W	7.1
August	..	..	300 S 46 W	7.2
September	..	..	297 S 45 W	7.0
October	..	..	203 S 47½W	7.0
November	..	..	112 N 24 W	7.5
December	..	..	114 N 36½ W	7.2

Vegetation

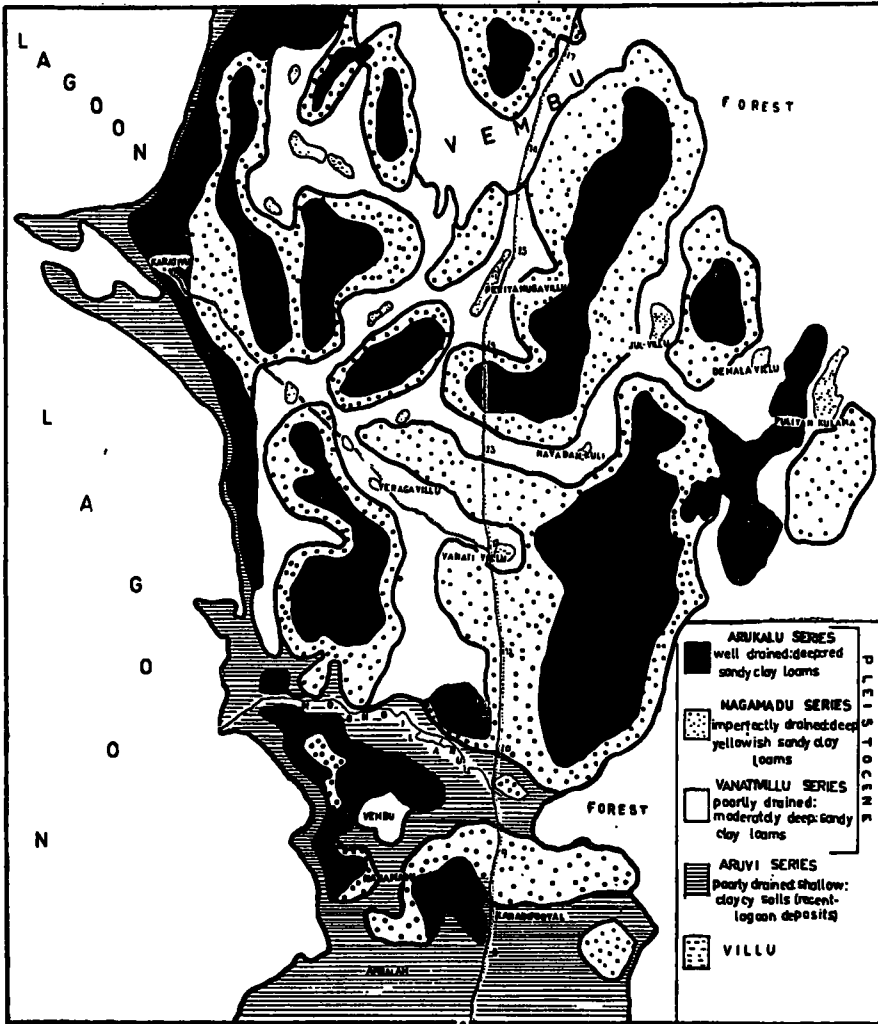
The natural vegetation of the area consisted of a dry zone forest climax, the dominant plants being ebony (*Diospyros Ebenum*), Satin wood (*Cloroxylon Swietenia*), Milla (*Vitex Altissima*), Weera, Palu (*Mimusops Indica*). On the level of scrub were woody twiners (lianes) and a dense and almost impenetrable thorn scrub.

Soil Classification

It was believed by previous workers in this area that only the red and yellow loams existed, and that these were distributed in pathes without a definite sequence, but the photoanalysis of the landscape by means of the Aerial Survey and co-ordinated field work has revealed that the soil series are in a catenary sequence related to a rolling topography, and that three soil series exist on the catena, the third series lying in the valley of the villus. This is the bleached yellow series (Vanathavillu series) the newest series to be described in this area.

The Aruvi Series consist of Recent lagoonal deposits, and has a wide distribution South of the 7th mile post.

SOIL MAP - PUTTALAM NORTH



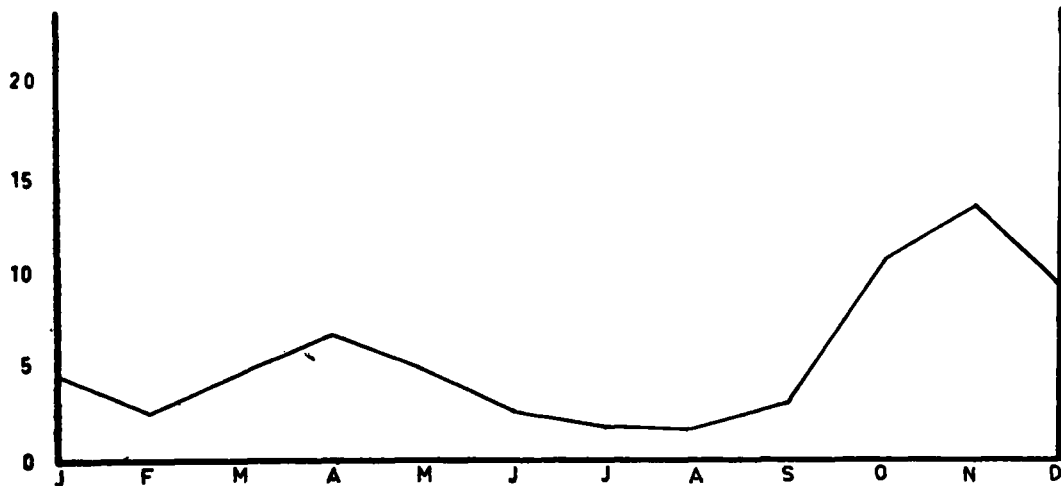
Maped by K.S.G. Perera

Scale 1:50,000

Vegetation in relationship to soil classification

It was observed in photoanalysis and subsequently checked by ground observations that the density of the red loam forest was very much higher than that of the other series. Secondly in the bleached yellow forests there were a number of open spaces consisting of scrub only. This pattern of vegetation greatly facilitated the mapping of the series.

PUTTALAM



Series I (Arukalu Series)

This series consisted of the deep red soils (2.5 YR) lying on the highest contours, the red intermediates (5 YR) grading to the yellowish reds 7.5 YR on the contours lying adjacent to the yellow loams. The depth of the red loams vary with the topography the average depth being between 18-20 feet. At Aruakalu hill the depth was over 70 feet.

The following is a profile description for a typical red loam.

0-20" 5 YR Sandy clay loam, peds small angular blocky, friable when moist. Sticky and plastic when wet, roots in surface fine to medium, sub-soil many, coarse. Surface runoff rapid, internal drainage *medium* to *rapid* horizon boundary clear grading to

20"-42" 7.5 YR, clayey gravel (gravel ferruginous cemented by clay), slightly sticky and slightly plastic, Internal drainage poor, horizon boundary diffuse grading to

42" below Kaolin content increases passing into horizon of small subangular quartz grains. Water at 36 feet pH 6-7, Salt conductivity of surface horizon (0.9") ($.36 \times 10^2$ mhos) C.E.C. 20-22% of B horizon, T.E.B. 2-3 m.e. %.

Series II (Nagamadhu Series)

This series occupy the intermediate slopes of the catena ranging from a light reddish yellow, deep yellow to light yellow soils, the latter lying adjacent to the bleached yellow series. The following is the profile description of a typical yellow loam soil type.

0-35" 10 YR 7/8, sandy clay loam, dry, peds angular blocky and flattened, very firm, moderately massive, soil cracks upto pentagonal sections on drying, consistence when dry hard, when moist friable, slightly sticky and plastic, horizon boundary distinct.

35"-55" 10 YR 7/3, sandy clay, mottles reddish and many, horizon kaolinized.

55'-29" Kaolin increases with depth with abundant massive gravels and fairly large subangular quartz grains mixed with feldspars. Roots in surface soil many, sub-soil moderate distribution, size medium and coarse.

Drainage:—Runoff *slow* to *medium*, Internal *drainage* Imperfect. pH 6-7 C.E.C. 20-22 m.e. % T.E.B. 2-3 m.e. % Salt conductivity of A horizon 0-7". 0.44×10^2 mhos.

Series III (Vanativillu Series)

This series as was stated earlier is developed on the contour of the villus and because of its high water table the soils are bleached, and it is this high water table that differentiates these soils from the other two series.

The soil during the drought is a greyish white 10 YR 7/2 which passes into a light yellow colour 10 YR 6/3 when moist.

The typical Vanativillu series has the following profile characteristics.

0-36" fine sandy clay loam (grading into a silty clay loam near the villus). Peds small, subangular blocky loose structure, friable, sticky and plastic.

Surface runoff slow, internal drainage slow to medium. Water at 12 feet. pH, T.E.B. and C.E.C. in the same range as the other series. Salt conductivity 0.33×10^2 mhos.

The Aruvi Series I

These are recent lagoon deposits and extend along the lagoon shore and passes into the region South of the 7th mile post. This series also seem to extend for a short distance along the basin of the Moongil Aru, probably due to a lagoon transgression. As observed in the regions South of the 7th mile post, the profile consists of 2-3 feet of sandy clay followed by a calcareous sandstone. In these areas the vegetation was very poor due to bad drainage.

Aruvi Series II

In sub-divisions of this series as along the basin of the Moongil Aru, the calcareous sandstone is absent, though the topsoil has a heavy texture. Aruvi Series I may be of older origin where the calcareous sandstone was laid down. Series II may be due to more recent lagoon transgressions along the Moongil basin.

Hydrology

Water table measurements were carried out in the area, commencing from March, 1963 for a period of one year. The measurements were carried out in fifty wells distributed in the Arukalu Nagamadhu and Vanativillu series. Comparing the rainfall distribution for the same period, both on a daily and a monthly basis it was seen that the Arakalu and Vanativillu series wells had a higher water table than the Nagamadhu Series wells in the drought period, and the latter wells were the first to run dry.

The explanation for the high water table in the Vanativillu Series wells is obviously due to these wells lying in the depression of the valley of the villus, where rain water could accumulate, and secondly due to lateral conduction of water from the villus.

A geological explanation for the maintenance of a fairly high water table in the Red loam wells was the hypothesis of the limestone depression theory under the red loam wells.

A second explanation is the greater permeability of the red loams to rain water than the yellow loams, and hence the enrichment of the underground reservoir or aquifer.

(a) Permeability determinations were carried out in the laboratory using the permimeter. The rate of permeability of the red loams to yellow loams was in the region 2 : 1.

The lower rate of permeability of the yellow loams was due to the higher percentage of total clay in these soils.

(b) The mean percentage of total clay in the red loams was in the region .0185%-.0302%.

For the yellow loams the percentage was between .0469%-.0432%. For the Bleached yellow loams there was an intermediate value .034%-.026%.

(c) Correlated to differences in the total clay were the variations in the liquid limit and plasticity index of the red and yellow loams. Here both the LL values and pl values were slightly higher for the yellow loams.

Conclusion

It may be stated that the fertility of the virgin soils of Puttalam North is controlled by the soil physical factors of the water regime, porosity, permeability and soil structure, then by the chemical status of its soils, which have similar constants like the pH, C.E.C. and T.E.B.

The soil physical approach to the study of these soils has also revealed that the fertility of the red virgin soils as demonstrated by the study of forest vegetation is due not to any inherent chemical status of these soils but to the fundamental differences of these soils in porosity, permeability and associated morphological structure.

In the last analysis however only a future agronomic study on the plantations of these areas can demonstrate the validity of the theory of the Soil Survey of Puttalam North.

The Soil Survey of Padawiya

The area surveyed was along the Padawiya-Pulmoodai road for about three miles, extending from Bogahewewa junction, and also the lands along the Kebbitigollawa-Padawiya road from Bogahewewa.

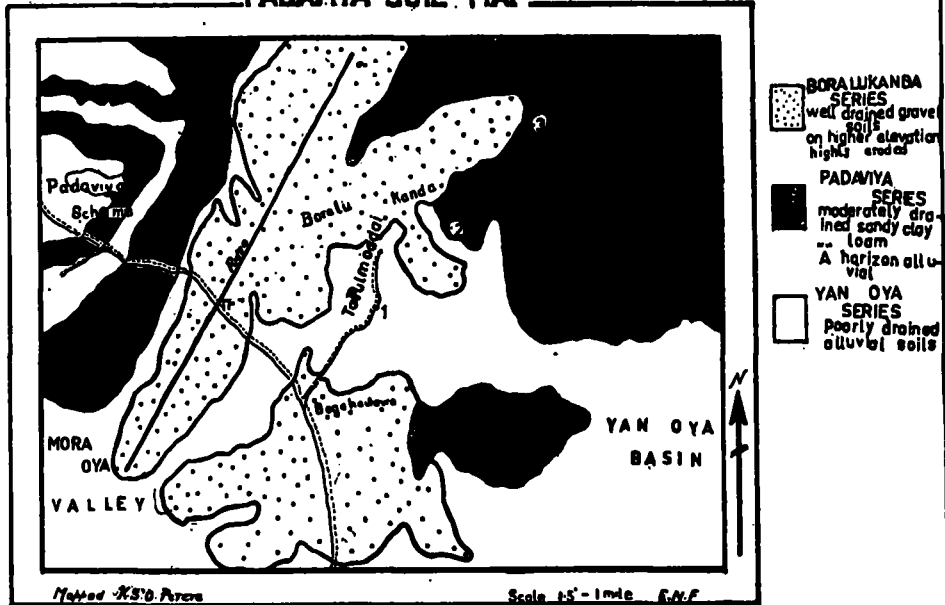
Climate and Vegetation

The climate and vegetation was that typically of the dry zone with a rainfall of 50-75 inches. The vegetation was a dry zone forest climax.

Geomorphology

The land form was a mature peneplaned surface, but there were a few ridges which had escaped complete denudation, the most prominent of which struck North-West from the 17th mile post along

PADAWIYA SOIL MAP



the Bogahawewa Padawiya road. This highly eroded remnant was called the Boralukanda, and this contained rounded boulders especially on the high elevations bordering the Padawiya reservoir. Undoubtedly the rounded boulders along the Pulmoodai road have been transported from the ridges as these are also found on the stream beds leading to the valleys. Apart from the prominent ridge or Boralukanda, there were erosional remnants of denudated ridges which also struck in a North-West direction.

Drainage

The chief drainage system of the area consisted of the Mora-oya which drained into the Padawiya reservoir and the Yan-oya. The Mora-oya, Yan-oya-basin forms a continuous valley, and the lesser and ephemeral streams on the elevations empty into this valley.

Geology

The rocks of the area consists of Biotite gneisses, and due to the dry climate there had been only a slow decomposition of the feldspars, which formed prominent masses derived perhaps from pegmatites

along the Pulmoodai road. The weathering seemed to be concentric for the rounded boulders were being formed by this mode of weathering. There was an abundance of ilmenite, Rutile and Zircon in these rocks, and the black sands of Pulmoodai have been derived from these heavy minerals.

Soil Classification—The Padawiya Catena

The Padawiya catena consisted of the (1) Boralukanda series on the elevations. (2) The Padawiya series on the slopes. (3) The Yan-oya series in the Yan-oya—Mora-oya basin.

The Boralukanda Series

Highly eroded soils, external drainage perfect, internal drainage good: The following profile was observed from a road cut—

0-20" 7.5 YR 3/2, sandy clay loam, slightly sticky, roots fine, medium coarse, slightly plastic, quartz present;

20"-69" 2.5 YR 5/6, clayey gravel (Gravel quartz) subangular, peds angular blocky firm, sticky, plastic;

69"-125" (Argillaceous granite sand). Same as above horizon, quartz increases and are massive (7"), blocky rock debris present, rich in magnetite and ilmenite.

125"-152" Argillaceous granite sand, containing highly weathered feldspars passes into the parent biotite gneisses.

The more eroded profiles were more gravelly, and passed into the feldspatic horizons. Since these soils are very shallow doubts have been expressed as to the suitability for coconut cultivation.

The Padawiya Series

These are moderately well drained soils, with an alluvial horizon derived from the Boralukanda series.

The soils in the Padawiya scheme on the slightly higher elevations bordering the paddylands of the Yan-oya series and also certain areas along the Pulmoodai road belonged to the Padawiya series.

The following profile was observed from a canal cutting.

Type I

0-4" Sandy clay loam. 5 YR peds small, angular blocky, moderately firm, plastic, sticky, roots fine, medium coarse, many.

Drainage:—Moderate, moderate permeability.

4"-17' Argillaceous granite sand, containing rock debris.

Below 17" Biotite granite gneiss.

Type II

0-12" Same as A horizon in type I.

12"-25" Sandy clay loam, contains quartz (rounded) drainage moderate. It is obvious that these horizons are elluviated from the Boralukanda series.

Below 25"—coarse sandy clay loam mixed with quartz, passed into horizon of granite sand and bedrock below.

Yan-oya Series

0-36"—fine sandy clay loam, peds massive, firm, angular blocky, plastic, sticky, very moist, high water table.

-36" passes into heavily mottled clay horizon.

There are various types in the Yan-oya series, which are of interest to the paddy soil surveyor.

It is obvious that only the Padawiya series could be safely recommended for coconut cultivation.

K.S.O. PERERA,
Officer-in-Charge, Soil Survey Unit.

REPORT OF THE CHIEF ADVISORY OFFICER

During the period under review the Division continued, through its free advisory service, to advise and demonstrate to coconut growers on methods of planting, replanting, after-care, soil and moisture conservation, draining low lying lands, application of fertilizers, control of pests and diseases, weeds and other problems relating to the cultivation of coconut. This service was made available to those who needed it, irrespective of the extent of plantation, through the Field Advisory Staff who were stationed in the ranges. Officers of the Department of Agriculture, Land Development and Divisional Revenue Officers, have often co-operated with our field staff by giving them every possible assistance to carry out this extension service. During the year the Division participated in three agricultural exhibitions and continued to maintain the six demonstration centres, that had been previously established, for the benefit of coconut growers.

Reports of increasing incidence of Red Weevil damage called for special attention and the field staff have, on a large number of coconut lands especially on Colonization Schemes, carried out demonstrations on the technique of injecting insecticides into affected palms. Besides this direct method of control, the field staff have also advised owners of land, on preventive methods with special emphasis on estate sanitation and the need for frequent inspection of young plantations. A well attended conference, at which the Divisional Revenue Officers, Land Development Officers, Advisory Field Officers of Kurunegala District and myself were present, was held by the Government Agent, Kurunegala and a programme of work, for the control of Red Weevil especially in the Colonization Schemes in the District, which was drawn was implemented. Six demonstrations on the injection technique and after-care of young plantations against the ravages of this serious pest were conducted with the assistance of the staff and material supplied by the Land Commissioner's Department.

Increasing incidence of Red Weevil infestation in Land Development Schemes, in the Puttalam District, have been brought to the notice of the Government Agent, Puttalam. Instances of Leaf Scorch were reported by the Field Officer at Koggala, while occurrences of yellowing due to magnesium deficiency have been reported by the Field Officers of Gampaha, Piliyandala and Koggala. In the case of the latter, application of "Keiserite" and dolomitic magnesium fertilizers has been recommended as a measure to correct this deficiency.

The work done during the year is summarised below:

1. GENERAL ADVISORY VISITS TO SMALL HOLDINGS AND ESTATES

A. *Small Holdings*

1. No. of holdings visited for general advisory work	4449
2. No. of holdings visited for soil conservation work	131
3. Extent of drains traced	2302 chains
4. No. of holdings visited to advice on draining low lying lands	52
5. Extent of drains pegged	421 chains

B. Large Holdings

1. No. of holdings visited for general advisory work	1051
2. No. of holdings visited for soil conservation work	38
3. Extent of drains traced	631 chains
4. No. of holdings visited to advice on draining low lying lands	16
5. Extent of drains pegged in these lands	271 chains

2. INSPECTIONS UNDER THE FERTILIZER SUBSIDY SCHEME

a. No. of small holdings visited	1411
b. No. of manure application forms distributed to small holders	678
c. No. of manure application forms distributed to large holders	92

3. PESTS AND DISEASES

Number of holdings visited for advice on the following pests and diseases.

	<i>Small Holdings</i>	<i>Large Holdings</i>
a. Termites	445	183
b. Black beetle	561	281
c. Red Weevil	611	307
d. Caterpillar	72	132
e. Grey Blight	38	24
f. Scale Insect	44	27
g. Other pests and diseases	114	58

4. PRE-PLANTING AND FOLLOW-UP SERVICE

A. Pre-Planting

1. Small Holdings

a. No. of holdings lined for planting	449
b. Extent lined for planting—Square and triangular method	597 acres
c. No. of holdings visited for soil conservation work	08
d. Extent of drains traced for soil conservation work	75 chains
e. No. of holdings visited to advice on draining low lying lands	05
f. Extent of drains pegged in these lands	44 chains

2. Large Holdings

a. No. of holdings lined for planting	142
b. Extent lined for planting—Square and triangular method	222 acres
c. No. of holdings visited for soil conservation work	01
d. Extent of drains traced for soil conservation work	14 chains

B. Follow-up

1. Small Holdings

a. No. of visits for follow-up work	861
b. No. of holdings visited for soil conservation work	02
c. Extent of soil conservation drains traced	03 chains
d. No. of holdings visited for advice on draining low lying lands	02
e. Extent of drains pegged in these lands	05 chains

2. Large Holdings

a. No. of visits for follow-up work	279
b. No. of holdings visited for soil conservation work	01
c. Extent of soil conservation drains traced	03 chains

5. MEETINGS AND TALKS

a. No. of meetings attended by the Field Staff	112
b. No. of talks delivered by the Field Staff	73

6. DEMONSTRATION CENTRES

Pallai

The underplanted seedlings were manured twice during the year with C.R.I. mixture "C". In addition to this "Keiserite" too was added at the rate of $\frac{1}{2}$ lb. per seedling. The adult palms were manured with C.R.I. mixture "C". A mixture of *Centrosema pubescens* and *Calopogonium mucunoides* seeds were sown on four acres of land in Block A. The indigenous cover of *Canavalia ensiformis* was allowed to remain on the land. In the under-plantation 124 poor and dead seedlings were replaced during the year. "Atlas Tree Killer" has been continued to be used on old palms that have been marked for removal. The entire land was ploughed by tractor.

Alampil

The seedlings were manured twice during the year with C.R.I. mixture "A". An application of dolomite too was done at the rate of 2 lbs. per seedlings. Due to Wild Boar attack, 50 seedlings had to be replaced. Seedlings were treated with "Dieldrex extra" as a preventive measure against Black beetle. The mixed cover of *Centrosema pubescens* and *Calopogonium mucunoides* as well as the indigenous cover of *Canavalia ensiformis* were continued to be maintained.

Mundel

The replanted seedlings were manured twice during the year with C.R.I. mixture "C", and dolomite.

Draining was done on $1\frac{1}{4}$ acres in the recently planted area. 18 old palms in the underplantation were removed. Illuk, which in the past was a noxious weed in the block has now been successfully controlled with the establishment of a mixed cover of *Centrosema pubescens* and *Calopogonium mucunoides*.

Koggala

Owing to heavy rain, which prevailed during the year and the situation of the land, it was not possible to do any draining. Seedlings in Blocks A, B and C were affected most as a result and continued to remain yellow owing to water logging. The adult stand was manured with C.R.I. mixture "C". The seedlings were manured twice during the year with C.R.I. mixture "C" and dolomite. Attempts to establish a mixed cover of *Centrosema pubescens* and *Calopogonium mucunoides* have failed owing to damage caused by Kalutara snails. The use of chemical bait against this serious pest was not of much value in controlling same.

Hettipola and Ratmalagara

These were continued to be maintained. The palms were manured with C.R.I. mixture "B". At Ratmalagara 79 husk pits were cut and husk buried in them as a moisture conservation practice.

SECTION II

CITRONELLA SUBSIDY SCHEME

Work under the Subsidy Scheme for planting coconuts on Citronella lands of 20 acres and under in the Matara and Hambantota Districts, continued to be done during the year. Issues of seedlings free of cost were completed in December, 1963, and no further issues are contemplated under the Scheme. Since the inception of the Scheme in 1960, a total of 1,634,355 seedlings have been issued for planting 21,848 acres, 2 roods, 10 perches. Inspection of lands to recommend payment of the Annual Cash Subsidy was continued to be done. In addition to this work the field staff carried out a follow-up service on the planted lands for the benefit of land owners.

The field staff reported that owners of land have shown a greater interest than before in their young coconut plantations and that in a good number of areas the seedlings were coming up well. Unfortunately, a noxious weed *Eupatorium odoratum* which was not too common in the area in the past, has invaded the young coconut plantations and in certain planted lands even smothered the coconut seedlings. The field staff have on their rounds cautioned owners of land on the dangers of this weed and advised them to uproot the plants no sooner than they are detected. It is proposed to give wide publicity to this fact through large posters, as this weed, if left uncontrolled could seriously affect the plantations under the Scheme.

A summary of work done during the year is given below:

(A) *May/June and October/November, 1963 Issues*

- | | |
|--|-------------------------------|
| (1) No. of applicants who took delivery of seedlings and fertilizer and "Aldrex 2" | 1321 |
| (2) Total No. of seedlings issued to applicants | 354469 |
| (3) Acreage planted according to permits | 4764 Acres 2 Roods 01 Perches |
| (4) Tonnage of fertilizer issued among applicants | 118 Tons 2 Cwts. 42 lbs. |
| (5) Quantity of "Aldrex 2" issued among applicants | 28348½ ozs. |

(B) Range Work

(1) Total No. of lands visited by the field staff for lining	610
(2) Total No. of holes pegged on the square and triangular system by the field staff	37297
(3) Approximate acreage	496 acres
(4) Total No. of lands visited by the field staff for checking	3386
(5) Total No. of seedlings certified by the field staff	440996

STAFF

Transfers

The following Advisory Field Officers were transferred in January, 1963:

Mr. T.D.J.R.D. Peiris from Kandy to Gampaha.

Mr. P.D. Wijesinghe from Gampaha to Kandy.

Mr. P.A.H. Gomes from Kurunegala to Piliyandala.

Mr. G.P.M. Amarasinghe from Piliyandala to Alawwa.

Mr. K.M. Francis from Alawwa to Pasyala.

Mr. P.A. Wijewickrama from Pasyala to Matara.

Mr. S.A. Swamy from Matara to Kurunegala.

Mr. Dunstan Fernando, Advisory Field Officer, Lihiriyagama was transferred to Head Office as Advisory Field Officer, Head Quarters as from 1st November, 1963.

Mr. L.D. Thambugala, Advisory Field Officer, Kegalle was transferred to Kurunegala as from 1st December, 1963.

Mr. C. Iddawela, Advisory Field Officer, Head Quarters was transferred to Kegalle as from 1st December, 1963.

Mr. G.P.M. Amarasinghe, Advisory Field Officer, Alawwa was transferred to Head Office temporarily as from 2nd December, 1963.

Messrs. C. Gunasekera and M.M.A. Abeyratne, Field Attendants were sent out to ranges in February 1963.

Mr. J.M.S. Fernando, Field Attendant, Kirama to Vitharandeniya on 4.9.63.

Mr. E.V.M.M. Edirisinghe, Field Attendant, Vitharandeniya to Head Office on 28.8.63.

Mr. R.W. Senaratne, District Coconut Instructor continued to work in the Department of Census and Statistics on full time duty for field supervision and technical scrutiny of work connected with F.A.O. Pilot Coconut Survey.

Messrs. K.B. Samarakkody, M.A.S. Perera and K.N.L.P. Seneviratne, Advisory Field Officers who were attached to the Department of Census and Statistics for work in the F.A.O. Pilot Survey were released during the latter part of the year.

These officers have since been posted down south for work under the Citronella Subsidy Scheme.

Mr. R.M. Asoka Peiris Ratnayake, Advisory Field Officer, continued to work in the Department of Census and Statistics, till end of December.

Resignations

Messrs. H.H. Samarakoon and S.A. Swamy, Advisory Field Officers resigned from their posts in August and September, 1963, respectively to take up appointments elsewhere.

Messrs. W.S.S.R.M. Charles and W.K. Mettapala, Field Attendants resigned to take up appointments as Grama Sevakas.

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

REPORT OF THE PLANTING OFFICER

1. STAFF

Planting Officer:— Mr. P.D.L. Fernando

Assistant Planting Officer:— Mr. C.W.S. de Silva

Clerk/Typists:—

Messrs. E.M.S. Fernando
H.W. Molligoda
W.A.W. Wijesooriya

Accounts Clerk:— Mr. R. Panchawarnam

Field Assistants:—

Messrs. J.A. Cadelis (S.F.A.)
Ernest de Silva (S.F.A., Carmel)
H.W. Fernando (Wilpotha)
D.P. Jayamanne (Koggala)
C.H. de Alwis (Medamulana)
J.L.D. Fernando (Walpita)
W.A. Sivappagasam (Alampil)
V. de Paul Fernando (Rathmalagara)
S. Nanthagobal (Mylambavely)

Nursery/Attendants:—

Messrs. K. Edmund Perera (Head Office)
D.C. Karunasekera (Walpita)
A.M.K. Mohamed (Mylambavely)
B.D.G. Weerasooriya (Koggala)
B.M. Jayanayake (Eramingolla)
D.L. Karunanayake (Wilpotha)
R.B. Wewalpola (Hettipola)
Y.V. Sirisena (Handapangala)
K.W. Kithsiri (Walpita)
S.L. Sumanasiri (Rathmalagara)
I. Joseph Fernando (Medamulana)
K. Austin Silva (Medamulana)
W.B.E. Fernando (Head Office)
A.T. Fernando (Rathmalagara)
W.G. Fernando (Wilpotha)
P.P. Jayasundera (Wilpotha)
J.B. Fernando (Kilinochchi)
J. Mathews (Head Office)

K.D. Jathiratne (Head Office)
P.P. Sumanatillake (Kalawewa)
J.K.D.W. Siriwardane (Handapangala)
G. Themapala (Head Office)
S.T. Fernando (Rathmalagara)
J.S. Roberts (Alampil)
S.D. Mullevitane (Carmel)

Three lorry drivers, one van driver and three lorry cleaners.

Recruitments:—Nil.

Promotions:—Nil.

Resignations:—Mr. D.L.G. Dharmadasa left the services of the Institute in 1963. Services of Mr. Vincent de Paul Fernando, F.A., were terminated from March, 1963.

2. NURSERIES

Seednuts:—2,097,507 seednuts were planted in the nurseries during the year, for the general replanting scheme and 579,610 for the Citronella Subsidy Scheme.

The distribution of seednuts in nurseries is as follows:

SEEDNUTS PLANTED IN 1963 FOR ISSUE OF SEEDLINGS IN

<i>Nursery</i>				<i>May/June 1963</i>	<i>Oct./Nov. 1963</i>	<i>Total</i>
1.	Rathmalagara	..	..	143,850	268,205	412,055
2.	Eraminigolla	..	..	35,000	35,050	70,050
3.	Carmel	..	..	108,200	268,432	376,632
4.	Walpita	..	..	97,700	85,000	182,700
5.	Hettipola	..	..	23,900	26,860	50,760
6.	Wilpotha	..	..	104,540	203,760	308,300
7.	Koggala	..	..	41,000	65,000	106,000
8.	Handapangala	..	..	—	100,000	100,000
9.	Mylambavelly	..	..	—	74,800	74,800
10.	Kalawewa	..	..	—	125,288	125,288
11.	Kilinochchi	..	..	—	93,352	93,352
12.	Mullaitivu	..	..	—	125,870	125,870
				554,190	1,471,617	2,025,807
	Medamulana	..	..	—	71,700	71,700
					1,543,317	2,097,507
<i>Citronella Subsidy Scheme:</i>						
13.	Medamulana	..	..	125,610	329,000	454,610
14.	Mapalana	..	..	125,000	—	125,000
				250,610	329,000	579,610

Seedlings

Orders for 1,380,365 seedlings were booked for both planting seasons i.e. May/June and October/November 1963. Distribution of seedlings from the nurseries is as follows:

<i>Name of Nursery</i>	<i>Total No. of seedlings booked for May/June</i>	<i>Total No. of seedlings booked for Oct./Nov.</i>	<i>Total No. of seedlings booked for both seasons</i>
1. Rathmalagara	90,458	102,361	192,819
2. Hettipola	26,160	28,800	54,960
3. Wilpotha	57,730	151,643	209,373
4. Carmel	70,370	180,150	250,520
5. Walpita	78,873	62,167	141,040
6. Koggala	31,806	37,530	69,336
7. Eraminigolla	22,345	24,046	46,391
8. Medamulana	25,403	54,840	80,243
9. Mapalana	1,033	—	1,033
10. Kalawewa	—	67,110	67,110
11. Alampil	—	87,645	87,645
12. Kilinochchi	—	65,795	65,795
13. Handapangala	—	70,635	70,635
14. Mylambavely	—	43,465	43,465
	404,178	976,187	1,380,365

3. INSPECTIONS

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

<i>Nurseries</i>	<i>No. of visits for the year</i>		
	<i>P.O.</i>	<i>A.P.O.</i>	<i>S.F.A.</i>
Rathmalagara—Hettipola and Wilpotha	6	2	6
Carmel—Kalawewa and Batticaloa	5	6	10
Kilinochchi and Alampil	3	4	5
Southern Province	3	2	3
Walpita and Eraminigolla	5	2	9

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

REPORT OF THE WELFARE OFFICER

The position was as follows:—

	<i>Senior</i>	<i>Intermediate</i>	<i>Assistant</i>	<i>Minor</i>
At the end of 1962	8	5	124	111
New appointments in 1963	—	2	2	—
	8	7	126	111
Less resignations, retirements in 1963, and promotions	—	—	7	4
Position as at 31.12.63	8	7	119	107
<i>Internal appointments:—</i>				
From Assistant Staff to Intermediate Staff	—	1	—	—
From Minor Staff to Assistant Staff	—	—	1	—

The cadre of the entire staff at the end of 1963 was 241 as compared with 249 last year. Only two vacancies have been filled from applicants outside the Staff of the Institute during the year. Recommendations regarding retrenchment of cadre by not filling up vacancies and to transferring excess officers of one Division to another were made by the Director in order to stabilise the Institute's finances. One appointment to the Intermediate Staff from Assistant Staff Grade I and one from the Minor Staff to the Assistant Staff Grade II were made during the year. The Minor Staff yet continues to benefit from the service qualification in lieu of the minimum academic qualification while such concessions have not been extended to a number of higher grades in the Staff. In respect of such concessions employees in the Institute labour force too do not have service qualifications nor are they considered as internal candidates for appointments to the Minor Staff Grade. Another glaring anomaly in the labour force is that monthly paid watchers are eligible for appointment to the Minor Staff Grade after 15 years of service while other monthly paid employees, such as Drivers, Cleaners, etc., who are not in Minor Staff have no such concessions for eligibility to the Minor Staff Grade.

According to the Employees Provident Fund Register the labour force as at 31.12.63 was 432 distributed as follows:—

On monthly pay	—	32
On daily pay	—	400

The monthly paid workers referred to above are not attached to the Staff but are entitled to Dearness and Special living allowances at Government rates. Daily paid workers are continued to be paid accordingly to the respective trades they are classified in accordance with the nature of their work. Many more labourers continued to qualify for the service allowance of 15 cents and 25 cents on completion of the respective periods of service. There were 14 accidents during the year as against 13 last year and a sum of Rs. 589/35 has been paid on temporary disablement cases. There were no partial disablements and fatal accidents during the year. Medical Certificates from snake bite specialists were recognised by the Board for payment of compensation.

Housing:—A sum of Rs. 35,586/55 has been spent in the construction of buildings and a sum of Rs. 6,051/27 on furniture during the year. One meeting of the Housing Committee was held during this period and the allocation of the bungalow at R/E for which applications were called was deferred. Canteen, Bathroom and Rest Room facilities are continued to be made common to all employees of the Institute without any discrimination on the class or category of work and their status.

Financial Aid:—A sum of Rs. 37,075/- has been paid as Festival Advances to the employees of the Institute at the rate of Rs. 100/- per head to the monthly paid employees amounting in all to Rs. 20,100/- and Rs. 50/- per head to the daily paid employees amounting in all to Rs. 16,975/-. A sum of Rs. 42,731/50 has been paid as loans to officers from the amount lying to their credit in the Provident Fund—Rs. 28,716/50 for construction of houses and Rs. 14,015/- for purchase of building sites. The total amount paid from the Provident Fund on Insurance Premia in respect of officers who have taken Policies for payment from the amount lying to their credit in the fund during the year was Rs. 36,213/90. The total amount contributed by the Staff to the Provident Fund in 1963 was Rs. 85,144/90 to which a sum of Rs. 26,801/07 has been accrued as interest. All applications from employees for Provident Fund, Gratuity, Medical Aid, Loans, Transport, Accommodation, Training and generally the establishment work of the Institute have been dealt with during the year.

Medical Aid:—9 Meetings of the C.R.I. Medical Aid Fund were held and a sum of Rs. 23,198/26 was paid on bills approved by the Committee of Management while the contributions were Rs. 29,181/33 during the year. Loans under Rule 14 of the Fund were also approved for payment in cases of special hardships and special concessions to members have been obtained from doctors in the panel.

Thrift, Savings and Supply of Goods:—The C.R.I. Co-operative Welfare Society have expanded its business in the supply of articles which are in short supply in the market and were sold below retail rates to members. It caters to the economic needs of the members and thrift and savings were also a part of Society's business during the year. The Board's annual grant to the Society is Rs. 1,500/-.

A fully furnished Rest Room with Canteen facilities and Radio Music have been maintained at the Institute's expenses during the year.

Recreational and Cultural Activities:—The C.R.I. Recreation Club participated in the "D" Division Government Service Cricket Tournament and was eliminated in the Semi-final played with the Colombo Port Commission. The Annual Christmas party was held and a number of gifts were distributed among the children. A sports meet and a variety entertainment were the main features of the Party. The Board continued to give its annual grant of Rs. 500/- to the Club and a further grant of Rs. 65/- per cricket match was allowed for the Government Service Cricket Tournament.

The C.R.I. Art Circle made further progress in its activities during the year. Additional novel books were purchased for the library, excursions were arranged and the Sinhalese New Year was celebrated in a grand scale.

Industrial Relations:—Every effort was made by the Coconut Research Board to maintain cordial employer-employee relationships during the year.

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

REPORT OF THE PUBLICATIONS OFFICER

The following issues of the 'Ceylon Coconut Quarterly' and 'Ceylon Coconut Planters' Review' were published during the year under review.

1. Ceylon Coconut Quarterly, Vol. XIII, Nos. 1/2; Vol. XIII, Nos. 3/4.
2. Ceylon Coconut Planters' Review, Vol. II, No. 4; Vol. III, No. 1; Vol. III, No. 2.

Leaflets No. 2, 4, 8, 15, 36 and 37 were reprinted during the year. A new leaflet entitled 'Magnesium Deficiency in Coconut Palms' (No. 43) was published. Leaflets No. 18, 30, 31 and 32 were withdrawn from circulation.

Translation Work

The need for the dissemination of information on Agriculture in the national languages is becoming increasingly important. All the Farm Schools and the Peradeniya School of Agriculture now use the national languages as medium of instruction. Inquiries from these organisations showed a particular demand for information through the national languages. Besides the switch over to national languages in the educational policy, the nature of the ownership in the Coconut Industry makes it imperative that knowledge should be disseminated through the national languages. Apart from the small holders who own a greater share of coconut lands, majority of whom one may safely assume as people not "proficient in English", the estate owners have been classified as follows by the Census of Agriculture 1946.

- | | | |
|--|---|---------|
| 1. "A" Estates:—i.e. estates which were 20 acres or more in extent, had 10 or more resident labourers and had their Census Schedules filled up in English by the Superintendent or person-in-charge. | } | 108,280 |
| 2. "B" Estates:—i.e. estates which were 20 acres and over, in which the number of resident labourers was less than ten or which was in-charge of a person not well acquainted with the English language. | | |

Ceylon Coconut Planters' Review, Vol. II, No. 4 and Vol. III, No. 1 were translated to Sinhala and published as "Polpawath". This Journal is now distributed among all Gr. 1 and Gr. 2 Schools, Rural Development Societies and Community Centres situated in the coconut growing areas.

All the new leaflets and revised leaflets were translated to Sinhala and published. Arrangements were made to translate these leaflets to Tamil.

Translations to Sinhala were done by the Publications Officer. Apart from translations for publication purposes, official documents like the Manual of Procedure, letters of appointment etc. were translated by him.

Radio Talks

The printed word alone does not satisfy the need for publicity. A series of Radio Talks on Coconut Cultivation and Coconut Products was delivered in Sinhala by the Publications Officer. The purpose of the talks was to create an interest in scientific information regarding coconut cultivation and coconut products. The large number of inquiries received subsequently, showed that the talks have achieved their purpose. Some daily newspapers consented to publish our articles on advice to coconut planters, but this had to be postponed because time had to be devoted to other duties which demanded prior attention. Fuller exploitation of mass media, for Agricultural Extension during 1964, is however envisaged.

A.K. GUNAPALA,
Publications Officer, Coconut Research Institute.

REPORT ON THE ESTATES

I. BANDIRIPPUWA ESTATE

Acreage

	A.	R.	P.
B/E (1)	153	0	00
B/E (2) A	118	0	38
B/E (2) B	59	3	26
B/E (2) C	34	3	07
	<hr/>	<hr/>	<hr/>
	365	3	31
	<hr/>	<hr/>	<hr/>

The above acreage comprises as follows:—

Research Section (working a/c)	175	0	04
Estate Section (working a/c)	168	0	13
Buildings, streams and roads	17	0	00
Waste land and Paddy	0	3	14
Playing Field	5	0	00
	<hr/>	<hr/>	<hr/>
	365	3	31
	<hr/>	<hr/>	<hr/>

Census

Census of palms as at February 1963 is as follows:—

Fields	1	2	3	4	5	6	BB	CA	GB	A	B	C	Total
Full bearing	1495	632	1239	1928	843	115	37	104	273	3989	2606	1563	14824
Partial bearing	285	145	194	430	97	49	35	62	21	1568	904	429	4219
Duds	36	73	44	65	11	11	13	—	—	1068	189	128	1638
In Flower	1	8	3	47	—	1	—	48	—	22	1	2	133
With Stem	6	112	3	184	10	1	—	106	—	48	—	2	472
Established Plants	1	27	1	36	110	—	—	117	—	1452	—	6	1750
Supplies	—	11	—	48	9	—	—	9	—	75	—	—	152
Vacancies	32	1	43	68	88	6	—	—	6	617	217	220	1298
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total	.. 1856	1009	1527	2806	1168	183	85	446	300	8839	3917	2350	24486
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>

Field Notes

Weeding:—The whole estate has been controlled of its heavy growth of weeds.

Drains:—Altogether 692 fathoms of new drains in the contour have been cut in B/E (2) B and No. 3 fields. 3,248 fathoms drains were cleaned and repaired.

Roads:—All estate roads have been maintained in good order.

Streams:—1,619 fathoms streams have been deepened and silt removed once for the year.

Husk pits:—661 husk pits (9' × 6' × 1') have been cut in the alternate rows in B/E (2) A and No. 1 fields and they were closed with an application of husks.

Pests and Disease:—Frequent examination for beetle and other pests have been undertaken.

Cultivation:—Discharring of the whole estate has been undertaken twice for the year.

Rainfall

This compares with the previous year as follows:—

<i>Average</i> 1934/50	<i>Months</i>	1962 <i>inches</i>	<i>Wet</i> <i>days</i>	1963 <i>inches</i>	<i>Wet</i> <i>days</i>
2.20	January	3.27	4	5.48	10
2.17	February	4.57	1	3.28	9
5.38	March	3.94	8	9.43	12
8.40	April	8.22	11	7.12	14
10.31	May	17.96	11	16.96	16
7.42	June	8.68	14	7.83	17
2.82	July	3.34	8	6.22	18
3.45	August	3.78	12	2.92	11
4.28	September	4.06	16	12.64	16
12.56	October	20.46	26	14.69	19
12.92	November	4.46	9	14.60	25
4.81	December	0.87	5	4.39	13
<u>76.72</u>	Total	<u>83.61</u>	<u>125</u>	<u>105.56</u>	<u>180</u>

Crops

This compares as follows:—

<i>Picks</i>	1959	1960	1961	1962	1963	<i>5 year average</i>
1	152823	72224	132987	177091	136099	130126
2	216861	165615	234073	208157	245978	198546
3	195786	202811	338525	290938	302346	253808
4	178196	206694	288305	247566	258931	231026
5	130296	137012	185311	144433	152098	149773
6	76358	119750	120618	111280	129715	106628
Total	950320	904106	1299819	1179465	1225167	1069907

The total crop received for 1963 was 1,225,167 nuts from 19,042 palms equivalent to 302 acres. Thus nuts per palm were 64.3 nuts and 4,056.8 nuts per acre.

The disposal of crops as follows:—

	<i>Nuts</i>
Sold on Contract	98000
Sold to Planting Division	23700
Sold to Research	3885
Sold to Staff	498
Nursery	2092
Cured into Copra	1057395
Allowances to Staff	27029
Empties	12568 1.0%
	<hr/>
	<u>1225167</u>

The 1057395 nuts cured into copra obtained 872 candies. 327 lbs. on an out-turn of 1,212 nuts to a candy. The percentage of No. 1 quality copra was 95.0%.

Manuring

The following palms have been manured for the year:—

<i>Estate</i>	No. 1	1673	} <i>Dosage</i> —3 lbs. Sulphate of Ammonia 3 lbs. Saphos phosphate 3 lbs. Muriate of potash 60% 9 lbs. @ 7 lbs. per palm half circle
	2	545	
	3	1144	
	4	776	
	5	263	
	6	191	
	BB	66	
	GA	123	
	A	3705	
	B	2168	
	C	735	
		<hr/>	
		<u>11389</u>	
<i>Research</i>	N.P.K. Experiment	1004	} As per experimental requirements
	Botanist	900	
	Botanist young plantation	1460	
	Pasture plots	2449	
	Response curve	2314	
		<hr/>	
		<u>19516</u>	

Manure was applied on half circle of palms and forked in.

Expenditure

The estate expenditure for the year per 1,000 nuts is as follows:—

	<i>Expenditure</i>		<i>Estimate</i>	
General charges	Rs. 34756.04	@ 28.37	Rs. 39840.00	@ 33.20
Upkeep	Rs. 13403.15	@ 10.94	Rs. 16308.00	@ 13.59
Cultivation	Rs. 21427.78	@ 17.49	Rs. 27438.00	@ 22.86
Collection	Rs. 18415.52	@ 15.03	Rs. 13310.00	@ 11.09
	<u>Rs. 88002.49</u>	<u>71.83</u>	<u>Rs. 96896.00</u>	<u>80.74</u>

D.F. WITHANA,
Superintendent, Bandirippuwa Estate.

II. RATHMALAGARA ESTATE

Director:—Dr. M.L.M. Salgado.

Superintendent:—Mr. D.P.L.E. Silva.

Estate Staff:—Mr. W.W.H.R.A. Fernando, F/A Estate.

Tractor Driver and Four Watchers.

Acreage Statement:—This Research Station is approximately 272 acres in extent, and comprises of the following Divisions, which have their own Officers-in-Charge of the experiments. Division of Botany, Division of Soil Chemistry, Division of Agrostology, Planting Division, Advisory Division and the Estate Division. There is a 3 acre block of clonal Rubber planted by the Rubber Research Institute, now under estate management.

Census of Palms

<i>Details</i>	1	2	3	4	5	6	7	8	B/B	Total
Full bearing	1555	232	756	1361	1171	1577	2532	333	2721	12238
In flower	1	—	—	26	—	4	31	8	—	76
Young palms	47	—	15	85	—	2	200	2	6	613
Vacancies	8	2	34	40	—	56	20	6	262	312
Duds	20	6	19	11	—	40	11	4	146	111
Total	1631	240	824	1523	1171	1679	2794	353	3135	13350

<i>Months</i>	<i>Rainfall for five preceding years</i>				
	1959	1960	1961	1962	1963
January	1.86	.29	3.12	.94	3.15
February	1.11	4.13	4.78	1.20	.15
March	2.47	1.65	2.48	1.85	5.05
April	8.86	10.60	3.09	1.52	3.06
May	12.09	14.68	10.81	15.91	7.21
June	4.39	2.37	9.09	4.26	3.14
July	4.35	13.91	5.68	.79	7.80
August	2.74	.50	2.20	1.69	.99
September	4.31	.25	8.20	2.95	4.65
October	10.53	9.81	5.59	14.30	10.11
November	9.74	14.21	5.98	3.64	10.90
December	1.92	.72	3.13	1.18	4.67
Total	60.06	73.12	64.15	50.23	60.88

<i>Pick</i>	<i>Crops picked for five preceding years</i>				
	1959	1960	1961	1962	1963
1	67729	65166	63476	103957	88806
2	80546	121471	123186	169045	154890
3	80329	122657	119706	177848	208134
4	63860	105728	107782	179191	175252
5	54575	70850	56500	109552	93738
6	36309	42309	63974	87732	72627
Total	383348	5281181	534623	827325	793447

Disposal of Nuts

<i>Pick</i>	<i>Crop</i>	<i>Estate Section</i>				
		<i>Sold to Planting Division</i>	<i>Cured</i>	<i>Sold on Contract</i>	<i>Allowances</i>	<i>Rejections</i>
1	58997	33100	24107	—	832	958
2	102245	—	98435	—	2010	1800
3	145483	—	50284	89814	2613	2772
4	125589	—	2471	118280	2073	2765
5	63098	—	60696	—	1248	1154
6	41451	—	5387	33293	1692	1079
Total	536863	33100	241380	241387	10468	10528

The 241380 nuts cured produced 204 cdy. 337 lbs. of copra of grades nos. 1, 2 and 3 giving an average outturn of 1128 nuts per cdy. About half of the crop had to be sold without curing due to the inadequacy of the Copra Kiln at Rathmalagara Estate. This Estate which has an annual crop of 700,000 nuts approximately should have a larger Kiln.

Field Work

The following field works have been carried out during the year.

<i>Item</i>	<i>Quantity</i>	<i>Fields</i>
Weeding	8946 squares	1, 3, 4, 6 and 7
Clearing	200 squares	8
Opening Drains	446 fathoms	3, 6, 8 and 4
Clearing Boundaries	85 fathoms	Hedge Plantation
Opening Husk Pits	1011 pits	1, 2, 3, 4, 6 and 7
Repairing Roads	418 fathoms	—
Repairing Fences	857 fathoms	4, 1, and 3
Manuring	3255 palms	—
Multching	2500 squares	1, 2, 3, 4, 6 and 7
Collecting Fronds	80 acres	In all Fields
Closing Husk Pits	401 pits	1, 2, 3, 4, 6 and 7

Buildings:—These are all in order. No new buildings were put up during this year.

Fences:—The boundary fences are all in order.

D.P.L. EBERT SILVA,
Superintendent, Rathmalagara Estate.