CEYLON COCONUT QUARTERLY

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ANNUAL REPORT OF THE COCONUT RESEARCH INSTITUTE OF CEYLON FOR 1965

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REPORT OF THE CHAIRMAN

On 1st January, 1965 the Coconut Research Board consisted of the following:—

Ex-officio Members

Director of Agriculture—Mr. A.T.M. Silva, C.A.S.
Treasury Representative—Vacant.
Commissioner, Coconut Rehabilitation—Mr. C. Chanmugam, C.A.S.
Chairman Low Country Products Association—Mr. P. Nadesan, C.M.G., O.B.E.
Director, Coconut Research Institute—Mr. C.A. Coorey, C.A.S. (Acting).

Nominated Members

Nominated by the Honourable Minister from Senators and Members of Parliament—Vacant.

Nominated by the Planters' Association of Ceylon.
Mr. C.T. Van Geyzel, *J.P.*
Mr. B. Warusavitharne.

Nominated by the Low Country Products Association.
Mr. C.A.M. de Silva (Chairman Coconut Research Board).
Mr. C.S. Samaraweera.

Nominated by the Honourable Minister to represent Small-holders.
Mr. M.M. Kumarakulasingham.
Mr. L.W.A. Fernando.

Meetings

Five meetings of the Coconut Research Board, the 204th, 205th, 206th, 207th and 208th were held on 23rd January, 13th March, 12th June, 11th September and 11th December respectively.

Committees

Administrative Committee (as at 1st January 1965):

(1) Mr. C.A.M. de Silva (Chairman).
(2) Treasury Representative (Vacant).
(3) Mr. B. Warusavitharne.
(4) Mr. C.S. Samaraweera.

(5) Mr. C. Chanmugam.
(6) Mr. A.T.M. Silva.
(7) Mr. C.A. Coorey.

The 49th, 50th and 51st meetings of the Administrative Committee were held on 13th February, 24th July and 16th October respectively.

Estates and Experimental Committee (as at 1st January 1965):

(1) Mr. M.M. Kumarakulasingham (Chairman).
(2) Mr. B. Warusavitharne.
(3) Mr. C.A.M. de Silva.
(4) Mr. C.T. Van Geyzel, *J.P*
(5) Mr. L.W.A. Fernando.
(6) Mr. A.T.M. Silva.
(7) Mr. C.A. Coorey.
(8) Mr. P. Nadesan.

The 51st, 52nd, 53rd and 54th meetings of the Estates and Experimental Committee were held on 6th February, 22nd May, 14th August and 13th November respectively.

Extension Committee (as at 1st January 1965):

(1) Mr. C.T. Van Geyzel, *J.P.* (Chairman).
(2) Mr. M.M. Kumarakulasingham.
(3) Mr. C.A.M. de Silva.
(4) Mr. L.W.A. Fernando.
(5) Mr. C. Chanmugam.
(6) Mr. P. Nadesan.
(7) Mr. C.A. Coorey.

The 41st, 42nd and 43rd meetings of the Extension Committee were held on 24th April, 28th August and 6th November respectively.

Editorial Committee (as at 1st January 1965):

(1) Mr. L.W.A. Fernando (Chairman).
(2) Mr. C.A. Coorey.
(3) Mr. M.M. Kumarakulasingham.
(4) Dr. D.V. Liyanage.
(5) Dr. E. Abeyratne.

The 9th, 10th, 11th, 12th and 13th meetings of the Editorial Committee were held on 3rd March, 29th May, 10th August, 1st September and 20th December respectively.

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

Ceylon Cocon. Quart. (1966) 17, 89-96.

REPORT OF THE DIRECTOR

1. STAFF

The Staff of the Coconut Research Institute during 1965 was as follows:—

Administration Division

Director—(Up to 12.2.65)—Mr. C.A. Coorey, B.Sc. (Lond.), C.A.S. (Acting).
(13.2.65 to 25.6.65)—Mr. D.C.L. Amerasinghe, B.A. (Lond.), C.A.S. (Acting).
(From 26.6.65)—Mr. A.T. Mahinda Silva, B.A. (Ceylon), C.A.S. (Acting).

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).

Chemistry Division

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

Botany Division

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

Soil Chemistry Division

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

Agrostology Division

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

Crop Protection Division

Crop Protection Officer—Mr. U.B.M. Ekanayake, B.Sc. (Agric.), Ceylon. (On Overseas Study leave).
Officer-in-Charge—Mr. J.K.F. Kirthisinghe.

Biometry Division

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

Advisory Division

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

Planting Division

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

2. GENERAL

Dr. David Robertson, Head of the Agricultural Zoology Department, North of Scotland College of Agriculture, Aberdeen, was attached to the Coconut Research Institute from 8th January until 1st April and carried out nematological work in relation to the 'Leaf Scorch' disease in the Southern province.

Dr. D.A. Nethsinghe, Soil Chemist, attended a meeting in Vienna for Consultant Groups on the Use of Isotopes in Studies on the Fertilization of plantation and Orchard Crops, which was sponsored jointly by the International Atomic Energy Agency and F.A.O.

Mr. D.E.F. Ferdinandez, Senior Technical Assistant, Division of Agrostology, underwent a course of three months' training in Tropical Pasture Management at the Department of Primary Industries, University of Queensland, Australia.

Coconut Crops

An all time record in coconut production estimated at 3,148 million nuts was registered in 1964. The estimated production for 1965 however is 2,835 million nuts, representing a decrease of 9.9% from 1964, and an increase of 1.2% over the average production (2,801 million nuts) for the past 5 years.

The decrease in production during 1965 is also reflected in the volume of exports for the year. These represent decreases of 21.4% and 5.0% from 1964 and the average for the past 5 years, respectively. A shortfall in crops (associated partly with the poor rainfall distribution in some coconut growing areas during 1964) may be adduced as the principal factor for the decrease in overall production. The progressive increase in internal consumption (consequent on population increase) on the other hand, would be one of the factors affecting the exportable surplus.

3. TRAINEES

Mr. Sudasrip Hardjoprajitno a trainee from Indonesia under the Colombo Plan Technical Cooperation Scheme was attached to the Institute during the year and was given intensive instruction in the Chemistry Division on all aspects of Coconut Technology with emphasis on the theoretical and practical aspects of copra manufacture.

4. VISITORS

The visitors during the year included the following:—

His Excellency William Gopallawa M.B.E.—Governor General of Ceylon, visited the Institute on 15th September.

Dr. Frederick Sanger, F.R.S. (Chief Guest at the 1965 Session of the Ceylon Association for the Advancement of Science) visited the Institute on 20th December. Dr. Canuto Manuel and Mr. Conrado E. Lotho of the National Institute of Science and Technology, Republic of Philippines.

Mr. C.D. Aidney, of the Copra Board, Fiji. Mr. D.B. Hill and Mr. T.C. Mindell of the Unilever Film Team.

5. PUBLICATIONS

Articles entitled "Coconuts in 1965" and "Activities of the Coconut Research Institute in 1965" were contributed by the Chemist to the Annual Report of the Planters' Association of Ceylon.

The Ceylon Coconut Quarterly, Volume XIV (combined Nos. 3 and 4) and Volume XV (combined Nos. 1/2 and 3/4) were published during the year.

The Ceylon Coconut Planters' Review, Volume IV No. 1 was published during the year.

6. 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 Division

(i) *Desiccated Coconut*:--for the purpose of consolidating quantitative information on the out-turn of desiccated coconut, a simple experiment was carried out at a factory in Nattandiya. One thousand dehusked nuts (as normally delivered for processing) were used for the experiment and the out-turn in relation to the weight characteristics of the nuts and nut-components were worked out.

If adequate co-operation is forthcoming, it should be informative to repeat the experiment at other factories spread out over different coconut growing areas.

(ii) *The Standard Ceylon Copra Kiln*:—Work in connection with the Standard Ceylon kiln was continued during the year. On the basis of a series of experiments the drying principles underlying the kiln were critically examined and appropriate factual information consolidated for publication.

An improved type of kiln capable of processing about one million nuts per year was erected on one of the large company estates during the year. On the basis of advice given, a number of small estates too have incorporated certain improvements in their kiln by effecting modification to their dimensional features.

(iii) *Studies on the Coconut Endosperm*:—(*a*)The observation has been made that when copra is cured in the form of cups, the oil contents of the kernel from the distal and embryo ends are significantly different.

In order to follow the changes in the distal and embryo ends of the kernel, the experiment commenced in 1964 was continued during the year. The chemical examination of ten physiological germination stages in all have now been completed.

(*b*) The observation has been made that there are moisture and oil gradients in the coconut kernel.

Employing six random samples of dead ripe fallen nuts, average values have been worked out for moisture and oil gradients within the kernel on segments drawn from the equatorial region of the nuts.

(*c*) Employing six random samples of dead ripe fallen nuts, it has been established that there are sugar and protein gradients in the coconut kernel.

(*d*) An extension of this study to the mineral nutrients has shown that concentration gradients also exist in the coconut kernel for most of the macro-nutrients.

Since the observations made in these studies are of biochemical interest, it is hoped to extend them to the kernel from the less mature developmental stages of the drupe.

(iv) *Coconut Treacle*:—It has been found that coconut treacle is a product that varies very much in chemical composition and keeping qualities.

In continuation of the work reported last year, over 20 laboratory samples of *freshly prepared* coconut treacle were examined chemically.

(v) *Arrack*:—Twelve palms were tapped for toddy during the year. The toddy collected was used for laboratory studies on fermentation efficiencies and the preparation of experimental samples of arrack.

(vi) Vinegar:—(*a*) The vinegar generator installed at the new factory at Nainamadama, continued to operate satisfactorily during the year. The factory was inspected at intervals and the acid strength of the finished vinegar was found to be consistently over 5.5%.

(*b*) A prospective vinegar maker was given full advice regarding the erection and maintenance of a factory employing the "Generator" process.

(vii) *Pot Culture Experiment*:—A *sixth* sand pot-culture experiment on 288 seedlings was laid down in April 1965.

The main objective of the experiment is to determine the errors (if any) in using leaf punch samples as against the entire laminae of different ranks for foliar diagnosis. As seven treatments (+ All, – All, – N, – P, – K, – Ca and – Mg) are involved, the estimations are being restricted for the present to the two elements K and P.

The chemical examination of the plant samples prepared from the previous pot-culture experiments are in progress.

Botany Division

(i) The yield recording of Progeny Trials at Marandawila, Bandirippuwa and Walpita were continued during the year. Four years' yield data are available from the Walpita Trial and from their analysis more prepotent palms and palms of high-breeding value have been identified. These palms will be used in the production of quality seed by artificial pollination.

(ii) The *typica* × *pumila* hybrids (experimental material) at Ratmalagara are 15 years old and continue to give highly satisfactory yields. The mean yield during the year was 180 nuts with a husked-nut weight of 295.8 lb. per palm. The same material planted at Bandirippuwa in November, 1957, has given a mean yield of 72 nuts with a husked-nut weight of 131.5 lb.

In a trial at Ratmalagara, planted in May, 1958 on an adverse soil type, 90.3 percent were in flower in under $3\frac{1}{2}$ years, and their mean yield for the year was 64 nuts with a husked-nut weight of 77.6 lb. per palm.

(iii) Controlled pollination work was carried out at five stations and over 38,000 female flowers were pollinated, consisting of 25,500 *typica* × *typica* (prepotent) and 12,600 *typica* × *pumila* crosses. 9,631 hand pollinated seednuts resulting from the crosses done in 1964 were harvested and planted in the nursery, and 5,916 hand pollinated seedlings were issued to the industry. Assistance has been given to ten private estates to carry out their programme of controlled pollination and 1,926 *typica* (prepotent) and 1,498 *pumila* pollen samples were supplied sufficient for pollinating about 10,000 inflorescences.

(iv) 125 acres have been planted to-date at the Isolated Coconut Seed Garden. The clearing of a further 20 acres was undertaken during the year. A 5-acre block of selected pumila palms within the seed garden has been systematically emasculated to produce a large quantity of hybrid seed through natural cross pollination with *typica* palms.

The squatters in the Western Isolation barrier were evicted and coconut palms in their illicit clearings were destroyed. Work is in progress to re-afforest the isolation barrier where necessary.

(v) A diallel cross using *typica* and *pumila* palms was completed—the purpose of the trial is to study genetic parameters of various components of the seed-nut.

(vi) At the request of F.A.O. a germination trial on fumigation of seed coconuts was initiated. Preliminary results indicate that the use of HCN gas as a fumigant reduces germination by about 50 per cent.

(vii) During the year 2,590,480 seednuts from selected seed palms were supplied to the Planting Division for raising seedlings.

SOIL CHEMISTRY DIVISION

A. Field Experiments

(i) The eight field experiments covering the problems of N,P and K requirements of both adult and young palms, fertilizer placement, frequency of manuring, liming acid soils, ploughing, and the efficiency of different sources of nitrogen and phosphorus were continued in 1965. The observation trials on the problems of leaf scorch, magnesium deficiency and immature nut fall were also maintained.

(ii) The experiments on ploughing and rates of N,P and K manuring at Ratmalagara were modified to study the effects of sub-soiling and higher rates of manuring.

The 30 year old 3^3 NPK experiment at Bandirippuwa and the 9 year old observation trials on magnesium deficiency were discontinued at the end of 1965.

(iii) Premanurial yield recording was commenced for a new NPK experiment in the Gampaha area, and also for an observation trial on the peculiar leaf chlorosis in regularly manured palms on the coastal sandy soils of Chilaw. A 30 acre jungle clearing at Pothukulama was planted with coconut seedlings for an experiment to compare the efficiency of different sources of inorganic nitrogen and phosphorus.

(iv) Field experimental results of particular practical interest are as follows:—

(*a*) In all experiments at Bandirippuwa, Ratmalagara and Pothukulama significant responses have been obtained to each of three major plant nutrients, N, P and K.

(*b*) At Ratmalagara 17-year old palms treated annually with CRI mixture 'A' at the rate of 9 lbs per palm gave a yield of 104 nuts per palm in 1965. The corresponding figures for palms not treated with any fertilizer, and those receiving 4½ lbs fertilizer mixture were 46 and 55 respectively.

(*c*) At Pothukulama, about 75% of the young palms treated with complete NPK mixture were in flower at the end of their 5th year. Only 30% of the untreated palms were in flower.

(*d*) At Nattandiya, the liming of an acid lateritic soil to raise its pH from 4.2 to about 7 has increased copra yields by about 200 lbs per acre per year in 1965.

(*e*) At Nattandiya the cheaper method of surface application of fertilizer round palms has continued to be as effective as the expensive trench manuring system. Broadcast application was less efficient.

(*f*) At Bingiriya, the experiment on organics Vs inorganic fertilizers on a light sandy soil has continued to show that there is no advantage to be gained by the use of expensive organic manures.

B. Laboratory Investigations

(v) Laboratory work was mainly directed to the study of the chemical composition of coconut water (N,P and K) and leaflet samples (N,P,K, Ca,Mg) in relation to fertilizer treatment and response to manuring. This is a long term project with the ultimate objective of developing a method for making quantitative manurial recommendations to individual lands. Leaf samples from the 3^3 NPK trial at Bandirippuwa, and 4^3 NPK trials at Pothukulama were analysed. Nut water samples from the 3^3 and 4^3 NPK trials at Bandirippuwa were also analysed to compare the relative merits of nut water and leaf analysis as a guide to fertilizer response.

(vi) A study of the chemical composition of leaflets from the observation trials on magnesium deficiency showed that the ratio of magnesium to total cations in leaves is a better a guide to the diagnosis of magnesium deficiency than the absolute magnesium content of the leaves.

(vii) Preliminary studies on the chemical composition of leaf samples from chlorotic palms on the coastal sandy soils in Chilaw indicate that the problem is probably associated with nitrogen deficiency, although the palms have been regularly manured with ammonium sulphate. Investigations on the question whether ammonium sulphate is an inefficient source of nitrogen under such conditions are in progress.

(viii) Leaflet and root samples from "Leaf Scorch" palms at Gonapinuwala and "immature nutfall" palms at Bingiriya were sent abroad for trace element analysis. Leaf samples from healthy bearing palms have also been sent for analysis for comparison.

(ix) Soil Analysis in 1965 was confined to the analysis of soil survey samples.

C. Soil Surveys

The Chief project for 1965 was a reconnaissance survey of the coconut growing areas of Galle, Matara and Ambalantota. The former areas have been completed. Work on the Ambalantota area is in progress.

Agrostology Division

(i) *Soil Fertility Studies*:—Studies on the nutrient status of the Gonapinuwela gravel was completed and those on Walahapitiya and Irranawila are nearing completion. The exami-

nation of two new soils (viz. Gurumadeniya and Halgashena), was also commenced during the year. The leteritic gravel from Kendakelle (near Bandirippuwa Estate) has been sampled to study the response pattern to phosphate.

(ii) *Pasture Studies*:—In addition to the main experiments on pasture/coconut competition for major nutrients another study on the placement of fertilizer in relation to two crops under coconut was initiated.

Ancillary studies were also made on the effect of nitrogen, light and management factors on pure and mixed swards.

(iii) *Studies on Inter-crops*:—During the N.E. Monsoon, a number of varieties of cowpea, green gram, ground nut, paddy and pineapples were planted in observation plots under coconut at Bandirippuwa.

(iv) *Cattle*:—In addition to the normal breeding of pure Sinhala and Sinhala × Scindi crosses, artificial insemination of Sinhala with (*a*) Fresian and (*b*) Jersey was continued, during the year. Of the ten cows that calved consequent on artificial insemination, eight produced bull calves.

Crop Protection Division

(i) *Pests*

(*a*) *The Red Weevil Rhyncophorus ferrugineus*:—Palm injection trials were done to select better insecticides that could destroy the pest breeding inside the palms. The insecticide Telodrin has given promising results, though not satisfactory enough for a general recommendation.

Further evidence has been recorded that by phytosanitary methods alone, outbreaks of this pest could be kept under control.

Studies on the ecology of this pest were initiated with a view to obtaining a clear understanding of its occurrence, development, and economic importance.

(*b*) *The Coconut Caterpillar* (*Nephantis serinopa*):—The biological control project initiated in 1960 was continued during the year. The evidence is that on the basis of the liberations so far done two of the parasites that were introduced have not established themselves in the field. Three others, on the other hand, have been found more or less effective.

(*c*) *The Coconut Scale* (*Aspidiotus destructor*):—Infestations of this pest were found only towards the latter part of the year. Only seven infestations have been reported, which is a very very favourable decline from last year. The infestations were brought under control by spraying with Kerosene oil emulsion.

(ii) *Diseases*

(*a*) *'Leaf Scorch' decline*:—Investigations on Leaf Scorch decline has been the major work during the year under review. The most noteworthy results obtained are the findings of the Colombo Plan Nematologist, which have eliminated the possibility of plant parasitic nematodes being a causal factor.

(*b*) *Bud Rot*:—Altough 'bud rot' can destroy both young and adult palms, its incidence is higher on young plantations about 3 to 10 years old.

With the co-operation of the Plant Pathologist of the Dept. of Agriculture a fungicidal trial using Antimucin (a mercurial spray) for controlling the disease was commenced during the year.

Biometry Division

(i) *Statistical Service*:—The division continued to assist all the Research Divisions of the Institute, in the design of experiments, statistical analyses and interpretation of experimental data.

(ii) *Biometrical Research*:—

(*a*) The recordings in the calibration trial at Ratmalagara estate were carried out satisfactorily.

(*b*) The nut yields of the 300-palm block of the Botany Division were analysed to determine the efficiency of pre-experimental yield as a calibrating variate for experiments on adult coconut palms. This work is still being continued.

(iii) *Agri-Meteorology*:—The meteorological stations at Bandirippuwa, Ratmalagara and the Isolated Seed Garden at Ambakelle were maintained satisfactorily during the year.

(iv) *Honorary Work*:—The Biometrician was consulted by Research Officers of the Rubber Research Institute, Department of Agriculture and Kantalai Sugar Corporation in their statistical problems.

Advisory Division

(i) *Advisory Visits*:—During the year 10,251 visits have been made by the field staff to coconut lands for advice and demonstrations on planting, soil conservation, draining, manuring, cultivation, pests and diseases control and for inspections under the Fertilizer Subsidy Scheme.

(ii) *Demonstration Centres*:—The routine work associated with the maintenance of the centres at Pallai, Mundel, Koggala, Alampil and Mylambavelly were carried out during the year. A further five acres at Mylambavelly have been cleared for planting.

(iii) *Cintronella Subsidy Scheme*:—The main items of work for the year under this Scheme, comprised inspection of lands for the payment of cash subsidy and the issue of free fertilizer. The actual fertilizer distribution was as follows:—

(*a*) 1885 applicants who had obtained seedlings and fertilizer during May/June 1962 were issued 226 tons, 13 cwt 28 lbs. of fertilizer in May/June 1965.

(*b*) 2,018 applicants who had obtained seedlings and fertilizer during October/November 1962 were issued 361 tons, 1 cwt. 14 lbs of fertilizer in October/November 1965.

Planting Division

(i) *Seed Nuts*:—The Planting Division maintained 12 nurseries during the year. A total of 1,811,647 seed nuts were planted for issue of seedlings in May/June and October/November seasons. 489,991 seed nuts were planted for issue of seedlings in May/June and 1,321,656 seed nuts for October/November.

(ii) *Seedlings*:—In May/June 335,843 seedlings were issued. A further 826,096 seedlings (making a total of 1,161,939 seedlings for the year) were booked for delivery during the October/December Season.

The demand for seedlings in 1965 exceeded the available supply.

W. R. N. NATHANAEL
Acting Director, Coconut Research Institute.

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REPORT OF THE CHEMIST

1. DESICCATED COCONUT

For the purpose of consolidating quantitative information on the out-turn of desiccated coconut, a simple experiment was carried out at a factory in the Chilaw district.

One thousand de-husked nuts (as normally delivered for processing) were used for the experiment. These were weighed in ten lots of 100 nuts each, and then treated as follows:—

(1) Each lot was shelled and the shells and shelled nuts were weighed separately—Table I (*a*)

(2) The shelled nuts were pared, and the pared kernel split to eliminate nut water. The paring and white meat were weighed, and the weight of nut water was estimated by difference—Table I (*a*).

(3) The white meat was washed, sterilized and disintegrated in the usual way. Random samples of the disintegrated meat were drawn for estimations of moisture content which averaged 50.1%.

(4) The disintegrated meat from the thousand nuts was dehydrated in two batches (bulked from 500 nuts each), in an 8-tray, Ceylon type, tray-compartment drier. The out-turns of D.C. (classified into coarse, medium and fine) for the two lots were worked out—Table I (*b*).

(5) In order to follow the moisture changes as the trays are moved along, samples were drawn from each tray at ten minute intervals for examination. The results are summarised in Table I (*c*).

(6) Temperature readings within the drier were recorded at 5 minute intervals and the results are summarised in Table I (*d*).

The overall results of the experiment (for the two batches A and B) show that when the average husked nut weights are 769 and 782 grammes, the corresponding out-turns of desiccated coconut are 371 lbs. and 389 lbs. per 1000 nuts respectively (equivalent to 168 grammes and 177 grammes per nut respectively at 2.5% moisture content). The overall moisture content of the parings from the two batches was found to be 25.1%.

On the basis of the mean values obtained, the weights of the two products (Desiccated Coconut and Parings) recovered from batches A and B, calculated as percentages of the respective nut component weights are charted in Table I (*e*).

If adequate co-operation is forthcoming, it should be informative to repeat the experiment at other factories spread out over different coconut growing areas.

TABLE I (*a*)

Weight characteristics of the nuts and nut-components

(In Grammes, weighed in ten lots of 100 nuts each)

1	2	3	4	5	6	7	8	9
BATCH	*LOT*	*Husked nuts* (*Gms*)	*Shelled nuts* (*Gms*)	*Shells (By difference)* (*Gms*)	*Pared nuts (with water)* (*Gms*)	*Parings* (*Gms*)	*Pared meat (without water)* (*Gms*)	*Water (By difference)* (*Gms*)
A	1	74,390	52,618	21,772	46,154	5,954	33,340	12,814
A	2	79,040	56,757	22,283	47,685	7,258	35,154	12,531
A	3	75,638	53,808	21,830	46,381	6,010	33,680	12,701
A	4	78,926	57,324	21,602	47,798	6,464	34,984	12,814
A	5	76,715	53,638	23,077	44,963	6,407	34,304	10,659
Mean	1-5	76,942	54,829	22,113	46,596	6,419	34,292	12,304
Average/nut	1-5	769	548	221	466	64(+18)*	343	123
S.D.	1-5	2037.31	2079.16	594.92	1176.76	521.92	791.03	926.74
C.V. (%)	1-5	2.65	3.79	2.69	2.53	8.13	2.31	7.53
B	6	83,122	60,499	22,623	53,014	6,520	36,458	16,556
B	7	74,957	54,602	20,355	51,767	6,350	33,396	18,371
B	8	77,792	56,587	21,205	48,365	6,974	34,077	14,288
B	9	77,792	55,566	22,226	45,133	6,634	33,907	11,226
B	10	77,339	55,339	22,000	47,628	6,237	35,041	12,587
Mean	6-10	78,200	56,519	21,682	49,181	6,543	34,576	14,606
Average/nut	6-10	782	565	217	492	65(+8)*	346	146
S.D.	6-10	2992.38	2335.62	904.30	3195.43	285.24	1209.04	2897.40
C.V. (%)	6-10	3.83	4.13	4.17	6.50	4.36	3.50	19.84
OVERALL MEAN	1-10	77,571	55,674	21,898	47,888	6,481	34,434	13,455
OVERALL Average/nut	1-10	776	557	219	479	65(+13)	344	135
S.D. (OVERALL)	1-10	2502.89	2266.89	756.53	2647.65	401.90	974.73	2363.16
C.V. (%) (OVERALL)	1-10	3.23	4.07	3.45	5.53	6.20	2.83	17.56

*(+18) for A and (+8) for B on losses (obtained by difference) on the weights of parings.

TABLE I (*b*)

Out-turns of Desiccated Coconut

1	2	3				4			
BATCH	*No. of Nuts*	*WEIGHT OF D.C. (Grammes)*				*OUT-TURN (pounds/1000 nuts)*			
		Coarse	*Medium*	*Fine*	*Total*	*Coarse*	*Medium*	*Fine*	*Total*
A	500	680	17,010	66,452	84,142	3.0	75.0	293.0	371.0
B	500	624	11,000	76,658	88,282	2.8	48.5	338.0	389.3
MEAN	500	652	14,005	71,555	86,212	2.9	61.8	315.5	380.2

TABLE I (*c*)

Moisture Contents of Meat in the Moving Trays (at 10 minute intervals)

(Average initial moisture content — 60.1%)

Time interval (minutes)	*TOP ROW*			
	T_1	T_2	T_3	T_4
10	47.34	46.39	43.25	35.84
20	44.98	37.01	40.25	24.40
30	35.47	26.21	17.74	8.43
40	34.77	16.61	13.99	2.58
50	21.42	5.32	5.01	(2.58)
Time interval (minutes)	*BOTTOM ROW*			
	B_1	B_2	B_3	B_4
10	48.44	47.91	44.93	42.71
20	45.43	42.04	40.01	32.49
30	39.91	37.24	35.26	16.87
40	35.18	28.06	23.04	2.50
50	28.68	26.75	16.62	(2.50)

T_1 to T_4 = Four trays in top row of Drier.

B_1 to B_4 = Four trays in bottom row of Drier.

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TABLE I (*d*)

Temperature readings (°F) in Drier (at 5 minute intervals for 50 minutes)

BATCH	*Temperature (°F)*										*Mean (°F)*
A	180	169	167	167	165	169	165	173	175	163	169
B	170	178	179	185	187	187	185	180	178	178	181
									OVERALL MEAN		175

TABLE I (*e*)

Percentage relationships between the weights of D.C., and parings recovered and the respective nut-component weights

BATCH	*DESICCATED COCONUT*								*PARINGS*							
	Wet Basis (3% moisture)				*Dry Basis*				*Wet Basis (3% moisture)*				*Dry Basis*			
	as % of Husked Nut	*as % of Shelled Nut*	*as % of Pared Nut (with water)*	*as % of Pared Nut (without water)*	*as % of Husked Nut*	*as % of Shelled Nut*	*as % of Pared Nut (with water)*	*as % of Pared Nut (without water)*	*as % of Husked Nut*	*as % of Shelled Nut*	*as % of Pared Nut with water)*	*as % of Pared Nut (without water)*	*as % of Husked Nut*	*as % of Shelled Nut*	*as % of Pared Nut (with water)*	*as % of Pared Nut (without water)*
A	22.0	30.8	36.3	49.3	21.3	29.9	35.2	47.8	8.2	11.5	13.5	18.4	7.9	11.1	13.1	17.8
B	22.8	31.5	36.2	51.4	22.1	30.6	35.2	50.0	7.3	10.1	11.6	16.5	7.0	9.7	11.2	15.9
Mean	22.4	31.2	36.3	50.0	21.7	30.3	35.2	48.0	7.8	10.8	12.6	17.4	7.5	10.4	12.2	16.8

Basis of Calculation.

A. Dry weight of D.C. per nut = 164 gms.
Dry weight of Parings per nut = 61 gms.

B. Dry weight of D.C. per nut = 173 gms.
Dry weight of Parings per nut = 55 gms.

2. THE STANDARD CEYLON COPRA KILN

(*a*) Work in connection with the Standard Ceylon Kiln was continued during the year. On the basis of a series of experiments the drying principles underlying the Kiln were critically examined and appropriate factual information has been consolidated for publication.

With a view to minimising the effects of external draughts on the fires in the kiln, a system of sliding shutters (with appropriate fixtures) have been designed. It is considered that this contraption definitely increases the efficiency of the Ceylon kiln.

(*b*) An improved type of kiln (incorporating these refinements) and capable of processing about one million nuts per year was erected on one of the large company estates during the year. On the basis of advice given, a number of small estates too have incorporated certain improvements in their kilns by effecting modifications to their dimensional features.

(*c*) *Experiments on Solar-drying*:—As the use of the Ceylon kiln combines sun-drying with kiln-drying, the preliminary experiments on solar-drying that were started earlier were continued during the year.

Six lots in all (batches IV, V and VI), each comprised of 250 (selected, medium size, ungerminated) SEASONED NUTS, were processed entirely by solar-drying (10 hours per day—7 a.m. to 5 p.m.) during the year. These six lots were dried in three parallel batches (500 nuts each) during three separate non-overlapping periods. Whilst 250 nuts in each batch were washed in clean water prior to sun-drying, the balance (250 nuts) were dried in the usual way with the adhering nut water. Moisture estimations were done in triplicate on samples (of 10 half-nuts) drawn from each lot of each batch at the close of each day's sun-drying. The copra produced from each of the six lots was classified, and graded for quality. The full results, along with those reported earlier are summarised in Table II (*a*) and (*b*).

It was found that the keeping qualities of the washed and unwashed nuts (used in the experiments) were not significantly different.

The average maximum and minimum air temperatures (for ten-day periods) taken at 8.30 a.m. and 5.30 p.m. when Batches I to VI were processed, are given in Table II (*c*), along with sunshine records for corresponding times of the year.

3. COCONUT TREACLE

It has been found that coconut treacle is a product that varies very much in chemical composition and keeping qualities.

In continuation of the work reported last year, 24 laboratory samples (labelled STV_{13} to STV_{36}) of freshly prepared coconut treacle were examined chemically during the year. The full results are summarised in TABLE III.

Since it was difficult to obtain any reliable values for the acidity of the finished treacle by titration (owing to masking of the end point) approximate values alone are reported for the product at the stage when it was just turning syrupy. Titrations were done on the original sweet toddy and on parallel samples drawn during progressive stages of evaporation on both sand and water baths. In general, the values obtained for the sand bath were somewhat lower than those for the water bath, probably due to greater losses of acid at the higher temperatures of the former.

TABLE II (*a*)

Sun-drying Experiment on Mature, Seasoned Coconuts

(Progressive Changes in Moisture Content)

BATCH	Lot	No. of Nuts	% Moisture											
			†Fresh Kernel	Air-dry Kernel	1st Day	2nd Day	3rd Day	4th Day	5th Day	6th Day	7th Day	8th Day	9th Day	10th Day
UNWASHED NUTS														
I	1	250	—	—	30.9	24.3	16.8	12.9	10.1	8.3	7.5	6.8	6.0	5.2
II	2	250	—	—	34.5	21.5	17.5	11.9	10.6	8.3	7.0	7.2	6.1	5.7
III	3	250	—	—	34.0	22.9	14.4	11.3	10.3	8.8	7.1	6.4	6.0	5.5
IV	4	250	—	—	34.5	26.2	20.0	15.2	10.8	9.6	8.5	6.3	6.5	5.9
V	5	250	—	—	39.1	27.7	18.5	14.8	11.1	9.7	8.0	6.7	6.4	5.4
VI	6	250	—	—	37.3	24.8	17.3	12.9	11.1	9.6	8.1	7.0	6.8	5.3
Mean			46.9*	43.8*	35.0	24.6	17.4	13.2	10.7	9.0	7.7	6.7	6.3	5.5
WASHED NUTS														
I	7	250	—	—	36.7	22.4	16.7	13.5	10.1	7.7	7.0	7.1	5.6	5.4
II	8	250	—	—	32.9	22.7	16.0	12.4	9.5	8.1	7.1	6.3	5.8	5.5
III	9	250	—	—	31.7	22.5	19.5	13.2	10.7	8.2	7.1	7.1	6.0	5.7
IV	10	250	—	—	37.8	31.3	20.5	14.9	12.6	10.0	8.0	7.4	6.2	5.4
V	11	250	—	—	35.8	24.8	18.3	13.6	10.5	8.9	7.6	6.9	6.0	5.4
VI	12	250	—	—	32.7	22.1	19.0	12.9	10.8	9.1	8.1	7.3	6.2	5.5
Mean			46.9*	43.8*	34.6	24.3	18.3	13.4	10.7	8.7	7.5	7.0	6.0	5.5

† From dead-ripe fallen nuts. *From separate experiment.

TABLE II (*b*)

Sun-drying experiment on mature, SEASONED Coconuts
(Out-turns, Grades and Classification)

Batch	Lot	No. of nuts	Overall Out-turn Nuts/ Candy †	GRADES (%)				CLASSIFICATION (*Half nuts as % of Total*)						
				No. 1	No. 2	No. 3	Total	Charred "Rathu"	Stained "Kahata"	Pitted "Dhya-madha"	Immature "Kalati"	Spoiled "Kunu"	Good Copra	Total
UNWASHED NUTS														
I	1	250	1097	97.7	1.2	1.1	100.0	Nil	5.2	Nil	1.4	0.9	92.5	100.0
II	2	250	1034	93.0	5.6	1.4	100.0	Nil	Nil	Nil	6.5	1.8	91.7	100.0
III	3	250	1003	95.0	4.8	0.2	100.0	Nil	Nil	Nil	5.8	0.3	93.9	100.0
IV	4	250	1068	96.8	2.3	0.9	100.0	Nil	Nil	Nil	5.3	0.6	94.1	100.0
V	5	250	1026	95.1	3.9	1.0	100.0	Nil	Nil	Nil	5.6	1.5	92.9	100.0
VI	6	250	1053	93.9	4.9	1.2	100.0	Nil	Nil	Nil	6.0	0.9	93.1	100.0
Mean			1047	95.2	3.8	1.0	100.0	Nil	0.9	Nil	5.1	1.0	93.0	100.0
**WASHED NUTS*														
I	7	250	1105	97.2	2.0	0.8	100.0	Nil	Nil	Nil	2.4	0.8	96.8	100.0
II	8	250	951	93.2	3.5	3.3	100.0	Nil	Nil	Nil	7.5	0.8	91.7	100.0
III	9	250	1155	94.3	4.1	1.6	100.0	Nil	Nil	Nil	5.6	0.7	93.7	100.0
IV	10	250	1059	98.1	1.2	0.7	100.0	Nil	Nil	Nil	4.8	0.6	94.6	100.0
V	11	250	1098	96.3	2.8	0.9	100.0	Nil	Nil	Nil	4.4	0.3	95.3	100.0
VI	12	250	1102	95.3	2.9	1.8	100.0	Nil	Nil	Nil	4.0	1.1	94.9	100.0
Mean			1078	95.7	2.8	1.5	100.0	Nil	Nil	Nil	4.8	0.7	94.5	100.0

*Visually the copra from the WASHED nuts was superior to the UNWASHED. † 1 Candy = 560 lbs.

TABLE II (*c*)

Maximum and Minimum Air Temperatures (°F)—

(Averages for 10-day periods)

BATCH	*MAXIMUM* (°F)		*MINIMUM* (°F)		*Hours of Sunshine per day (Means for 10 day periods)*
	8.30 a.m.	5.30 p.m.	8.30 a.m.	5.30 p.m.	
I	87.2	90.7	72.2	74.5	6.83
II	85.9	90.0	72.2	75.6	6.15
III	86.0	90.8	70.5	75.1	7.56
IV	86.8	90.4	73.6	76.6	8.33
V	84.6	89.3	72.2	76.6	7.77
VI	88.6	90.5	78.1	79.2	8.00
Overall Average	86.5	90.3	73.1	76.3	7.44

4. STUDIES ON THE COCONUT ENDOSPERM

(*a*) The observation has been made that when copra is cured in the form of cups, the oil contents of the kernel from the distal and embryo ends are significantly different.

Changes in the oil content of the composite kernel during progressive stages of germination have already been established. In order to follow the changes in the distal and embryo ends of the kernel, samples were drawn and chemically examined from batches of 12 seedlings, from each of the seven following pre-determined physiological growth stages, during germination:—

Stage I:—Sprout just emerging out of the husk ("Crow's beak" stage).

Stage II:—One leaf emerging but not fully open. No appearance of second leaf.

Stage III:—First leaf fully exserted. Second leaf emerging.

Stage IV:—First and second leaves fully exserted. Third leaf emerging.

Stage V:—First, second and third leaves fully exserted. Fourth leaf emerging.

Stage VI:—First to fourth leaves (inclusive) fully exserted. Fifth leaf emerging.

Stage VII:—First to fifth leaves (inclusive) fully exserted. Sixth leaf emerging.

The mean values obtained from the above seven stages of the experiment are charted in Table IV (*a*) and (*b*). The oil-free extracted meals from this experiment were examined for the mineral constituents and the results are shown in Table IV (*c*).

TABLE III

Analytical Characteristics of 24 samples of Coconut Treacle (Freshly prepared Laboratory samples)

STV 13 to STV 36	% *Moisture*	% *ASH (sulphated) W/W*		% *POTASH (as K_2O) W/W*			% *Total Sugars (as sucrose) W/W*	* % *ACIDITY (as acetic) about*
		Wet basis	*Dry basis*	*Wet basis*	*Dry basis*	*As % of ASH*		
STV 13	14.1	2.06	2.40	0.89	1.04	43.3	61.3	0.13
STV 14	12.7	2.58	2.96	0.85	0.97	32.8	64.5	0.24
STV 15	17.2	2.18	2.63	0.98	1.18	44.9	62.5	0.32
STV 16	12.1	2.18	2.48	0.99	1.12	45.2	57.3	0.22
STV 17	21.4	2.61	3.32	0.95	1.20	36.1	60.6	0.26
STV 18	17.8	2.12	2.58	0.97	1.18	45.7	57.7	0.14
STV 19	15.7	2.42	2.87	1.03	1.22	42.5	60.9	0.09
STV 20	18.2	2.14	2.61	0.85	1.04	39.8	62.9	0.13
STV 21	20.1	2.60	3.24	0.88	1.11	34.3	62.5	0.11
STV 22	19.2	1.82	2.26	0.93	1.15	50.9	59.3	0.17
STV 23	19.5	2.20	2.73	0.88	1.10	40.3	59.6	0.13
STV 24	22.9	2.12	2.76	0.83	1.08	39.1	59.6	0.16
STV 25	18.5	2.15	2.64	0.97	1.19	45.1	58.3	0.17
STV 26	14.3	2.18	2.55	0.83	0.97	38.0	69.1	0.20
STV 27	18.9	2.01	2.48	0.82	1.01	40.7	64.4	0.26
STV 28	18.8	1.62	2.00	0.89	1.10	55.0	63.1	0.11
STV 29	17.5	1.78	2.16	0.91	1.10	50.9	62.9	0.22
STV 30	17.0	1.75	2.11	0.74	0.90	42.7	59.6	0.13
STV 31	12.2	1.82	2.08	0.84	0.96	46.2	67.3	0.11
STV 32	14.0	2.12	2.47	1.01	1.17	47.4	67.1	0.12
STV 33	15.1	2.03	2.39	0.94	1.11	46.4	63.3	0.09
STV 34	14.1	2.04	2.37	0.96	1.11	46.8	57.2	0.10
STV 35	17.5	2.20	2.68	1.01	1.15	42.9	61.1	0.22
STV 36	18.7	1.97	2.43	0.89	1.09	44.9	61.8	0.18
Mean	16.98	2.11	2.55	0.91	1.09	43.41	61.83	0.17
Range	12.1 to 22.9	1.62 to 2.61	2.00 to 3.32	0.74 to 1.03	0.90 to 1.22	32.8 to 55.0	57.2 to 69.1	0.09 to 0.32
C.V. (%)	17.08	11.67	12.97	8.08	7.73	12.10	5.08	37.37

*Acidity figures were obtained on samples evaporated down on a water bath.

TABLE IV (*a*)

Weight characteristics of seedling components
(Weights in Grammes—Mean values for 12 seedlings)

1	2	3	4	5	6	7	8	9	
Stage	*Weight of Whole Nut*	*Weight of husked Nut*	*Weight of Husk*	*Weight of Apple*	*Weight of Shoot*	*Weight of Roots*	*Volume of Water (ml.)*	*COPRA PER SEEDLING*	
								Embryo End	*Distal End*
I	2799	1007	1792	60	37	—	200	128	132
II	2786	900	1886	88	46	4	86	117	115
III	2668	800	1868	132	69	7	31	92	108
IV	2603	785	1818	143	97	14	nil	91	114
V	2368	843	1525	155	173	18	nil	80	103
VI	2237	884	1353	177	232	24	nil	73	94
VII	2839	599	2240	166	400	45	nil	52	88

TABLE IV (*b*)

Oil Content of the Kernel

1	2			3		
STAGE	*EMBRYO END (E)*				*DISTAL END (D)*	
	% Moisture	*% OIL*		*% Moisture*	*% OIL*	
		Wet basis	*Dry basis*		*Wet basis*	*Dry basis*
I	4.8	69.1	72.6	4.7	68.3	71.7
II	4.0	70.7	73.7	4.5	68.8	72.0
III	3.4	73.3	75.8	3.8	71.7	74.5
IV	3.1	74.0	76.4	3.7	71.8	74.6
V	3.3	75.5	78.1	4.1	73.5	76.7
VI	3.2	74.7	77.1	3.6	73.5	76.2
VII	3.6	75.2	78.0	7.2	70.8	76.3

TABLE IV (*c*)

Mineral Constituents in oil—free meal

1	2													3										
Stage	*EMBRYO END (E)*													*DISTAL END (D)*										
	% Moisture	*Ash*		K_2O		*N*		P_2O_5		*CaO*		*MgO*		*% Moisture*	*Ash*		K_2O		*N*		P_2O_5		*CaO*		*MgO*	
		Wet	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*		*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*
I	5.8	6.5	6.9	2.3	2.4	3.2	3.3	1.3	1.4	0.07	0.07	0.52	0.55	6.8	6.2	6.7	2.4	2.6	3.0	3.2	1.2	1.3	0.07	0.08	0.49	0.53
II	6.1	6.4	6.7	2.1	2.2	4.0	4.2	1.5	1.6	0.12	0.13	0.62	0.66	4.7	6.5	6.8	2.2	2.3	3.5	3.7	1.4	1.4	0.13	0.13	0.66	0.69
III	8.1	6.3	6.8	1.7	1.9	4.2	4.6	1.5	1.6	0.09	0.10	0.60	0.65	7.8	5.6	6.0	1.8	2.0	4.1	4.4	1.4	1.5	0.15	0.16	0.51	0.55
IV	6.6	6.3	6.6	1.6	1.7	4.0	4.3	1.6	1.7	0.12	0.13	0.55	0.59	7.6	6.4	6.9	1.8	1.9	4.0	4.3	1.4	1.6	0.11	0.12	0.61	0.66
V	1.4	5.6	6.3	1.6	1.8	4.4	4.9	1.5	1.7	0.10	0.11	0.51	0.57	10.7	5.3	6.0	1.5	1.7	3.7	4.1	1.4	1.6	0.11	0.12	0.74	0.83
VI	8.8	5.2	5.7	1.2	1.3	4.4	4.8	1.6	1.7	0.12	0.13	0.60	0.66	9.6	5.0	5.5	1.2	1.3	3.9	4.4	1.4	1.5	0.11	0.12	0.69	0.75
VII	6.9	4.5	4.8	1.4	1.5	4.6	5.0	1.7	1.8	0.11	0.12	0.61	0.65	5.2	6.9	7.3	1.9	2.0	4.6	4.8	1.6	1.7	0.08	0.09	0.64	0.67

This study on the coconut endosperm is being continued.

(*b*) The observation has been made that there are moisture and oil gradients in the coconut kernel.

Employing six random samples of dead-ripe fallen nuts, average values have been worked out for moisture and oil gradients within the kernel on segments drawn from the equatorial region of the nuts. The results are summarised in Table V.

TABLE V

Moisture and Oil Gradients in the Coconut Kernel
(Dead-ripe Fallen nuts—six samples)

Region	% *MOISTURE*						% *OIL (DRY BASIS)*							
	I	*II*	*III*	*IV*	*V*	*VI*	*Mean*	*I*	*II*	*III*	*IV*	*V*	*VI*	*Mean*
T	30.7	30.7	27.3	27.0	27.5	27.3	28.4	60.0	61.9	61.1	62.2	58.0	58.6	60.3
RT	21.2	24.9	21.6	21.3	19.6	22.1	21.8	77.4	78.2	78.8	78.4	79.6	78.9	78.6
IR	34.8	35.3	35.3	39.1	32.3	32.6	34.9	71.4	73.8	73.1	68.5	74.8	74.6	72.7
RW	65.0	61.9	63.4	67.4	61.2	63.2	63.7	46.8	53.3	49.3	41.5	51.0	53.2	49.2
Mean	37.9	38.2	36.9	38.7	35.2	36.3	37.2	63.9	66.8	65.6	62.7	65.9	66.3	65.2

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

Since the observations made in these studies are of biochemical interest, it is hoped to extend them to the kernel from the less mature developmental stages of the drupe.

5. ARRACK

Twelve palms were tapped for toddy during the year. The toddy collected was used for laboratory studies on fermentation efficiencies and the preparation of experimental samples of arrack. The results will be reported later.

6. VINEGAR

(*a*) The vinegar generator installed at the new factory at Nainamadama, continued to operate satisfactorily during the year. The factory was inspected at intervals and the acid strength of the finished vinegar was found to be consistently over 5.5%.

(*b*) A prospective vinegar maker was given full advice regarding the erection and maintenance of a factory employing the "generator" process.

7. POT-CULTURE EXPERIMENT

A sixth sand pot-culture experiment on 288 seedlings was laid down in April 1965.

The main objective of the experiment is to determine the errors (if any) in using leaf punch samples as against the entire laminae of different ranks for foliar diagnosis. As seven treatments (+ALL, − ALL, −N, −P, −K, −Ca and −Mg) are involved, the estimations are being restricted for the present to the two elements K and P.

The chemical examination of the plant samples prepared from the previous pot culture experiments are in progress.

8. MISCELLANEOUS WORK

(*a*) Analyses and reports were made during the year on samples of copra, desiccated coconut and poonac.

(*b*) Four samples of dry-milled coir-fibre dust received from two different sources were examined and reported on during the year.

(*c*) Mr. Sudasrip Hardjoprajitno a Colombo Plan trainee from Indonesia was given intensive instruction during the year on the theoretical and practical aspects of copra manufacture.

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Chemist, Coconut Research Institute.

Ceylon Cocon. Quart. (1966) 17, 110-113

REPORT OF THE BOTANIST

1 PROGENY TRIALS.

The three coconut progeny trials at Marandawila, Bandirippuwa and Walpita were maintained during the year. The Marandawila trial planted in 1934 consists of the unselected progeny of nine high-yielding mother palms and the accumulated data have been used to determine some genetic parameters. In the Bandirippuwa trial planted in 1959, unselected progenies of 125 selected high-yielding palms are being tested in the form of a Cubic Lattice, and since it has been grown as an under-plantation, the general growth of palms is rather poor, and only a few palms are in flower. The Walpita trial planted in 1948 and 1949 is in the form of two Cubic Lattices A and B, and progenies of 125 unselected palms are tested in each Lattice. The main purpose of these progeny trials is to isolate palms of high-breeding value.

The analysis of four years yield data-weight of husked-nuts of both Lattices of the Walpita trial has been completed and it has been possible to classify the 223 seed parents used for this experiment according to their breeding values. The mean weight of adjusted husked-nuts per progeny during the four-year period (age of palms 13 to 16 years) has varied between 133.3 lb. and 25.8 lb. per year, and that indicates the extent of variation relative to breeding values present between the seed parents.

The general mean for Lattice A progenies was 79.6 lb. husked-nut weight per year and that for Lattice B 82.4 lb. per year, and these figures are rather low, largely due to the adverse environment in which the progenies have been grown. 13 percent of the parents of Lattice A progenies, and 16 percent of the parents of Lattice B progenies, have given a progeny yield 20 percent more than the respective population means. Selected palms out of this lot are being used for breeding purposes. The best 5 percent of the parents of Lattice A according to their phenotypic values are indicated below:—

SEED PARENT		*PROGENY*	
No.	*Wt. of husked-nut per year* * *lb.*	*Wt. of husked-nuts per progeny per year* † *lb.*	*Breeding value*
55	174.3	108.9	58.6
85	173.7	96.1	33.0
222	158.4	73.0	- 13.2
179	150.5	104.7	50.2
145	150.4	70.3	- 18.6

* age of palms 16 to 19 years.
† age of palms 13 to 16 years.

In the above table the breeding value has been taken as twice the deviation of the progeny mean from the population mean. Although all the five parents were of high phenotypic value, only three of them are of good genetic value. The yield of the parents and progenies are not directly comparable due to their differences in age and as they have been grown in separate environments. The variation in yield of progeny between the parents is the important factor.

There were a number of families with high progeny means, purely due to the presence of two to three very high-yielding progenies within each family. Since family size is small (9 and 6 progenies per seed parent in Lattices A and B respectively) these few high-yielding individuals could inflate the family means, even if the other progenies are of average performance only. After elimination of these and other parents whose high phenotypic value appeared to be due to non-additive genetic effects, it was possible to identify only nine parents out of 223 tested that are good for breeding purposes. These nine palms are being used for pollen collection, and a number of other palms amongst the pool tested are being used as female parents in controlled pollination work.

2 HYBRIDISATION BETWEEN VARIETIES AND FORMS.

In pursuance of the breeding programme, besides the progeny trials referred to above, the following trials are in progress: (*a*) study the effect of inbreeding *typica* palms, (*b*) isolation of male transmitters and (*c*) study of heterosis in varietal crosses. Most of the field trials have been planted after 1961 except under (*c*), and yield data are not available still.

A field trial was planted in November, 1962 to study the growth and relative yields of the three types of seedlings indicated below; design is randomised blocks with 12 replications and 12 palms per plot.

A — F_1 of *typica* · × *pumila*.
B — F_1 of *typica* × *typica* where the male parent has been clasified provisionally as prepotent.
C — Open-pollinated progenies of *typica* palms.

Number of new leaves produced per plant per year was scored. Analysis of variance of the total number of leaves produced since transplanting to November, 1965, *i.e.* age of palms 3 years, showed that the differences between treatments were significant (P = 0.01) and the three treatments could be placed in the following order of merit.

Treatment	*Total no. of leaves produced per plant during 3 years.*
A F_1 of *typica* × *pumila*	27.22 ± 0.56
B F_1 of *typica* × *typica*	24.31 ± 0.56
C *typica* open pollinated	23.55 ± 0.56

Treatment A was significantly better than treatments B and C, the difference between the latter two treatments being not significant with respect to leaf production during the first three years of growth. Since rate of leaf production demonstrates vegetative vigour, the first genetion palms of *typica* × *pumila* could be considered to be more vigorous vegetatively during their juvenile condition than the palms of the other two types.

Typica × *typica*. The programme on production of commercial seed by hand pollination of selected female parents with pollen of palms of high-breeding value was continued at five stations. The setting of female flowers was exceptionally low, due to the prolonged drought experienced during the year. 9630 hand pollinated nuts arising from the pollinations of the previous year were harvested. 3424 pollen samples from the Pollen Bank were supplied to ten private estates who are carrying out their own controlled pollination programmes; this quantity of pollen would have been sufficient to pollinate 10,000 inflorescences.

An experiment was carried out to ascertain whether any useful correlation between a nut-character and the breeding value of the respective palm could be established. Nine palms of high—, average—, and low-breeding values (with three palms in each group) were used as the male parents in crossing five palms taken at random for each male. The nuts were harvested during the 52nd week after pollination and the following characters of each nut were scored; weight of husked-nuts, endosperm, shell and embryo. Similar data of the open-pollinated nuts of the same female parents were recorded. As is usual with experiments of this type only a few nuts per cross were obtained. An analysis of variance for the four characters showed that the only significant variance was due to between females within males (significant at P = 0.1 percent), variances between families and between males being not significant. Comparision of data between pollinated and open-pollinated nuts within the same male group did not, show any marked differences in the four characters listed above, in relation to the known breeding values. The male parents used for this experiment, belonged to different phenotypic groups relative to yield of copra. Although negative results have been obtained from this experiment, it is proposed to repeat the same experiment in a slightly modified way.

3 NURSERY.

At the request of the F.A.O., an experiment was carried out to study the effect of a seed-fumigant on germination of seed coconuts and on the quality of seedlings. The seed was treated prior to planting with Hcn gas at the following levels. Fumigation was carried out at normal atmospheric pressure without temperature control.

Treatment A — 1.25 lb. Hon/1000 cu. ft. applied for 2½ hours
„ B — 2.50 „ „ „
„ C — 5.00 „ „ „
„ D — Control

The treated seed-nuts were planted in the nursery in a randomised block lay-out with 25 nuts per plot and six replications. All the seed-nuts were collected from 30 seed parents of the *typica* variety.

The following data were collected: (*a*) date of sprouting of each seed-nut, (*b*) height of seedling at four-weekly intervals and (*c*) classification of seedlings on a basis of vigour.

PERCENTAGE SPROUTING AND QUALITY OF SEEDLINGS

Treatment	*Percentage of seed-nuts sprouting-weeks from date of planting.*				*Percentage good seedlings*
	8	16	20	24	
A	nil	40	45	45	34
B	nil	43	48	51	33
C	nil	42	48	49	33
D (control)	43	90	92	94	76

Analysis of variance after appropriate transformation of data showed that the differences bewteen treatments with respect to percentage germinations at the end of 24 weeks were significant ($P = 0.01$). Seednuts in all the three types of fumigation showed significantly less germination than in the control, and the differences between the former treatments were not significant. Thus fumigation as indicated above has adversely affected the germination of seednuts. A detailed report will be published later.

4 SEED SUPPLY SCHEME.

Seednuts were collected from selected palms distributed on 20 estates and 2,590,480 nuts were supplied to the Planting Division for raising seedlings.

5 MITES ON COCONUT POLLEN.

The association of mites with coccnut inflorescences has been reported earlier, and when present, are considered to be doubtfully injurious to coconut pollen (Annual Report of the Botanist, 1953). Recently, our attention was drawn to an isolated group of king coconut palms (variety *Aurantiaca*), which were reported to be producing barren nuts, inspite of a large number of female flowers produced. On examination, the inflorescences on these palms were found to be infested with pollen mites. Pollen viability was very low, with an unusually high proportion of 'dummy' grains (irregular in shape and devoid of cytoplasm)-23 to 41 percent. Very low pollen viability, coupled with scarcity of atmospheric pollen due to the spatial isolation of these palms (1 to 1½ miles from the nearest coconut plantation) may be responsible for the production of barren nuts. The pollen mites were identified as *Blattisociidae* near *Zercoseius* sp. by the U.S. Department of Agriculture.

6 MISCELLANEOUS.

Personnel. Dr. D.V. Liyanage, Botanist, assumed duties in April, 1965 after returning from overseas study leave.

Conferences. Dr. D.V. Liyanage was elected President of Section B of the Ceylon Association for the Advancement of Science for the year, 1965. The Presidential Address on "Plantation Tree Crops in the Tropics" was delivered at the Annual Sessions.

A paper on "Breeding, selection and propagation of coconut palms" by D.V. Liyanage and M.A.P.P. Manthriratne was presented at a symposium held at the 21st Annual Sessions of the C.A.A.S. in December, 1965.

Radio talks on "Planting Material in Coconuts" were broadcast over Radio Ceylon both in Sinhala and English.

Publications. Manthriratne, M.A.P.P., Coconut Pollen. Ceylon Coconut Quarterly Vol. 16, Nos. 3 and 4.

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

Ceylon Cocon. Quart. (1966) 17, 114-133

REPORT OF THE SOIL CHEMIST

A. FIELD EXPERIMENTS

1. 3 × 3 × 3 NPK factorial experiment (Bandirippuwa Estate)

This experiment was terminated in December 1965 at the conclusion of its 30th year. As in the previous years, the potash response for copra yields continued to be highly significant. But the phosphate response failed to reach statistical significance—except in the number of nuts produced.

Leaf samples were taken from the experimental palms for chemical analysis in March 1965. Nut water was also sampled from each plot for the six picks in 1965 for chemical analysis (see under "Laboratory Investigations" below).

2. Manurial × Cultivation Experiment (Ratmalagara Estate)

(see CRI Annual Report for 1959 for details of treatment and design).

This experiment which completed its 22nd year in July 1965 continued to show a highly significant response to phosphate for the manurial year 1963/64. But there was no response to potash or ploughing. Previously, phosphate was tested at two levels—zero, and 1 lb. P_2O_5 (P_1) per palm biennially, while potash was tested at three levels—zero (Ko), 1 lb. K_2O (K_1), and 2 lbs. K_2O (K_2) per palm biennially. Ploughing was done to a depth of 6 inches biennially. All palms were given a basic dose of 3 lbs. ammonium sulphate per palm biennially. In May 1965 the experimental treatments were modified as follows:—

Previous P_0 plots ——————> P_1 — phosphate being given at the rate of 5 lbs. saphos phosphate (1.37 lbs. P_2O_5) per palm per annum.

Previous P_1 plots ——————> P_0 (zero phosphate).

Previous K_0 plots ——————> K_2 — potash being given at the rate of 5 lbs. muriate of potash (50%) (2.5 lbs. K_2O) per palm/annum.

Previous K_2 plots ——————> K_0 (zero potash).

Previous K_1 plots were given potash at the rate of 2½ lbs. muriate of potash (1.25 lbs. K_2O) per palm annually.

The basic dose of ammonium sulphate given to all palms was increased to 5 lbs. ammonium sulphate per palm per annum. The treatment for cultivation plots was modified to sub-soiling to a depth of 18 inches followed by ploughing to a depth of 10-12 inches, annually.

The objects of these modifications are to study the effects of deep cultivation, to see how quickly nutrient starved plots could be revived by high rates of manuring, and to study the rate of deterioration when manuring is suspended.

3. 3 × 3 × 3 NPK experiment on young plams (Ratmalagara Estate)

(see CRI Annual Report for 1959 for details of treatment and design).

The 17th annual manuring of this experiment was carried out in December 1965, with the following modifications:—

(i) The annual rates of nitrogen application which had been previously zero (N_0), 1½ lbs. (N_1) and 3 lbs. (N_2) ammonium sulphate per palm were changed to 1½ lbs., 3 lbs. and 4½ lbs. ammonium sulphate respectively.

(ii) The annual rates of phosphate application which had been previously zero (P_0), 1½ lbs. (P_1) and 3 lbs. (P_2) Saphos phosphate per palm were changed to 1 lb., 2 lbs. and 3 lbs. saphos phosphate respectively.

(iii) The annual rates of potash applications which had been previously zero (K_0), 1½ lbs. (K_1) and 3 lbs. (K_2) muriate of potash (50%) per palm were changed to 1½ lbs., 3 lbs. and 4½ lbs. muriate of potash respectively.

All fertilizer applications were done in full circles in the entire area round the palm upto a distance of 5½ feet from the bole.

The yield data for the main effects of N, P and K for 1965 are given in Table I. All three nutrients have again given a highly significant yield increase (P.001). As in the previous year both the NP and NK interactions have also proved to be highly significant (P.01) See Table II.

TABLE I

Yield data for 1965—3^3 NPK experiment on young palms (Ratmalagara Estate)

(55 palms/acre)

Treatment (annual)	*Lbs. copra/ acre*	%	*Difference lbs. copra/ acre*	*Copra out-turn nuts/ candy*
N_0 (no nitrogen) ..	1668	100	—	1022
N_1 (1½ lbs. ammonium sulphate)	2090	125	+ 422***	1036
N_2 (3 lbs. ammonium sulphate)	2195	132	+ 527***	1082
P_0 (no phosphate)	1377	100	—	1019
P_1 (1½ lbs. saphos phosphate)	2317	168	+ 940***	1046
P_2 (3 lbs. saphos phosphate)	2259	164	+ 882***	1072
K_0 (no potash)	1849	100	—	1099
K_1 (1½ lbs. muriate of potash)	1954	106	+ 105	1046
K_2 (3 lbs. muriate of potash)	2151	116	+ 302**	1009

Significant difference at P.05 = 157 lbs/acre.

***Significant at P.001

**Significant at P.01

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TABLE II

Lbs. copra/acre

	N_0	N_1	N_2
K_0	1687	1915	1942
K_1	1607	2095	2158
K_2	1708	2259	2484
	P_0	P_1	P_2
K_0	1315	2123	2107
K_1	1277	2272	2312
K_2	1539	2556	2357
	P_0	P_1	P_2
N_0	1282	1899	1822
N_1	1508	2448	2314
N_2	1341	2604	2639

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

(see CRI Annual Reports for 1959 and 1964 for details of treatment and design).

The 7th year of this experiment was concluded in June 1965. As in the previous years all fertilizer treated plots gave significantly higher yields than the unfertilized plots. Once again there was no difference between inorganic and organic fertilizers, but cattle manure supplemented with potash and phosphate was better than the other two treatments.

There was no significant difference observed between annual and biennial manuring. The yield data for the year ending June 1965 is given in Table III.

TABLE III

Yield data for the year ending June 1965, experiment on organics vs. inorganics, Marandawila Estate

Copra yields adjusted by covariance analysis

(60 palms/acre)

	Lbs. copra/ acre	*Difference in lbs. copra/acre from control*	*Copra out-turn nuts/ candy*
Control	2038	—	1137
Inorganics annually	2563	+ 525	1094
Inorganics biennially	2545	+ 507	1022
Organics annually	2612	+ 574	1034
Organics biennially	2621	+ 583	1080
Cattle manure with supplements	2908	+ 870	1031

5. 4 × 4 × 4 NPK Experiment on adult palms (Bandirippuwa Estate)

(see CRI Annual Report 1960 for details of treatment and design).

The 6th annual manuring was done in December 1965. The yield data for the 5th year (1965) given in Table IV show a highly significant response to the applications of nitrogen and potash. For the first time the response to phosphate application has also shown s tatistical significance. The NK and PK interactions were also significant. The main effects and NK and PK interactions are shown in Tables IV and V.

TABLE IV

Yield data for 1965—4^3 NPK experiment on adult palms (Bandirippuwa Estate)

66 palms/acre

(*Copra yields adjusted by covariance analysis*)

Treatment (annual)	*Lbs. copra/acre*	%	*Difference in lbs. copra/acre*
N_0 (0.0 lbs. N)	1642	100	—
N_1 (0.5 lbs. N)	1780	108.5	+ 138*
N_2 (1.0 lbs. N)	1826	111	+ 184*
N_3 (1.5 lbs. N)	1811	110	+ 169*
P_0 (0.0 lbs. P_2O_5)	1744	100	—
P_1 (0.5 lbs. P_2O_5)	1708	98	− 36
P_2 (1.0 lbs. P_2O_5)	1740	99.5	− 4
P_3 (1.5 lbs. P_2O_5)	1870	107	+ 126*
K_0 (0.0 lbs. K_2O)	1498	100	—
K_1 (0.5 lbs. K_2O)	1792	120	+ 294***
K_2 (1.0 lbs. K_2O)	1876	125	+ 378***
K_3 (1.5 lbs. K_2O)	1894	126	+ 396***

Significant difference P.05 = 117 lbs. copra/acre.

*Significant at P.05

***Significant at P.001

TABLE V

Adjusted interactions—lbs. copra/acre

	N_0	N_1	N_2	N_3
K_0	1500	1453	1559	1492
K_1	1712	1742	1798	1934
K_2	1586	2045	1953	1935
K_3	1780	1899	2005	1900
	P_0	P_1	P_2	P_3
K_0	1528	1452	1378	1648
K_1	1763	1684	1748	1988
K_2	1858	1880	1830	1950
K_3	1833	1828	2015	1906

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

(see CRI Annual Report for 1961 for details of treatment and design).

The 4th year of this experiment was completed in December 1965. The 5th annual manuring was carried out in November 1965. Hitherto, there had been no difference between the methods of circular trench manuring (3 ft. wide trench 3 ft. away from the palm and 6 inches deep) and surface application of fertilizer in a 3 ft. wide circular strip 3 ft. away from the palm. Hence the trench placement was altered to surface placement in the entire area round the palm up to 6 ft. from the bole and digging over with mammoties. Previous studies using radioactive phosphorus indicated that this area had the highest density of absorbing roots. The above modification should help to determine whether fertilizer placement in this area would lead to more efficient utilization.

Soil samples taken from the limed plots had a pH of about 7 in the top 0-9 " soil, but in the subsoil the pH was still at 4.5. A further application of lime at 13½ cwt/acre (30 lbs. per square) was therefore done in December 1965. The entire experimental area was disc ploughed after the liming. The limed plots have so far received a total of about 3½ tons lime/acre over the four year period 1961-65.

The yield data for 1965 showed a significant response to liming, an increase of about 118 lbs. copra/acre (see Table VI). It is yet premature, however, to assess whether liming would give an economic return.

TABLE VI

Yield data for 1965—experiment on fertilizer placement and liming Walahapitiya Estate

(*Yield adjusted by covariance analysis*)

(50 palms/acre)

Treatment	*Lbs. copra/acre*	%	*Difference lbs. copra/acre*
O (no fertilizer)	1314	100	—
B (broadcast)	1502	114	+ 188**
C (circular trenches)	1549	118	+ 235***
S (Spread on surface in circular strips) ..	1559	119	+ 245***
	Significant difference P 05 = 68 lbs. copra/acre		
L_0 (no lime)	1410	100	—
L_1 (lime)	1528	108.5	+ 118*
	Significant difference P.05 = 69 lbs. copra/acre		
O (no fertilizer)	1314	100	—
F_1 (3½ lbs. NPK mixture)	1518	115	+ 204
F_2 (7 lbs NPK mixture)	1528	116	+ 214

* Significant at P.05
** Significant at P.01
*** Significant at P.001

The experimental results also indicated a significant placement × level of fertilizer interaction—the difference between broadcast application of fertilizer and the other two methods of application being most marked in favour of the latter methods at the lower level of fertilizer application (F_1).

7. 4 × 4 × 4 NPK experiment on young palms, Pothukulama Estate

(see CRI Annual Report 1961 and 1963 for details of treatment and design).

At the end of 1965 the palms in this experiment were 5 years old and about 50% of the total of 2639 palms had come into flower—compared to 16% in 1964. The half yearly manurings were done in June and November 1965.

Table VII gives the number of palms in flower according to the different treatments. It is seen that all three nutrient elements, N, P and K, had helped to promote flowering even on this comparatively rich soil which had been under jungle before the palms were planted.

TABLE VII

4^3 NPK experiment on young palms, Pothukulama Estate Palms in flower at the end of 1965

Treatment	*Number of palms in flower*	%
N_0	141	100
N_1	159	113
N_2	164	116
N_3	156	111
P_0	149	100
P_1	150	101
P_2	159	107
P_3	162	109
K_0	139	100
K_1	153	110
K_2	154	111
K_3	174	125

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

(see CRI Annual Reports for 1960-61 and 62).

These trials were closed down in 1965 at the end of their 8th year. The application of magnesium continued to give marked increase in yields.

9. Leaf Scorch problem, Gonapinuwela area

(see also CRI Annual Reports 1961 to 1964).

In October 1963, 220 diseased palms and an equal number of healthy palms were selected at Kirimetiya estate for differential manurial treatment. All palms were subject to biannual application of 5 lbs. C.R.I. Mixture "C" (ammonium sulphate, saphos phosphate, and muriate of potash 50% in ratio 5 : 5 : 6) and 1½ lbs. kieserite. The effects of biannual applications of sulphur, (10 lbs. elemental S per palm), borate (1 lb./palm) copper sulphate, and sulphates of iron, zinc and manganese (at the rate of 1 lb. of each) were tested with and without lime (25 lbs./palm biannually) on groups of 20 palms, healthy, and diseased. Groups of ten palms amongst the diseased and healthy palms were treated with cattle manure and supplements with and without lime.

At the end of 1965, 4 diseased palms out of the original group of 220 had died, while 25 out of the original group of 220 healthy palms showed mild symptoms of disease. However, the average yield had increased from 38 nuts/palm in 1964 to 43 in 1965 for diseased palms, while the corresponding figures for the healthy palms were 65 and 84 respectively. The diseased palms were observed to be poorer in female flower production, nut production, and copra outturn than healthy palms. Other characteristics of diseased palms are tapering of trunks, and elongation of nuts. The latter was observed in the early stages, while tapering set in with time. It is yet premature to judge whether any of the various manurial treatments would help to restore diseased palms, or make healthy palms less susceptible to leaf scorch. Census on the condition of palms were taken at six monthly intervals, and records of nuts, weight of nuts and female flowers of individual palms were kept for the two-monthly picks.

Leaf and root samples were taken from diseased and healthy palms at Kirimetiya estate for chemical analysis.

10. Experiment on nitrogen quality, Mawatte Estate, Dankotuwa (Co-operative Experiment)

(see CRI Annual Report 1964 for details of treatment and design).

This experiment completed its first year in December 1965. The annual, and biannual manurings were done according to schedule.

11. Experiment on nitrogen and phosphorus quality and frequency of application—Pothukulama

Seedlings were planted for this experiment on a 30 acre jungle clearing in May 1965. Owing to a long drought, growth of seedlings was poor. Hence the differential manuring was postponed.

B. SOIL SURVEYS

(Report submitted by Mr. K. S. O. Perera, Technical Assistant, Soil Survey Unit).

The soil survey of the Galle, Matara and Ambalantota 1" sheets were the chief projects for the year. The Galle and Matara sheets were completed.

Soil Survey of the Galle 1" sheet:—The mapping of the above sheet was continued upto Ahangama.

Climate and Vegetation:—Average annual precipitation was between 100"-125". Coconut is the dominant crop in the narrow coastal plain, the chief crops being rubber and tea in the higher elevations.

Geomorphology:—The following landform systems were studied:—

I. The flat coastal plain.

II. Coastal plain—rounded ridge and broad valley, relief low to moderate.

III. High relief, ridge-narrow valley system of the South Western ranges.

Geology:—Rocks were predominantly charnokites. Rocks of the highly folded area of high relief were calc rocks.

Soil Classification:—The Baddegama Series developed on the landform system II (Rounded ridge—broad valley).

Soils resting on C horizon of fully developed laterite, the latter in turn passing abruptly to parent rocks.

The series, though mapped as a unit, show local variations to a well drained granular Ratmehera type and to the imperfectly drained slightly more clayey Monrovia type. (Profile description c.f. Soil survey of the Ambalangoda 1" sheet Annual Report 1964).

Kahawa Series:—Soils of the landform system I. (Flat Coastal plain). Soils rest on a calcareous layer of marine origin.

0-13" 10 YR 5/3 fine sandy loam, slightly sticky and plastic.

13"-30" 10 YR 6/6—fine sandy loam, slightly sticky and plastic.

30"-44" 10 YR 7/2 fine sandy clay.

44"—down—calcareous fossils of marine origin.

Drainage:—Moderately well drained.

Land Use:—Extensive coconut lands are found in the series. Where the soils were highly calcareous as at Koggala, the palms were adversely affected.

Galle Catena:—Soils of the high relief land system of the tea and rubber belt.

Ginganga Series:—Alluvial, poorly drained soils of the Ginganga basin.

Land Use:—Paddy cultivation.

Soil Survey of the Matara 1" Sheet

Climate and Vegetation:—The heavy rainfall belt of 75"-100" was separated from the low belt 75"-50" by a line passing through Matara, Kekanadura and Denegama.

The chief planted crop is coconut, and it occupies a very considerable area of the sheet.

Geomorphology:—The following land forms were studied:—

(i) The flat coastal plain of the Kahawa type ending at Nilwala ganga.

(ii) The gently rolling mantle plain stretching towards Tangalle.

(iii) The land form of low to moderate relief of rounded ridge and broad valleys.

(iv) The alluvial plain of the Nilwala ganga and Kekanadura tank.

(v) The landform of high relief, the high ridge-narrow valley system.

Geology:—The rocks of the Matara sheet consist predominantly of charnokites. Biotite gneisses are found towards the North of Walasmulla.

Soil Classification:—The soils fo the flat coastal plain (Landform unit—I) were the imperfectly drained sandy soils, with calcareous deposits of the *Kahawa series*.

Baddegama Series:—Soils developed on landform system II (Rounded ridge valley).

The deep red lateritic soils, developed on a completely laterised C horizon were mapped within the rainfall boundary 75"-100" passing from Matara to Kekanadura and Denegama.

The Dandeniya Series:—Soils developed on landform system II (Rounded ridge valley).

These soils are developed within the rainfall boundary 50"-75", on the same landform system as the Baddegama Series. The soils are yellow lateritic soils, with incomplete laterization of the C horizon, where rounded boulders and blocky ironstone were evident.

The following is a profile description:—

Site—Daminangoda—Drainage—Imperfect.

0-10" Sandy clay loam, sticky, plastic, 10 YR (Yellow).

10"-42" Gravelly clay loam, slightly sticky and plastic gravels ferruginous nodules.

42" down—Semi decomposed rounded large nodules in yellow lateritic profile.

Walasgala Series:—Developed on landform system II. (rolling mantle plain) well drained, deep soils.

0-43" coarse sandy clay loam 7.5 YR (Reddish) friable, peds angular blocky, sticky plastic—roots common.

43"-70" 7.5 YR. gravelly clay loam gravel—ferruginous nodules.

Land Use:—Good coconut lands are present in this series.

Kekanadura Series:—Developed on landform system IV, the alluvial plain of the Nilwala and Kekanadura depression.

Drainage—Imperfect to moderate.

0-22"—10 YR (yellowish), clay loam.

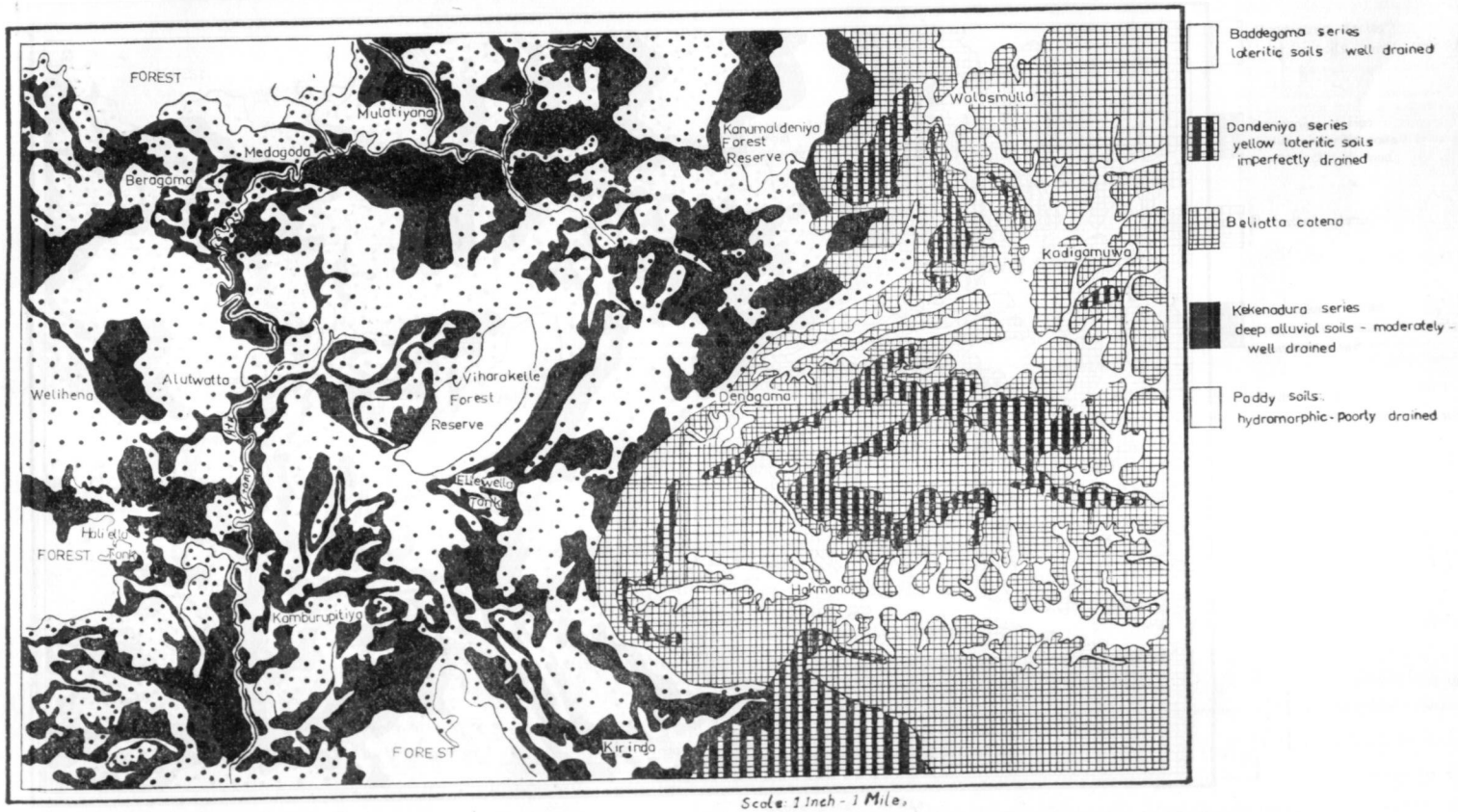
22" below—sandy clay.

Land Use:—Coconut trees showed signs of yellowing.

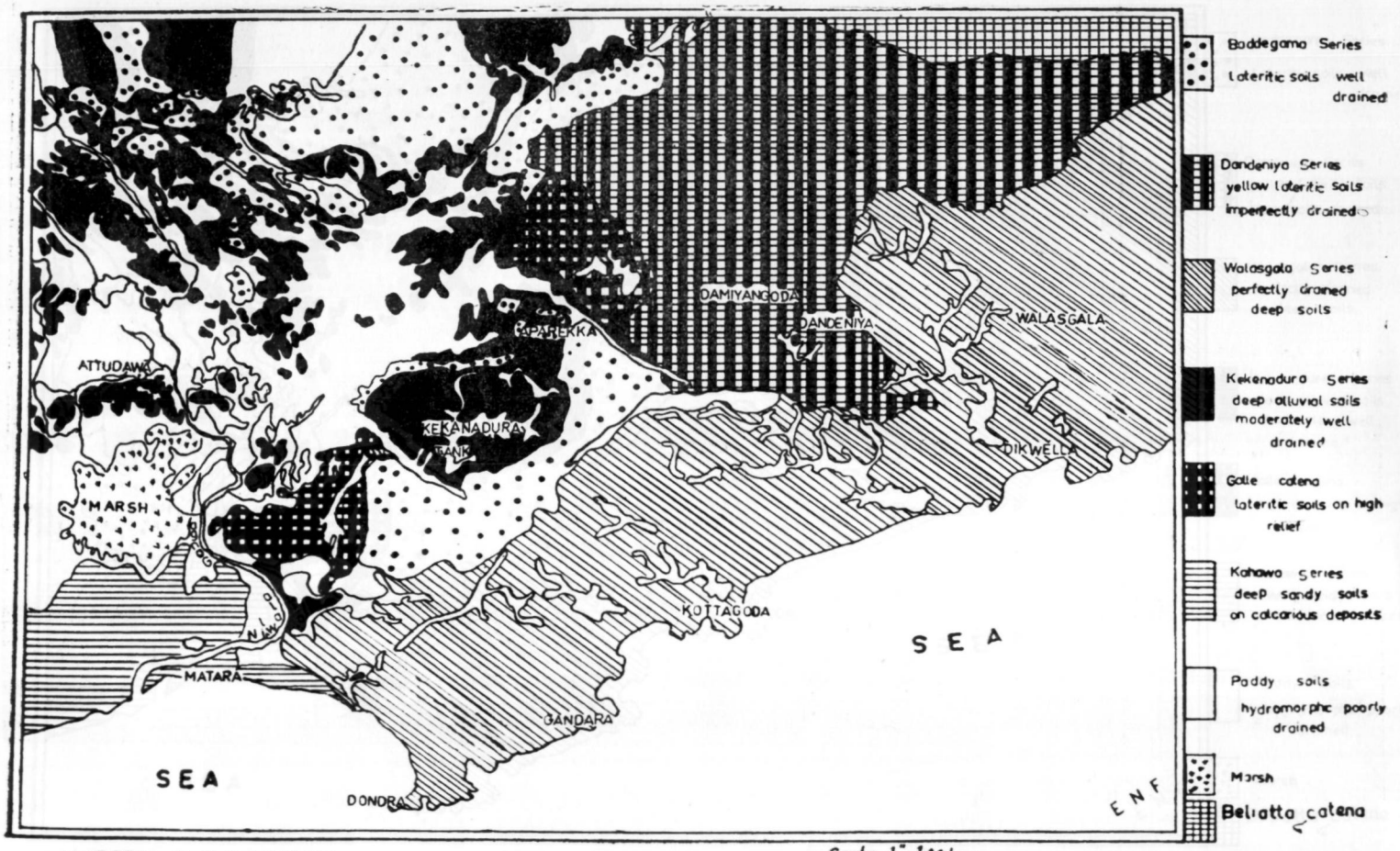
Beliatta Catena:—Soils developed on rounded elongated ridges, and broad U shaped valleys. Soils on the ridges are moderately well drained gravelly loams. Soils in the valleys are imperfectly drained alluvial soils.

Detailed survey of the catena still proceeding.

MATARA SOIL MAP (Upper section)



MATARA SOIL MAP (Lower section)



MAPPED- K S.O PERERA

Scale 1" 1 Mile

C. LABORATORY INVESTIGATIONS

Owing to the absence of the Research Assistant who was away on post-graduate study leave in U.K., and the resignations of two trained graduate Technical Assistants in February 1965, little progress was made in our laboratory investigations. Work was confined to leaf analytical studies.

1. Magnesium deficiency and nutrient imbalance in coconuts

(Report submitted by Mr. M. A. T. de Silva, Senior Technical Assistant).

Two sets of leaf samples (6th frond) were taken from various treatment groups of the magnesium deficiency trials of Walgama Estate and Mattegoda Estate. In these samples, the potassium, calcium and magnesium contents were determined in the usual manner. The analytical data are summarised in Tables I and II for Mattegoda Estate and Walgama Estate respectively. These tables give the mean leaf nutrient content of each group, (i) on an absolute basis as milliequivalents per 100 gm. of oven-dry plant material, and (ii) on a relative basis, as a percentage of each nutrient to the total nutrient i.e. K. + Ca + Mg. The latter ratio is referred to as the nutrient to total ratio, to distinguish it from the K/Mg ratio, which is a nutrient to nutrient ratio.

The results provide two apparently different situations for the two estates which show magnesium deficiency. The soil at Mattegoda Estate does not appear to be inherently deficient in magnesium, as evidenced by the fact that the samples from the control group show a higher content of this nutrient. This higher uptake of magnesium, induced by the withdrawal of potassium has also cured a fair number (14 out of 40 palms) of yellowed palms without any extra application of magnesium. But the fact that in group B, receiving NPK only, the recovery was very poor (i.e. 2 out of 40 palms), clearly demonstrates that the problem of yellowing at Mattegoda is not due to a soil inherently deficient in magnesium but due to the inhibitory effects of excess potassium on the uptake of magnesium. It is possible that the level of available soil magnesium (inherent) is now at a cirtical level when excess of potassium can cause antagonistic effects on the uptake of the former.

It is also observed that the magnesium to total ratio reaches a ceiling value of about 21%, both in the Mg + NPK treated groups and also in the healthy green palm receiving NPK only.

Walgama Estate on the other hand appears to be severely deficient in both potassium and magnesium, as evidenced partly by the significantly high compensatory uptake of calcium in the control group, and partly by the failure of either the potassium or magnesium ratio to increase in the control group. Here therefore only the addition of magnesium itself could restore the Mg to total ratio to approximately 21%. Those groups that received magnesium and attained a ratio of about 21% have mostly turned green, whereas the "Controls" and the NPK only group, that gave a very low ratio, showed practically no signs of recovery.

TABLE I

Mattegoda Estate

Mean leaf nutrient content in palms for different treatments

Treatment	*Potassium m.e./100 grms.*	*Calcium m.e./100 grms.*	*Magnesium m.e./100 grms.*	*K+Ca+Mg m.e./100 grms.*	$\frac{K \times 100}{K+Ca+Mg}$	$\frac{Ca \times 100}{K+Ca+Mg}$	$\frac{Mg \times 100}{K+Ca+Mg}$	*K/Mg*
Group: Green								
NPK (5 lbs.) only	39.78	10.72	12.56	63.06	62.27	17.56	20.17	3.176
Group A: yellow								
Control	26.22	14.97	27.08	68.27	38.27	22.11	39.90	1.059
Group B: yellow								
NPK (5 lbs.) only	27.80	14.00	10.85	52.65	52.72	26.52	20.68	2.664
Group C: yellow								
NPK (5 lbs.) + $MgSO_4$ (454 gm.)	35.66	12.88	12.27	60.81	58.59	21.33	20.28	2.935
Group D: yellow								
NPK (5 lbs.) + Dolomite (408 gm.)	35.86	13.32	15.33	62.51	57.16	21.37	21.48	2.736
Group E: yellow								
Cattle manure + PK supplements	37.42	10.63	13.32	61.37	60.11	17.86	22.02	2.923

TABLE II

Walgama Estate

Mean leaf nutrient content in palms for different treatments

Treatments	*Potassium* m.e./100 grms.	*Calcium* m.e./100 grms.	*Magnesium* m.e./100 grms.	*K+Ca+Mg* m.e./100 grms.	$\frac{K \times 100}{K+Ca+Mg}$	$\frac{Ca \times 100}{K+Ca+Mg}$	$\frac{Mg \times 100}{K+Ca+Mg}$	*K/Mg*
Group 1 : yellow Control	20.14	27.24	5.78	53.16	37.65	51.59	10.77	4.196
Group 2 : yellow NPK (5 lbs.) only	46.62	16.77	4.01	67.40	69.71	24.39	5.90	13.63
Group 3 : yellow NPK (5 lbs.) + $MgSO_4$ (1 lb.) ..	32.90	19.71	14.57	67.18	49.10	29.40	21.41	2.416
Group 4 : yellow NPK (5 lbs.) + $MgSO_4$ (2 lbs.) ..	34.88	12.51	15.36	62.75	54.83	20.24	24.93	2.494
Group 5 : yellow NPK (5 lbs.) + $MgSO_4$ (3 lbs.) ..	32.56	11.40	13.76	57.72	56.89	19.51	24.40	2.457

It is observed therefore that for all green palms either originally healthy or subsequently recovered the Mg to total ratio in the 6th frond has a ceiling value of about 21%, while the K/Mg ratio for palms of similar status reaches a higher ceiling value of 3: 1.

Thus due to the K-Mg interaction, the absolute leaf magnesium content does not give a true assessment of its availability in the soil. On the other hand the Mg to total ratio, or the K/Mg ratio offer better criteria, and are hopeful indices for evaluating the nutrient balance in palms, and possibly for the diagnosis of yellowing disease long before the symptoms appear.

Our previous work on leaf magnesium of coconut had indicated that the absolute magnesium content of the 6th frond to be of diagnostic value. (See Annual Report CRI 1963). This apparent contradiction is however due to the fact that our earlier studies on leaf magnesium of coconut were confined to plants receiving the normal NPK fertilizer, which resulted in overlooking the part played by potassium.

2. Leaf composition in relation to fertilizer response in young palms at Pothukulama and Ratmalagara Estates

Leaflets were sampled in May 1964 from the 1st, 4th and 7th fully opened fronds of 4 year old palms in the 4 × 4 × 4 NPK experiment at Pothukulama. Samples were taken from each experimental palm and composite samples made for each of the 64 plots (18 palms per plot). In 1965 the chemical analysis of samples for N, P, K, Ca and Mg were completed.

In this experiment, small but distinct responses were obtained to applications of nitrogen and potassium (as shown by leaf production and early flowering). But there was no marked response to phosphorus. As indicated previously (C.R.I. Annual Report 1964) the poor response to phosphorus was due to the presence of adequate soil phosphorus. The response to N and P was less pronounced than that obtained in the 3 × 3 × 3 NPK experiment at Ratmalagara (planted 1948). Table 3 shows the main effects of N, P and K on leaf production in the 4th year of age of the Pothukulama and Ratmalagara palms.

TABLE III

Fourth year leaf production in young palms at Pothukulama and Ratmalagara

Treatment	*POTHUKULAMA* (1964)		*RATMALAGARA* (1952)	
	Leaves/palm	%	*Leaves/palm*	%
N_0 (no nitrogen)	11.94	100	6.55	100
N_1 (0.5 lbs. ammonium sulphate)	12.43	104	6.95	106
N_2 (1.0 lb. ammonium sulphate)	12.56	105	7.02	107
N_3 (1.5 lbs. ammonium sulphate)	12.06	101	—	—
P_0 (no phosphate)	12.09	100	6.05	100
P_1 (0.5 lbs. saphos phosphate)	12.10	100	7.33	121
P_2 (1.0 lbs. saphos phosphate)	12.21	101	7.15	118
P_3 (1.5 lbs. saphos phosphate)	12.58	104	—	—
K_0 (no potash)	11.90	100	6.79	100
K_1 (0.5 lbs. muriate of potash) (50%)	12.11	102	6.79	100
K_2 (1.0 lbs. muriate of potash) (50%)	12.39	104	6.97	103
K_3 (1.5 lbs. muriate of potash) (50%)	12.59	106	—	—

It will be seen that the Pothukulama palms even without any fertilizer treatment had better vegetative growth than the Ratmalagara palms at a corresponding age (4 years). This indicates that the soil conditions were comparatively superior at Pothukulama. The leaf analytical figures for the 7th leaf in Table IV reflect the pattern of response to fertilizer application at Pothukulama. For comparison, the leaf analysis figures for the 7th leaf of palms in the $3\times3\times3$ NPK experiment at Ratmalagara are shown in Table V. The leaflets were sampled when the palms were 4 years old (January 1952). It will be seen that the N, P and K contents of leaves from the N_0, P_0 and K_0 plots respectively at Ratmalagara are considerably lower than those of leaves from corresponding plots at Pothukulama. This is in accordance with the differences in the pattern of response to N, P and K application at Pothukulama and Ratmalagara.

TABLE IV

4^3 NPK experiment, Pothukulama—composition of leaflets from 7th frond sampled from 4 year old palms (May 1964)

% element on oven dry basis

Treatment	*N*	%	*P*	%	*K*	%	*Ca*	%	*Mg*	%
N_0	2.15	100	0.137	100	1.96	100	0.355	100	0.295	100
N_1	2.21	103	0.139	102	2.06	105	0.373	105	0.307	104
N_2	2.18	101	0.137	100	2.00	102	0.355	100	0.305	104
N_3	2.18	101	0.139	102	2.00	102	0.368	104	0.308	105
P_0	2.14	100	0.131	100	2.06	100	0.361	100	0.302	100
P_1	2.17	101	0.138	105	1.98	96	0.365	101	0.310	103
P_2	2.17	101	0.137	104	1.99	97	0.377	104	0.301	100
P_3	2.24	105	0.146	111	1.98	94	0.346	96	0.303	100
K_0	2.15	100	0.136	100	1.88	100	0.378	100	0.322	100
K_1	2.17	101	0.142	104	2.00	107	0.360	95	0.303	94
K_2	2.21	103	0.138	101	2.05	108	0.351	93	0.300	93
K_3	2.19	102	0.136	100	2.11	112	0.360	95	0.290	90

TABLE V

3^3 NPK experiment, Ratmalagara—composition of leaflets from 7th frond sampled from 4 year old palms (January 1952)

% element on oven dry basis

Treatment	*N*	%	*P*	%	*K*	%	*Ca*	%	*Mg*	%
N_0	1.65	100	0.110	100	1.75	100	0.463	100	0.255	100
N_1	1.71	103	0.120	109	1.74	99	0.490	106	0.267	105
N_2	1.78	108	0.115	105	1.72	98	0.496	107	0.239	94
P_0	1.71	100	0.103	100	1.80	100	0.459	100	0.213	100
P_1	1.72	101	0.122	118	1.71	95	0.497	108	0.280	130
P_2	1.72	101	0.119	115	1.70	95	0.494	108	0.261	122
K_0	1.79	100	0.116	100	1.62	100	0.509	100	0.277	100
K_1	1.71	96	0.114	98	1.75	108	0.456	90	0.244	88
K_2	1.64	92	0.115	99	1.83	113	0.485	95	0.233	84

It appears that for 4 year old palms the optimum leaf composition in the 7th frond should be about 2.2% N, 0.14% P, and 2.1% K.

The leaf analytical figures clearly demonstrate the K-Mg antagonistic effect. At Pothukulama, where soil Mg seems to be at a comparatively high level, phosphate application has not had a noticeable effect on leaf Mg. But at Ratmalagara, leaf Mg has increased with phosphate application.

The rates of manuring at Ratmalagara appear to have been inadequate to produce the maximum benefits.

3. Leaf and Nut Water analysis—3^3 NPK experiment at Bandirippuwa Estate

In March 1965 leaflets were sampled from the 14th frond of palms in the 3×3×3 NPK trial at Bandirippuwa. Samples were taken from every experimental palm. The samples from each plot were bulked to form a composite sample. The dried samples were despatched to I.R.H.O., Paris, to whom we are deeply indebted for the chemical analysis given in Table VI.

In accordance with the pattern of yield response (Table VII), the level of N in the leaf samples has not been affected by the application of nitrogen fertilizer, while the levels of K and P have increased with the application of potash and phosphate respectively to the soil. The K levels are rather low, and it would seem that a higher rate of K application would have increased yields. K applications have increased N and P and decreased Mg contents of leaves. P applications have increased the N and Mg contents of leaves.

A summary of nut-water analysis for 1965 (mean of 6 picks) is given in Table VIII. As in the leaf samples, N application has not affected the N concentration in nut water, and K and P applications have increased N in nut water. The levels of K and P in nut water have been increased with the application of potash and phosphate respectively.

TABLE VI

3 × 3 × 3 NPK experiment at Bandirippuwa Estate—analysis of 14th leaf samples from adult palms—(sampled in March 1965)

% element on oven dry basis

Treatment	*N*	%	*P*	%	*K*	%	*Ca*	%	*Mg*	%	*Na*	%
N_0	1.91	100	0.129	100	0.489	100	0.381	100	0.294	100	0.192	100
N_1	1.93	101	0.128	99	0.460	94	0.397	104	0.270	92	0.187	97
N_2	1.94	102	0.124*	96	0.429	88	0.419*	110	0.283	96	0.162*	84
P_0	1.90	100	0.116	100	0.546	100	0.352	100	0.257	100	0·189	100
P_1	1.93	102	0.130**	112	0.445**	82	0.414**	118	0.289**	112	0.179	95
P_2	1.96*	103	0.134**	116	0.387**	71	0.431**	122	0.301**	117	0.173	92
K_1	1.89	100	0.122	100	0.269	100	0.418	100	0.327	100	0.148	100
K_2	1.96**	104	0.129**	106	0.450**	167	0.399	95	0.274**	84	0.195**	132
K_3	1.94*	103	0.129**	106	0.659**	245	0.380*	91	0.246**	75	0.198**	134

* Significant at P.05 ** Significant at P.01

TABLE VII

3^3 NPK experiment, Bandirippuwa Copra yields in lbs./acre for 1965

Treatment	*Lbs./copra acre*	%
N_0	1747	100
N_1	1806	103
N_2	1722	99
P_0	1671	100
P_1	1791	105
P_2	1812	108
K_1	1563	100
K_2	1800	115**
K_3	1911	122**

** Significant at P.01

TABLE VIII

3^3 NPK experiment, Bandirippuwa Estate—Nut Water analysis (1965)

Treatment	*N gm/lit.*	%	*P_2O_5 gms/litre*	%	*K_2O gms/litre*	%
N_0	1.128	100	1.718	100	9.623	100
N_1	1.108	98	1.684	98	9.453	98
N_2	1.26	100	1.697	99	8.836	92
P_0	1.111	100	1.557	100	10.200	100
P_1	1.102	99	1.734	111	9.137	90
P_2	1.148	103	1.808	116	8.575	84
K_1	1.113	100	1.717	100	6.939	100
K_2	1.105	99	1.720	100	9.550	138
K_3	1.144	103	1.663	97	11.423	165

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4. Composition of leaf samples from chlorotic palms at Irrenewila Estate, Chilaw

In spite of regular manuring with CRI mixtures, palms on the coastal sandy blocks of Irrenewila Estate, Chilaw, are in a poor chlorotic condition. The chlorosis is not characteristic of potash or magnesium deficiency. It seemed that palms treated with cattle manure had improved. Leaf samples were taken from the chlorotic and cattle manured palms from the 1st and 14th fully opened fronds for chemical analysis. The analytical figures given in Table IX indicate that the chlorotic palms are suffering from an acute deficiency of nitrogen. The nitrogen content of the 14th leaf from chlorotic palms being only 1.42% N, whereas the critical value for N is 1.8%. The palms which had turned green after cattle manure treatment had a satisfactory level of nitrogen (1.81% N). The content of K, Mg and P in leaves of chlorotic palms were satisfactory. But cattle manured palms had more K and P.

It seems that the problem of chlorosis on these soils is due to N deficiencies. Although regular applications of N had been made as ammonium sulphate it is likely that there is little or no nitrification, due to the sterile soil conditions (the soils are sandy, have no vegetative cover, and open to high temperatures and desiccation). This is a condition which is likely to have been aggravated through the continuous use of inorganic fertilizers. Field observation trials by way of foliar spraying of nitrates, soil application of nitrates, and application of organic manures to promote the growth of nitrifying bacteria have been planned to test the validity of this hypothesis which has been based on the leaf analytical data.

TABLE IX

Composition of leaves from chlorotic palms at Irrenewila Estate, Chilaw (means of 5 samples, each composed of leaflets from 5 palms)

1st Frond

(% *elements on oven dry basis*)

	N	*P*	*K*	*Ca*	*Mg*
Cattle manured palms	1.57	0.125	2.35	0.123	0.233
Chlorotic palms ..	1.32	0.114	2.15	0.148	0.249
14th frond					
Cattle manured ..	1.81	0.111	1.40	0.227	0.280
Chlorotic palms ..	1.42	0.098	1.00	0.253	0.323

5. Analysis of leaf and root samples from "leaf scorch" palms at Elpitiya and "immature nutfall" palms at Bingiriya

Leaf and root samples from "leaf scorch" palms at Kirimetiya Estate, Elpitiya, and leaf samples from immature nutfall palms at Palugaswetiya Estate, Bingiriya were analysed for both major and minor elements by the MacCaulay Institute for Soil Research, Aberdeen. The chemical analysis did not indicate that the problems of leaf scorch and immature nutfall are due to either a deficiency or toxicity of trace elements. We are grateful to the MacCaulay Institute for having carried out the analysis for us.

D. MISCELLANEOUS

1. The Soil Chemist, Dr. D.A. Nethsinghe, attended a meeting of the Consultant Group on the use of Isotopes in studies on the Fertilization of Plantation and Orchard crops held in Vienna in November 1965, on the invitation of the Joint FAO/IAEA Division of Atomic Energy in Agriculture. He presented a paper on "The application of isotopes in fertilizer research on the coconut palm" at the meeting.

2. Mr. M. A. T. de Silva, Senior Technical Assistant, presented a paper on "Magnesium deficiency and nutrient imbalance in coconuts" at the Annual Sessions of the Ceylon Association for the Advancement of Science held in December 1965.

3. Messrs. D. E. G. Nedimale, and K. Thanigasalam, Technical Assistants, resigned from their posts early in 1965—the former to take up a post at the Fisheries Corporation, and the latter to proceed to U.K.

4. Messrs. D. M. Selvanayagam and K. A. Don Anacletus assumed duties to fill the vacant posts of Technical Assistants in December 1965.

5. Messrs. K. V. W. de Silva and D. M. Pathirage were promoted to the grade of Field Assistant in 1965.

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

Ceylon Cocon. Quart. (1966) 17, 134-151

REPORT OF THE AGROSTOLOGIST

1. INTRODUCTION

During the year studies on the nutrient status of two soils were completed and that on two were commenced. In addition to these routine studies a lateritic gravel, adjacent to Bandiripuwa estate, was studied to follow the pattern of response to phosphate. An attempt was made to study the change in available phosphate and potassium in some soils with time of wetting. Another experiment was carried out to study the response of *P. commersonii* to levels of phosphate on Ratmalagara loam in pots of varying heights and diameters. Experiments on the loss of ammonia from nitrogenous fertilizers were continued.

On the competition between coconuts and pastures, in addition to the maintenance of the existing experiments, a new experiment on fertilizer placement was commenced. Ancillary studies on the management of pastures and fodders with particular reference to defoliation, nitrogen and light received considerable emphasis. A feature of interest during the latter part of the year was the laying down of plots of other crops such as paddy, ground nut, cow pea, grams, pineapple and minimal (*Vinca rosea*) for observation and seed production.

The short term experiments on the effect of types of feeds and levels of concentrates (coconut poonac) on lactating Sinhala cows were completed and such factors on the growth of weaner calves were commenced. Some of the Sinhala × Scindi crosses have come into their first lactation and the milk yields do not appear to be promising. The results of artificial insemination of the Sinhala cows with Freisian and Jersey semen could hardly be called satisfactory.

2. SOIL NUTRIENT STUDIES

Assessment of nutrient status

Gonapinuwela gravel

Experimental work on this soil is now complete, the data are being analysed and a paper will be prepared for publication shortly.

Walahapitiya gravel

An experiment to study the effect of minor nutrients (Fe, Cu, Zn, Mn and Mo) was planted on a subtractive basis to clarify the inconsistent effect of these nutrients recorded earlier (II.C. of Ann. Report 1964). None of the tested nutrients had any significant effects.

The experiment on forms of sulphur was completed. There was a significant increase in yield due to the application of sulphur both as element and as sulphates of ammonia, potassium, magnesium and hydrogen (acid) as compared to the corresponding chlorides. In the case of calcium however where the sulphate was compared to the carbonate there was either no response or a slight depression due to the sulphate, particularly in the early stages of growth,

Irranawila grey sand

The experiment on the effect of minor nutrients commenced late last year was completed. It was observed that iron depressed yields and entered into negative interactions with other nutrients, which however were not consistent. Copper, particularly at the latter stages, had some beneficial effects.

Another experiment to study the effect of different forms of calcium and nitrogen in presence and absence of sulphur was completed. The general effect may be seen from the data for the third harvest (Table I) and may be summarised as follows:—

TABLE I

	Nil			*Sulphur*		
	Nil	$Ca(OH)_2$	$CaSO_4$	*Nil*	$Ca(OH)_2$	$CaSO_4$
Nil ..	0.15	0.18	0.18	0.21	0.12	0.09
NH_4NO_3 ..	0.00	0.16	0.33	2.56	3.72	0.73
$(NH_4)_2SO_4$ ..	0.00	2.20	0.00	0.00	5.72	0.00
$CO(NH_2)_2$ ..	0.00	0.56	3.60	2.58	3.05	2.16

The effects of forms of calcium and nitrogen in presence and absence of sulphur on yield (gm. dry wt. per pot) of *Paspalum commersonii* in Irranawila grey sand.

1. In the absence of added sulphur and calcium there was little or no plant growth.

2. With the application of sulphur alone there was considerable growth in those treatments receiving $(NH_4)NO_3$ and $CO(NH_2)_2$. It is of interest to note that there was no growth in the $(NH_4)_2SO_4$ treatments.

3. In presence of lime—$Ca(OH)_2$—there was an improvement in yield, particularly in presence of sulphur. Here $(NH_4)_2SO_4$ was superior to other forms of nitrogen.

4. In presence of $CaSO_4$ there had been a drop in yield with NH_4NO_3 and $(NH_4)_2SO_4$ while $CO(NH_2)_2$ recorded highest yields.

5. These results are in conformity with the known effect of these chemicals on the pH of soils.

An experiment to determine the optimum requirements of P, K, S and Mg in a composite design has been completed and the data are bing analysed.

Keenakelle loam

Preliminary studies on this soil were commenced in 1961 (See Annual Report for 1961). It is now being followed up. In one experiment the effect of sulphur, molybdenum and boron at two levels of each and three forms of calcium are being studied. Preliminary indications are that the soil is deficient in boron and *Medicago sativa* would benefit from application of $Ca(OH)_2$ and $CaCO_3$.

In another experiment optimum requirements of P, K and Mg are being studied.

Hanwella gravel

Two experiments on the effect of major nutrients and minor nutrients on the subtractive basis were commenced on this soil.

Gurumadeniya sandy loam

Preliminary experiment were commenced late in the year and are in progress.

Kandakelle gravel

This property is close to Bandirippuwa estate with a similar gravelly soil. It was sampled to study the pattern of response to P.

In an experiment on a subtractive basis the following relative yields of P and K with time were recorded:—

TABLE II

No. of days from planting	..	22	41	63	98
Relative yield of P.	..	7	2	3	2
Relative yield of K.	..	67	76	61	15

(Relative yield for a particular nutrient is calculated as percentage of yield in absence of the nutrient to that of the complete fertilizer).

It is obvious that there was no increase in the relative yield indicating a lack of change in the high response to added P on this gravel. This would be the normal pattern of response to be expected in a soil deficient in P. It is contrary to that reported from the Bandirippuwa gravel by Paltridge and Santhirasegaram (1957). The response to K however appears to be similar in both soils.

Another experiment to study the optimum requirements of P, K, Ca and Mg on this soil was completed and the results are being analysed.

Change in the available P and K in some soils

Two soils with variable response (Bandirippuwa loam and Irranawila grey sand) and two with persistent response (Ratnalagara loam and Irranawila yellow sand) to P were kept wet for different lengths of time in glass jars and were analysed for available P and K by extracting with (*a*) H_2O, (*b*) 0.1 M $CaCl_2$ and (*c*) dil H_2SO_4.

There was no change in the concentration of P and K in the extracts of the different soils with time. The experiment however has to be repeated with certain modifications.

The changing pattern of response to P (high response at the early stages which with time changes to a depression to added P) appear to be related to phosphatic fertilizers applied to these soils in the past. A fuller account of this will be presented elsewhere.

Loss of ammonia from nitrogenous fertilizers

Rate and amount of loss

The rate of loss of ammonia from an acidic soil (Bandirippuwa loam pH 5.2) and an alkaline soil (Vanathivillu red loam pH 7.4) with the application of $(NH_4)_2SO_4$ and

$CO(NH_2)_2$ in presence and absence of added $Ca(OH)_2$ was measured over 18 days employing the technique reported in 1965 (II.f. of Annual Report for 1964). The pads of cotton wool were replaced at regular intervals.

The results are shown in Fig. I and may be summarised as follows:—

1. The rate and total loss was greater in the alkaline than in the acidic soil.
2. The application of lime ($Ca(OH)_2$) increased the amount of ammonia evolved particularly in the alkaline soil.
3. The rate of loss was high during the first week.

Soil pH and ammonia loss

The pH of these two soils were changed with the application of $Ca(OH)_2$.The relationship between the amount of ammonia lost from $(NH_4)_2SO_4$ and $CO(NH_2)_2$, and this initial pH and the pH after five days of application of nitrogenous compounds designated "reaction pH" were studied.

It was noted that the application of $(NH_4)_2SO_4$ reduced the reaction pH to slightly below that of the initial pH while $(CO(NH_2)_2$ increased it considerably. There was a very strong suggestion that the loss of ammonia from $CO(NH_2)_2$ was curvilinearly related to reaction pH regardless of the soil type. A paper based on this was presented at the 21st Annual Sessions of the C.A.A.S. (1965).

Acquaye and Cunningham (1965) employing essentially similar techniques have recorded an increase in pH on application of $CO(NH_2)_2$. They measured the pH seven days after application and designated it "final pH". It is suggested that "reaction pH" would be more appropriate than "final pH".

Nutrient response and size of pot

In view of the very strong relationship between the response curve of *P.commersonii* in pots and coconuts in the field to levels of P and K on Bandirippuwa and Ratmalagara loams (Santhirasegaram 1964), an experiment was carried out to study the P response of *P. commersonii* on Ratmalagara loam in pots of different diameters and heights. The pot sizes were:—

A. Diameter constant (6″) with varying heights.

1. Height 1.5″ wt. of soil 1000 gms.
2. ,, 3.0″ ,, 2000 gms.
3. ,, 6.0″ ,, 4000 gms.
4. ,, 9.0″ ,, 6000 gms.
5. ,, 12.0″ ,, 8000 gms.

B. Height constant (6″) with varying diameters.

1 Diameter 1.5″ wt. of soil 275 gms.
2. ,, 3.0″ ,, 1100 gms.
3. ,, 4.5″ ,, 2475 gms.
4. ,, 7.5″ ,, 6875 gms.
5. ,, 9.0″ ,, 9900 gms.

C. Control 6″ polysterene pot used in routine studies (diameter 5.5″, height 5″, wt. of soil 1875 gms.)

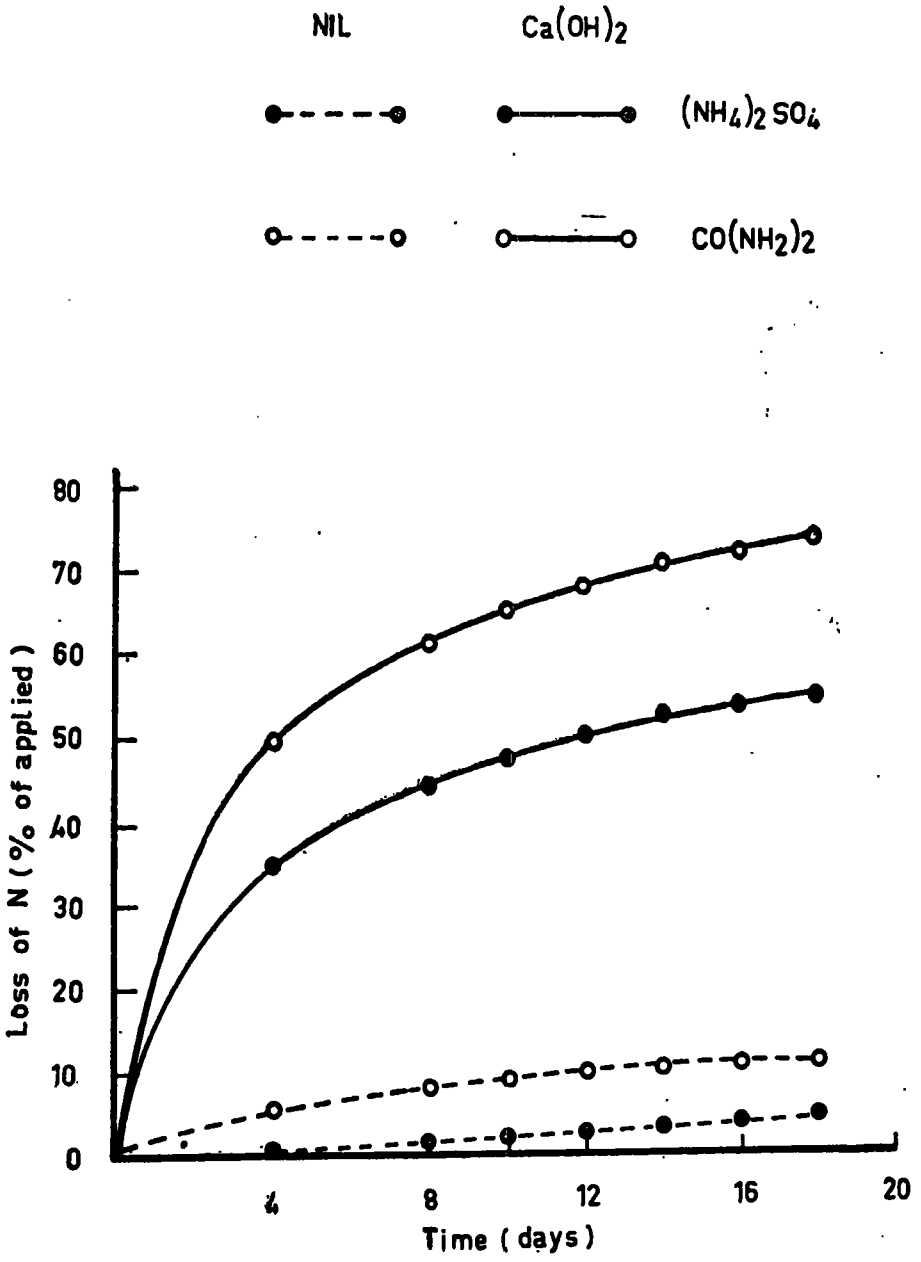
NIL
Ca(OH)2
(NH4)2 SO4
CO(NH2)2
Loss of N (% of applied)
80
70
60
50
40
30
20
10
0
4
8
12
16
20
Time (days)

Fig. 1

The levels of P tested were 0, 1, 2, 3 and 4 cwts/ac. $NaH_2PO_4.2H_2O$ applied on an area basis. A basal application of N and K at optimum levels (Santhirasegaram 1965) were made.

The experiment was harvested on two occasions. There was no difference in the response curve with the size of pot. The mean response at the two harvests may be expressed by the following equations:—

Harvest 1 : $Y = 1.0674 + 1.4502 X - 0.2164 X^2$

Harvest 2 : $Y = 0.9654 + 0.7234 X - 0.1081 X^2$

The experiment will be repeated with lower levels of P.

3. INTERCROPPING WITH COCONUTS

Effect of pasture on the yield of coconuts

Intensity of grazing and level of manuring on the yield of coconuts (P_5) R/E

This experiment has completed the second year since modification in 1963. It is yet too early to observe any definite trends. The uncorrected yield of number of nuts/ac. and herbage are presented in Table III.

TABLE III

	No. nuts/ac.	*Herbage gm. D.M./M²*
Weed control FN GO	6448	115.3
B. brizantha FN GO	3712	220.8
,, FN GN	4920	331.1
,, FN GH	3512	260.2
,, FH GN	3908	285.7
,, FH GH	4476	162.6

F = fertilizer, G = grazing, O = nil, N = normal, H = heavy

Number of nuts/ac. and D.M. yield of pasture (gm/m²) due to levels of grazing and manuring a coconut/pasture association.

Levels of nutrients (N, P and K) on coconut cum pasture association (P_{21}). R/E

This experiment commenced in 1963 has completed two years. The uncorrected yield data are presented in Table IV.

TABLE IV

Treatments	*No. nuts/ac.*	*Herbage gm. D.M./M²*
N_2 P_1 K_1	5278	261.4
N_4 P_1 K_1	4707	366.2
N_2 P_2 K_1	5975	283.5
N_4 P_2 K_1	5231	343.8
N_2 P_1 K_2	5649	295.6
N_4 P_1 K_2	4063	389.2
N_2 P_2 K_2	6127	294.9
N_4 P_2 K_2	4760	268.6

Number of nuts/ac. and D.M. yield of pasture (gm/m²)

Nut yield appear to be increased by phosphate and depressed by nitrogen. The reverse appear to hold with the grass. Potash do not show any trend.

Levels of manure × pasture management on the yield of coconuts and pastures (P_{22}). R/E

The treatments (See III. O. of Annual Report for 1964) commenced in 1964 were continued this year. The uncorrected yield data are presented in Table V.

TABLE V

Treatments	*No. nuts/ac.*	*Herbage gm. D.M./M²*
Manure ½ Mowing	5211	157.5
,, 1 ,, ...	5971	292.7
,, 2 ,, ...	5781	243.3
,, 4 ,, ...	6391	382.6
Manure ½ Grazing	5215	310.6
,, 1 ,, ...	5822	318.2
,, 2 ,, ...	6069	375 8
,, 4 ,, ...	5094	473.8

Number of nuts/ac. and D.M. yield of pasture (gm/m²)

Reduction of the level of manuring to half the normal appear to have depressed yields of both coconuts and pasture. Grazing compared to mowing appear to produce better growth of pasture particularly at the reduced level of manuring.

Pasture × manurial experiment on coconuts (P_7)B/E

The effect of the manurial treatment and the three vegetations on the yield of coconuts were essentially similar to that recorded for 1964. (II. d. of Annual Report 1964).

(i) *Yield of coconuts*:—The main effect of the treatments are shown in Table VI.

TABLE VI

Treatments	*Nuts/ac.*	*Copra lb./ac.*
N_1	3093	1481
N_2	3223	1528
N_4	3395	1552
P_1	3163	1478
P_2	3311	1562
K_1	3027	1413
K_2	3446	1627
Weeds	3517	1641
B. brizantha	2917	1392
B. miliiformis	3276	1527

Yield of coconuts (nuts/ac. and copra lb./ac.) at the various levels of treatments.

(ii) *Yield of herbage*:—The dry matter yield of the three vegetations differed at the three levels of nitrogen (Table VII).

TABLE VII

Treatments	N_1	N_2	N_4
Weeds	1123	1254	1387
B.brizantha ..	2088	2909	3595
B.miliiformis ..	2303	2573	3202

Yield of herbage (D.M., lb./ac.) of the three vegetations.

Rates of nitrogen application to coconut cum pasture association (P_{12}) B/E

This experiment a modification of an earlier trial was commenced in 1963. (See Annual Report for 1963). It is too early to expect any trends. The uncorrected yield data are shown in Table VIII.

TABLE VIII

Treatments		*Nuts/ac.*	*Copra lb./ac.*	*Herbage gm. D.M./M²*
Control (weeds)	N_1	3370	1203	249.0
	N_2	3050	1148	224.6
	N_4	3306	1356	217.3
B.brizantha	N_1	4528	1421	296.8
	N_2	4128	1602	344.0
	N_4	4582	1679	331.0
B.miliiformis	N_1	4656	1776	346.0
	N_2	4336	1573	434.0
	N_4	4581	1720	494.5
P.maximum	N_1	3584	1332	642.0
	N_2	2944	1070	632.8
	N_4	3313	1257	715.7

Yield of coconuts (nuts/ac. and lb. copra/ac.) and pasture (gm/m²) due to levels of nitrogen application.

Fertilizer placement to coconut cum pasture association (P_{38}) B/E

After establishment of *B.miliiformis* and pre experimental yield records for three years, the following treatments were commenced in November this year:—

	7 lbs.	*14 lbs.*
Total placed	A	D
½ placed + ½ broadcast	B	E
Total broadcast	C	F

The fertilizer mixture consists of 4 parts of sulphate of ammonia, 2 parts muriate of potash and 1 part of saphos phosphate by weight. The mixture is applied once a year (Oct./Nov.) in the "placed" treatments around the base of the palms. In the "broadcast" treatments the fertilizer is applied in two split doses in May/June and Oct./Nov.

Each plot has eight palms in two rows of four each. There are four replicates. The pasture was sampled four weeks after the manuring in October and are shown in Table IX.

TABLE IX

Treatments	*7 lbs.*	*14 lbs.*
Total placed	191.6	131.8
½ placed + ½ broadcast ..	234.2	209.3
Total broadcast	271.0	231.2

Dry matter yield of pasture (gm/m^2) due to type and level of manuring.

Selection establishment and management of pastures.

Selection of grasses and legumes

Considerable number of grasses and legumes are been collected from other tropical countries and progressively screened in pots. Promising species and strains are being multiplied in small field plots with a view to testing out in the various coconut growing areas. Greater attention is being paid to the following generra and species:—

Sorghum almum
Panicum maximum
Paspalum notatum
Brachiaria spp.
Chloris gayana
Urochloa sp.
Desmodium spp.
Pueraria Javanica (phaseoloides?)
Calopogonium mucinoides
Centrosema pubescens
Phascolus atropurpureus
Stylosanthes spp.

Growth and yield of ten grasses at Pothukulama (P_{34})

A preliminary trial was planted with 10 common grasses at three levels of nitrogen in May. They were harvested on three occasions during the season. The total dry matter yield produced are shown in Table X. It is too premature to make any conclusions at this stage.

TABLE X

Species	N_0	$N_{1\frac{1}{2}}$	N_3
Brachiaria brizantha	480	805	684
Brachiaria miliiformis	610	890	1042
Brachiaria mutica	865	876	902
Chloris gayana	1023	1178	832
Panicum maximum var. guinea ..	660	1045	1035
Panicum maximum var. greenpanic	529	716	759
Paspalum notatum	614	280	376
Pennisetum purpureum	870	823	1208
Sorghum almum	689	809	838
Urochloa sp.	420	696	792

Dry matter yield (gm/m²) of 10 grasses at three levels of nitrogen.

Growth and yield of ten legumes at Irranawilla (P_{37})

This trial was planted in October. The species were:—*Calopogonium mucinoides, centresema pubsescens, Desmodium aspenicum* (dwarf), *D. ovaliifolium, Eschemonna americana, Mimosa invisa, Phaseolus lathyroides, Pueraria javanica, Stylosanthes humilis* and *Canavalia sp.*

Rate and frequency of nitrogen application (P_{15}) B/E

This experiment on *B. miliiformis* was commenced in May. The treatments were four rates of nitrogen. ($\frac{1}{2}$, 1, 2 and 4 cwts/ac. ammonium sulphate) and four frequencies of application (once in 2 years (F_1), once each year (F_2), once each season (F_4) and twice each season (F_8)), in factorial combination. There was also included a nil (no nitrogen) treatment for purposes of comparison. There were two replicates of all treatments.

All treatments are being sampled at three weekly intervals. There were five such samplings commencing in May to beginning of the next season in October. The total dry matter yield of grass is presented in Table XI.

TABLE XI

	$N_{\frac{1}{2}}$	N_1	N_2	N_4	*Total*
F_1	911	1121	1236	1306	4574
F_2	871	1038	1366	1182	4457
F_4	935	1043	1286	1272	4536
F_8	999	1101	1191	1321	4612
Total	3716	4303	5079	5081	
Nil treatment = 912					

Dry matter yield (gm/m²) of *B. miliiformis*

Frequencies of nitrogen application and defoliation on the yield of P.maximum (var. green panic) (P_{23}) R/E

This experiment commenced in May 1964 has completed three seasons. The data for Oct. 64–March 65 is given in Table XII.

TABLE XII

	Cut. once in 8 wks.	*Cut. once in 4 wks*
Total N applied once ..	880	734
Total N in two splits ..	1190	1043
Total N in four split ..	1168	843

Dry matter yield (gm/m²) of *P. maximum* var. green panic.

Cutting once in 8 weeks and two split application of nitrogen per season is superior to the other treatments.

The response of B.miliiformis to forms of nitrogen ((P_{30}) Irranawila estate).

This experiment was planted in May and was harvested on two occasions. It is a 3 ×3 ×2 factorial of 3 forms of nitrogen (nil, $(NH_4)_2SO_4$ and NH_4NO_3), three levels of boron (nil, 3 and 6 lb. $Na_2B_4O_7$. $10H_2O$/ac) and two levels of sulphur (nil and 1 cwt./ac) in split plots.

Nitrogen had significant effect with 1216, 2017 and 2487 gm. for nil, NH_4NO_3 and $(NH_4)_3SO_4$ respectively.

Intensity and Frequency of defoliation of B.miliiformis (P_{10}) B/E

This is a 3×2×2 factorial experiment with 3 frequencies of defoliation (2, 4 and 8 weeks), two heights (1″ and 3″) and two levels of nitrogen (nil and 2 cwts. $(NH_4)_2SO_4$/ac.) on the yield and persistency of *B.miliiformis*.

The experiment was commenced in May and three cycles of defoliation were completed. The dry matter yield of grass and weeds are presented in Table XIII.

The dry matter yield of grass increased with increase in the height of cutting, nitrogen application and interval between cuts. The reverse was true of weeds. These trends become marked with time (Cycle I-III).

Dry matter yield and soil moisture exhaustion due to time and frequency of defoliation of B.brizantha (P_{19}) R/E

This experiment (details see 1964 Report III. 1) was commenced in May and is in progress.

The effect of nitrogen and height of cutting on the yield of mixed pastures

This was a 3 × 3 factorial of 3 legumes (*Centrosema*, *Calopogonium* and *Pueraria* mixed with *B.miliiformis*) and 3 levels of nitrogen (nil 2 and 4 cwts./ac $(NH_4)_2SO_4$) planted in May.

Germination was satisfactory in all plots, but during the July/August dry period most of the legumes died. However a height of defoliation treatment was imposed in October in split plots (1″ and 3″) and a sample taken in December (Table XIV).

Pueraria completely died in all plots and there was no growth of other legumes in the 1″ cut treatments.

TABLE XIII

		GRASS		WEEDS	
		N_0	N_2	N_0	N_2
Cycle I					
H_1	F_2	377	281	114	158
	F_4	448	350	108	158
	F_8	389	700	122	68
H_3	F_2	429	523	25	138
	F_4	489	559	50	74
	F_8	529	670	22	49
Cycle II					
H_1	F_2	202	164	204	252
	F_4	177	227	102	80
	F_8	364	548	81	21
H_3	F_2	187	433	102	66
	F_4	221	340	49	48
	F_8	325	567	39	33
Cycle III					
H_1	F_2	77	75	122	211
	F_4	324	202	122	134
	F_8	398	545	70	2
H_3	F_2	105	307	60	32
	F_4	227	396	60	32
	F_8	392	614	6	14

Dry matter yield of *B.miliiformis* and weeds.

TABLE XIV

		CALAPO		CENTRO		PURO	
		grass	*legume*	*grass*	*legume*	*grass*	*legume*
H_1	N_0	322	0	441	3	598	2
	N_1	870	4	845	8	1120	0
	N_4	1385	0	1270	0	1670	0
H_3	N_0	280	11	322	14	484	0
	N_1	559	5	538	10	509	0
	N_4	1045	0	860	7	1075	0

Dry matter yield (gm^1m^2) of grass and legumes

In the 3″ cut treatment the yield of the few legume plants decreased with increase in the levels of nitrogen applied

Management of fodder grass.

Effect of row spacing and nitrogen on the yield of P.maximum (P_{14}) B/E

This experiment was continued during the year. The results were similar to that summarised for 1964. During May a further treatment was imposed where each plot was split into two and were either cut at ground level or 6″ high. The effect of the treatment has not yet assumed significance.

Effect of spacing on the yield of P.maximum (P_{32}) B/E

In this experiment Guinea grass was planted at spacing of 1, 3, 5, 7 and 9 ft. apart in both N-S and E-W combinations, giving a total of 25 treatments late last year. After satisfactory establishment the experiment was sampled on three occasions between June and December this year. The mean yields are shown in Table XV.

TABLE XV

		1	3	5	7	9
1	Obs.	2762	2291	2099	1718	968
	Exp.	1964	2294	2056	1596	1258
3	Obs.	2388	2469	1797	1456	1126
	Exp.	2124	2263	1854	1289	913
5	Obs.	1854	2355	1393	919	649
	Exp.	2124	2033	1548	975	657
7	Obs.	1554	1398	726	728	501
	Exp.	1700	1602	1138	652	490
9	Obs.	1280	831	829	598	238
	Exp.	1020	972	624	323	411

Mean dry matter yield (lb./ac.) of *P.maximum* at various spacing.

The drop in yield at the closest spacing (1 × 1) compared to the next treatment (1 × 3) in both directions is contrary to the concept of ceiling yield of total dry matter or "biological yield", (Donald 1963). In view of this biological interest an experiment with appropriate spacing will be planted in the open to further examine the observation.

The correlation between observed and expected yield is 0.96099 and the calculated spacing for maximum yield is 2.5 ft. square planting.

Competition between Guinea grass and Centrosema (P_{18}) R/E

This experiment was continued. The results were similar to that summarised for 1964.

Competition between Guinea grass and legumes (P_{30}) R/E

This is a 3 × 2 factorial of 3 associated species (nil control; *Calopogonium*, a creeping type of legume; *Eschemonne*, an erect type of legume) and 2 levels of nitrogen (nil and 1 cwt./ac. $(NH_4)_2SO_4$) experiment.

The grass was established in rows 6' apart and the legumes planted in May. No data has yet been collected.

Effect of different forms of nitrogen on the yield of Guinea grass (P_{29}) R/E

This is a 4 × 2 × 2 factorial of 4 forms of nitrogen ($(NH_4)_2SO_4$, NH_4NO_3, $CO(NH_2)_2$ and F.Y.M.) applied in one dose or two splits each season, and two frequencies of cutting of the grass (3 and 6 wk) in split plots. A control plot with no nitrogen application is also included.

The experiment has gone through three cycles. There do not appear to be any difference in the forms of nitrogen applied. Split applications however is superior. Cutting at 6 weekly interval is superior to 3 weekly cutting.

Controlled experiments

Competition between B.brizantha and B.miliformis

The competitive relationship between these two species of *Brachiaria* for light and nitrogen was studied in plant beds. The results were presented at the 21st Annual Session C.A.A.S. In brief the data showed that *B.miliiformis* was the aggressive species in the association, due to its tolerance of shade and better response to nitrogen.

Effect of shade on the growth of Phaseolus lathyroides

Potted plants of *P.lathyroides* were placed on either side of a screen running N-S such that the plants were shaded during certain times of the day.

TABLE XVI

	Hav. 1	*Hav.* 2	*Hav.* 3	*Mean*
No shade	1.45	4.12	8.14	4.57
Shade from sun rise to 8 a.m. ..	1.31	4.55	7.22	4.36
Sun rise to 10 a.m.	1.43	4.52	7.47	4.44
Sun rise to noon	1.41	3.90	7.22	4.18
Noon to sunset	1.22	2.91	6.69	3.61
2 p.m. to sunset	1.34	4.03	8.21	4.53
4 p.m. to sunset	1.40	4.33	8.43	4.72

Dry matter yield (gm./pot) of *Phaseolus lathyroides* exposed to shade at different times of the day.

The shade around noon caused the greatest reduction in growth. This effect increased with time indicating a cumulative effect.

Soil moisture distribution within a coconut square

In an area planted with *Panicum maximum* at one foot spacing under mature coconuts the individual grass plants were harvested to determine the moisture content of the plants. The distribution of plant moisture within a square is shown in Fig. 2. It is assumed that plant moisture reflects soil moisture content.

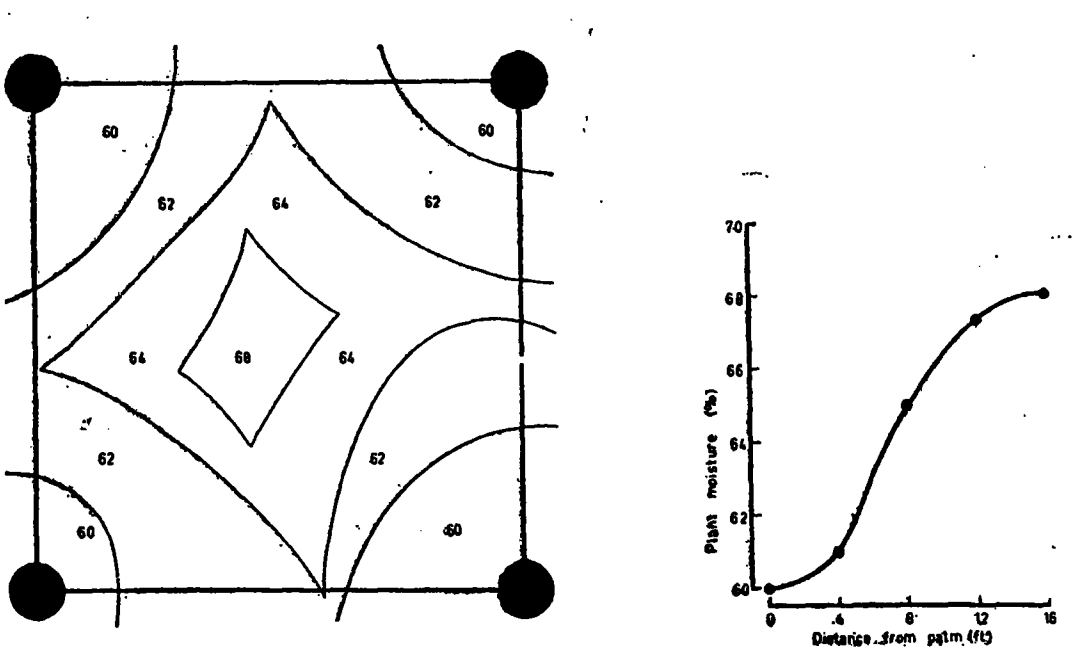

Fig. 2

Effect of scarification on the germination of legume seeds

Seeds of common legumes such as *Calopogonium mucunoides, Centrosema pubescens, Eschemonni ammericana* and *Pureria phaseloides* were treated with concentrated sulphuric acid for different lengths of time and germination recorded for a fortnight. Table XVII gives % germination at the end of 14 days.

TABLE XVII

	Duration of treatment (mins)							
	0	5	10	20	30	40	50	60
C.mucunoides ..	49.6	68.0	61.6	61.8	57.5	34.1	9.5	2.3
C.pubescens ..	6.6	16.6	18.3	18.1	13.3	11.5	1.0	1.5
E.ammericana ..	5.1	5.1	7.3	7.5	11.6	23.0	7.3	4.3
P.phaseloides ..	14.0	15.1	14.0	16.8	14.6	7.1	7.6	9.0

Percentage germination of four legume seeds treated with conc. H_2SO_4 for varying lengths of time (mins.)

Other crops

Cereals

Varieties of paddy, maize and sorghum were planted during the Oct.-Nov. season to produce seeds for more detailed experimentation.

Pulses

Six varieties of cowpea, three varieties of green grams and one variety of black gram were grown at B/E, R/E and Irranawila for seed production and observation on performance.

Ground nuts

An experiment on the performance of eight varieties of ground nuts to nitrogen and lime application was planted at B/E.

Minimal; Vinca rosea

In one experiment on already established plots of this plant a 3 × 3 factorial of 3 levels of N (nil, 1 and 2 cwt. $(NH_4)_2SO_4$/ac) and 3 levels of K (nil, 1 and 2 cwt./ac KCl) was laid.

In another experiment the establishment of this crop from seeds and cuttings were compared. Establishment was very poor due to bad seeds and failure of cuttings to root.

Preliminary trials in pots in the glass house however showed more than 90% strike of cuttings.

A preliminary experiment therefore was carried out with five plant hormones to induce rooting. This was a 5 × 6 × 4 factorial of 5 hormones (indolyl acetic, propionic, buteric acids, naphthalene acetic acid and M.C.P.A.) at six concentrations (0, 1, 5, 10, 20 and 40 p.p.m) and four durations of treatment (12, 24, 36 and 48 hrs.).

There were 12 cuttings per treatment. They were planted in rows and regularly watered.

The most successful treatment was indolyl propionic acid at concentration of 5 p.p.m. and treated for 12 hours.

More critical studies will be undertaken.

4. CATTLE

Herd Statistics

Herd strength on 31.12.65

	B/E	*R/E*	*Total*
Bulls	4	1	5
Cows	46	37	83
Heifers	67	35	102
B'calves	72	19	91
Total	189	92	281

Of this 2 were Sinhala × Jersey, 9 were Sinhala × Fresian, 81 Sinhala × Sindhi and the rest were Sinhala.

This herd strength is 39 less than in 1964. There were 23 and 27 births at B/E and R/E respectively, with 12 deaths due to bacterial infection among the calves at B/E. During the year 67 animals comprising of 1 bull, 30 cows, 5 heifers and 31 bull calves were sold.

Milk yield

A total of 31,557.5 pt. and 1904.5 pt. of milk were produced at B/E and R/E respectively. 15,892.5 pt. were sold to the staff. A further 17,128 pt. were offered to the Milk Board of which 2,273 pt. were rejected. 263.5 pt. were converted to ghee. The balance of 178 pt. were fed to calves and used in testing for fat content. The reduced production of milk during the year (71,555.5 pt. to 31,557.5 pt.) was mainly due to the change in milking frequency from the normal twice daily to once daily and the elimination of concentrate feeding.

The Sinhala herd

The experiment on concentrate feeding was completed and another on type of feeds and in presence and absence of concentrates was commenced. The preliminary data from both experiments were presented in a paper at the 21st Annual Sessions of the Ceylon Association of the Advancement of Science.

The Sinhala × Sindhi herd

Of the 53 Sinhala × Sindhi females raised, 7 came into lactation during the year. The mean daily yield during the first two months of lactation was about 5.5 pt. compared to the Sinhala herd, here, which gave a similar yield during the corresponding period.

The Sinhala × European crosses

Systematic artificial insemination of Sinhala cows with Fresian and Jersey semen supplied by the Department of Agriculture was continued. Of the 82 animals that were inseminated only 7 conceived. Of those returned, 44 were inseminated a second time and 2 conceived. 19 of those returned a second time were inseminated a third time and only one conceived. Of the 10 calves produced 8 were males.

It is now hoped to obtain a Jersey bull from the Department of Agriculture.

5. GENERAL

Publications

The following papers were published during the year:—

1. Intercropping with coconuts by K. Santhirasegaram. Jour. Nat. Agric. Soc. Cey. 2. June 1965.
2. Studies on the Nutrient status of some coconut soils of Ceylon. 4. The lateritic soils at Ratmalagara by K. Santhirasegaram, C.R.I. Bull. 23 July 1965.
3. Agronomic practices aimed at reducing competition between cover crops and under-sown pastures by K. Santhirasegaram and J.N. Black. Herbage Abst. 35. December 1965.

4. Sulphur Deficiency in some soils of Ceylon by K. Santhirasegaram. Proc. Cey. Ass. Ad. Sci. Dec. 1965.

5. Loss of ammonia from two nitrogen fertilizers by K. Santhirasegaram and D.T. Rajaratnam *ibid.*

6. Competitive relationships between two species of *Brachiaria* by K. Santhirasegaram and D.E.F. Ferdinandez. *ibid.*

7. Response of Sinhala cattle to types and levels of feed by K. Santhirasegaram and G.C.M. Goonesekara. *ibid.*

8. "Dry Dust" from coconut fibre mills. A useful soil amiliorant by K. Santhirasegaram, C.C.Q. XVI. 1965. (in print).

Six other papers have been accepted for publication by various Journals during 1966.

The Agrostologist addressed the L.C.P.A. and talked over the National Service of Radio Ceylon on Intercropping, which was presented in Sinhala by the S.T.A. and in Tamil by the R.A. The Agrostologist served on a Sub-committee of the Planning Council on Intercropping with coconuts.

Staff

The Senior Technical Assistant, Mr. D.E.F. Ferdinandez followed a course of training in Tropical Pasture Management in Queensland, Australia, under the Colombo Plan Aid Scheme. He was in Australia from February to July.

There was no change in the personnel during the year. The Animal Husbandry Officer, Mr. G.C.M. Goonesekera was transferred from Ratmalagara to Bandirippuwa with effect from March. His place was taken by the Field Assistant Mr. K.C. Muthuchamy.

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K. SANTHIRASEGARAM,

Agrostologist, Coconut Research Institute.

Ceylon Cocon. Quart. (1966) 17, 152-161

REPORT OF THE OFFICER-IN-CHARGE CROP PROTECTION DIVISION

INTRODUCTION

Investigations on the 'Leaf Scorch' and its decline have been the major work during the year 1965. The most noteworthy results obtained are the findings of the Colombo Plan Nematologist, which conclusively eleminates the possibility of plant parasitic nematodes being a cause. Although this is only a negative result, the conclusions are nevertheless important, in that, one line of investigation is finally settled and no further effort and resources need be expended on such work in the future.

There were no major out-breaks of pests, but infestations of Red Weevil, Coconut Caterpillar and Coconut Scale pests were found to be occurring, as in previous years. There was no difficulty in controlling the Coconut Scale pest wherever it appeared. The Coconut Caterpillar infestations continued to fluctuate, whilst parasites were liberated in all areas where the pest was reported to be occurring. The Red Weevil pest yet remains to be the most destructive. As usual, it developed in areas where there has been negligence and no attention paid, either to treat the infested palms or destroy them to prevent breeding.

PESTS

(1) The Red Weevil (*Rhynchophorus ferrugineus F*), and its control

Some studies on the ecology of the pest was begun with a view to obtain information on distribution, development, economic importance and such data which are a necessary prerequisite, to working out methods of control in plantation management.

(i) *Surveys*

In a land development colony, 30% of the allotments were affected by the pest. The extent of palms destroyed, was on the average 5%, the range being 3–34%. The palms were 1 to 6 years old. Out of 668 infested palms, only one had been dealt with, the grubs scooped and removed.

A survey was conducted in a village, in the Chilaw District, covering an area of approximately 140 acres. There were 54 small holdings each about ¼ acre to 6 acres in extent. The young palms 1–10 years old were underplanted palms or supplies to vacancies. The following information was obtained.

(*a*) Some holdings did not contain young palms—89% had.

(*b*) There were infested and uninfested zones where young palms were present.

(*c*) In the holdings which contained young palms, 63% was affected by the pest.

(*d*) In one holding, ten palms were raised; it is reported that all were destroyed by the pest. The lowest in the range was 4%.

(*e*) The mortality rate, on the average, has been 18% (infested zones).

(*f*) At the time of inspection, the infestation rate was 0.6%.

(*g*) Only 10% of the owners had paid attention to prevent or arrest infestations by the application of tar on wounds or scoop-out and remove grubs.

(*h*) Although several holdings reported that infested palms were cut and burned, it is not certain to what extent this was truly practised.

(*i*) All the infested palms, at the time of inspection were unattended.

(ii) *Insecticide injection trials*

As and when infested palms became available for treatment, these trials were conducted. A summary is given below.

TABLE 1

Injections of insecticides given to Red Weevil infested palms and results

Palm	*No. of palms treated*	*Insecticide*	*Dosage*		*Results*
			Injected	*Poured*	
Tall	3	Metasystox	5 cc	—	Recovered
	2	,,	10 cc	—	,,
	1	,,	17.5 cc	—	,,
	2	,,	20 cc	—	,,
	1	,,	35 cc	—	,,
Dwarf	5	Metasystox	2.5 cc	—	Recovered
	2	,,	2 cc	2.5 cc	,,
	3	,,	7.5 cc	—	,,
	1	,,	—	10 cc	Beyond recovery uprooted and burnt
	1	,,	10 cc	—	Recovered
Tall	1	Telodrin	7.5 cc	—	Recovered
	6	,,	5 cc	5 cc	,,
	2	,,	12.5 cc	—	,,
	1	,,	5 cc	20 cc	,,
Dwarf	7	,,	2.5 cc	—	Recovered
	1	,,	4.5 cc	—	,,
	1	,,	2.5 cc	2.5 cc	,,
Tall	1	Baygon	17.5 cc	5 cc	Recovered
	1	,,	27.5 cc	—	,,
	1	,,	32.5 cc	5 cc	,,
	1	,,	42.5 cc	—	,,
	1	,,	—	35 cc	Beyond recovery collapsed
	1	,,	—	35 cc	,,

Dilutions used were 0.5–1%. In heavily infested palms, a pouring in of the diluted insecticide was found to be beneficial. Baygon required higher doses for control.

(iii) *Traps and attractants*

The cabbage of the coconut palm was used as a medium to attract weevils and collect them. The table given below illustrates the results obtained.

TABLE II

Red Weevil traps

Breeding material	*Date trap was set*	*Daily collection of weevils*													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cabbage	22.2.65	—	6	—	6	—	5	—	—	—	—	—	—	—	—
Cabbage	28.4.65	—	3	—	—	—	—	—	—	—	—	—	—	—	—

The Red Weevil is of relative importance, as it fluctuates in abundance, in different localities. In areas where it occurs infrequently, regular inspection may not be worth the costs. However, in a young plantation periodical examination of palms should not be overlooked. The chemical treatment to destroy the pest infesting a palm is only a last resort to save the palm from complete destruction. Since considerable damage is already done when detection is made for the palm injection, the better method of control should be on the preventive side. The pest breeds in young coconut palms. In coconut plantations, no alternate breeding grounds have been seen. Therefore, the pest moves from one coconut palm to another, and these palms in which they breed can be detected, the pest material collected and destroyed. If the aim in pest control is to reduce populations of the pest, it appears that this can be achieved more easily with the Red Weevil pest than with some other pests of the coconut palm. It has been demonstrated that by detecting infested palms, and only destroying them, the insect populations can be brought down and the Red Weevil will not have a chance to develop and become a pest.

In estates where pest labourers have become unreliable, it has been found to be advantageous to put in a gang of men under strict supervision and carry out the task out-lined below,

(*a*) Inspect all young palms in the plantation ; look for infested palms.

(*b*) Smear tar on all fresh wounds.

(*c*) If cracks are present, in the bark, near the soil where roots emerge, an earthing up round the base of the palm should be done.

(*d*) Infested palms if found, should be treated with Metasystox.

(*e*) Palms that are beyond recovery should be cut, split into sizes inflammable, and incinerated.

Once the whole plantation has been combed-out, the operations can be repeated, periodically. If such attention is paid, the pest will have no chance to remain undetected and undestroyed.

(2) The Coconut Caterpillar (*Nephantis serinopa* Meyr.) and its control

The biological control project was persued further in 1965.

(i) *Production and despatch of parasites*

TABLE III

Production and despatches of parasites at the parasite breeding unit, Lunuwila

Parasites	*No. Produced*	*No. Liberated*	
		N.W.P.	*S.P.*
(*a*) Larval			
Microbracon brevicornis W.	1,653,500	694,600	84,000
Perisierola nephantidis M.	—	—	—
(*b*) Pupal			
Tetrastichus israeli M & K.	210,700	83,650	—
Trichospilus pupivora F.	27,350	131,800	—

TABLE IV

Production and despatches of parasites at the Parasite Breeding Station, Mylambavelly

Parasites	*No. Produced*	*No. Liberated*			
		E.P.	*N.P.*	*S.P.*	*N.W.P.*
(*a*) Larval					
Microbracon brevicornis W	413,960	199,100	4,800	800	—
Perisierola nephantidis M.	249,680	45,200	—	800	600
Spoggosia bezziana B.	728	—	—	—	—
(*b*) Pupal					
Trichospilus pupivora F.	—	—	—	—	—
Tetrastichus israeli M & K	231,200	96,450	—	—	—

At the Parasite Breeding Unit at Lunuwila, there was a set back in the production of parasites as the temperature controlling equipment broke down beyond repair and a replacement was not obtainable, although arrangements were made to secure one. (New equipment obtained from abroad will be installed shortly).

Cultures of laboratory host insects *Prodenia litura* and *Corcyra cephalonica* were maintained.

(ii) *Recoveries of parasites*

In a few selected estates population counts of the pest and parasites were maintained. Small numbers of the following parasites have been recorded.

At the Batticaloa Station

Perisierola nephantidis
Spoggosia bezziana
Apanteles taragamae
Dioctes sp.
Brachymeria nephantidis

At the Lunuwila Unit

Perisierola nephantidis
Apanteles taragamae
Dioctes sp.
Trichospilus pupivora
Brachymeria nephantidis

It appears that the two imported parasites, *Microbracon brevicornis* Wesm. and *Tetrastichus israeli* M & K are not yet established. In the Batticaloa region, the parasites that appear to be beneficial are *Perisierola nephantidis* Mues and *Spoggosia bezziana* Bar although the latter is being hyperparasitized. In the Western and North Western region, the more useful parasites are *Perisierola nephantidis* Mues and *Trichospilus pupivora*.

(iii) *The pest position*

The number of estates that reported infestations were as follows,

Station	1965	*Previous year*
Batticaloa	28	33
Lunuwila	17	17

(3) The Coconut Scale pest (*Aspidiotus destructor* Sign.) and its control

(i) *Incidence*

The prevalence since 1955 has been plotted in a graph Fig. 1 below, illustrates the trends up to the current year.

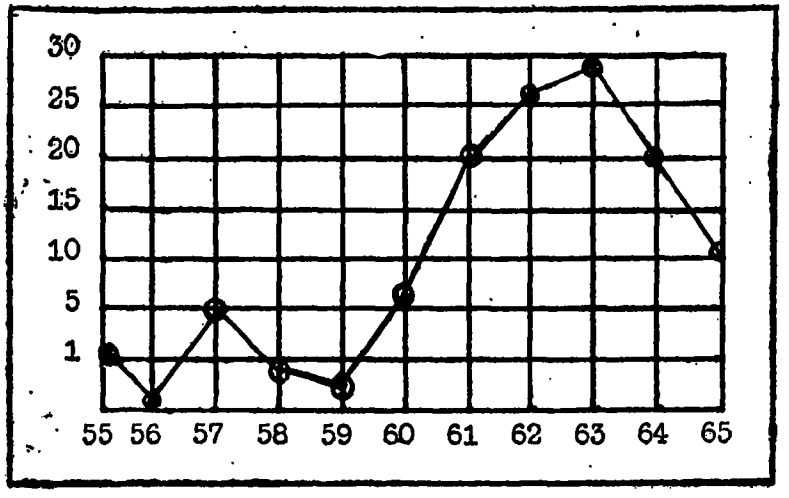

Fig. 1. Coconut Scale pest, reported infestations 1955 - 1965.

(ii) *Distribution*

The infestations reported were found distributed as follows,

North Western Province	9
Southern Province	1

(iii) *Control*

The pest was controlled successfully by spraying kerosene oil emulsion.

(4) Other pests

The following pests were reported,

Termites	Rats	Monkeys	Bats
Locusts	Bandicoots	Wild Boar	—
A chafer beetle (*Sophrops eurystoma*)	Porcupines	—	—

The usual recommendations were given for their control except for the chafer beetle which has yet to be studied.

The chafer beetle is *Sophrops eurystoma* Burm. It feeds on the leaves of seedlings. Damage to foliage was observed to be a 6% defoliation at one stage. The larvae were found breeding in the soil. When dry weather sets in, the larval populations dwindled fast and the damage also get diminished. Arrangements were made to carry out trials to ascertain, extent of damage, population fluctuations, insecticidal trials etc. when their numbers increase.

DISEASES

(5) Leaf Scorch Decline

(i) *Nematological investigations*

The Colombo Plan Nematologist, Dr. David Robertson investigated fully the possibility of plant parasitic nematodes being a possible cause of 'Leaf Scorch' and its decline.

The nematodes he isolated and recorded are as follows:—

From roots:

Spear bearing	Saprophytic
Aphelenchus sp.	*Rhabditis* sp.
Ditylenchus sp.	*Acrobeloides* sp.
Tylenchus sp.	
Aphelenchoides sp.	

From the Soil:

Xiphenema sp.	*Radopholus* sp.
Tylenchorhynchus sp.	*Trichodorus* sp.
Helicotylenchus sp.	*Caloosia longicaudata* Loos.

The Specialist concluded that nematodes are not a possible cause of 'Leaf Scorch' and its decline.

The investigation and results are recorded in the "Report of Dr. D. Robertson, Colombo Plan Nematologist, C.R.I., Ceylon 8th January–1st April 1965".

(ii) *Mycological investigations*

Previously recorded micro-organisms were re-occurring in the isolations that were done. The following are new records.

From roots of affected palms

(*a*) Bacterium—*Erwinia* sp.

(*b*) Fungi—*Fusarium solani* (Mort) Sacc.
Fusarium oxysporum Schlect ex Fr.
Ceratocystis sp.
Colletotrichum sp.
Phytophthora sp.

It is not possible to associate any of these micro-organisms with the 'Leaf Scorch' decline.

(iii) *Survey*

A survey of the heavily affected area, in Gonapinuwela (Galle District) was carried out. The results are as follows.

Prevalence rate 3.7 palms per acre (same as previous survey)
Mortality rate 1 palm in every three acres per annum.
'Leaf Scorch' decline is also present in the Negombo, Chilaw and Kurunegala districts.

(iv) *Tillex Trial*

Further reports were received that Tillex, soil fungicide has caused further recoveries of 'Leaf Scorch' affected palms. A trial was begun with nine hundred palms, both affected and unaffected in a comparative test with two fungicides with and without fertilizers, with a view to confirm this claim, if such beneficial effects are observed. The treatments are as follows:—

Plot 1	*Plot* 2	*Plot* 3
Tillex Weekly application 2 fl. ozs. in 2 gals. water + fertilizer annually 8 lbs/palm	*Cerasan* Weekly application 1 oz. in 2 gals. water + fertilizer annually 8 lbs/palm	*Control* only Fertilizer annually 8 lbs/palm
Plot 4	*Plot* 5	*Plot* 6
Tillex Weekly application as above + Fertilizer 2 lbs/palm bimonthly	*Ceresan* Weekly application as above + Fertilizer 2 lbs/palm bimonthly	*Control* only Fertilizer 2 lbs/palm bimonthly

Plot size=30 palms
Six plots per Block
Replicated five times in 5 estates in the Gonapinuwela area.

All palms in the plot were classified according to their condition.

Photographs of one set of palms were taken in colour prior to treatment.

Observations were recorded once in three months.

No conclusions can be derived as yet.

(v) *Other Observations*

Observations of affected and unaffected palms in selected blocks in four estates in the Gonapinuwela area were maintained.

(6) The Bud Rot disease and its control

Although Bud Rot can destroy both young and grown up palms, its prevalence and damage has been found to be heavier in young plantations 3 to 10 years old.

(i) *Causal organisms*

Isolations of micro-organisms from affected palms have produced the fungi,
Phytophthora palmivora Butler, *Phytophthora nicotianae* var. *parasitica* Dastur.

(ii) *Field Trial*

With the co-operation of the Plant Pathologist, Department of Agriculture a field trial was commenced to test the efficacy of two fungicides; packetted and placed in the axil of the top most leaf.

Treatments

(*a*) Antimucin, applied once in 2 months

(*b*) Antimucin, applied once in 4 months

(c) Mercury Spray, applied once in 2 months

(d) Mercury Spray, applied once in 4 months

(e) Control

diluted to 0.5%

Experimental area

400 young palms 7-8 yrs. old where the incidence was reported to be heavy.

Lay-out

Randomised blocks.

Results

At the end of 4 months the disease prevalence rate was 0.5%. This is a very low incidence rate at which it will be difficult to evaluate the efficacy of the treatments. The trial will be continued further.

(iii) *Control*

When early detection is not possible and the bud can reach an advanced stage of decay before it is detected, curative treatment is not possible.

The next consideration is a treatment for prevention. A prophylactic treatment such as spraying a copper fungicide or applying Bordeaux mixture can be uneconomical when the disease incidence is low.

However, when some measure of control is needed, when mortality is considerable (as it could be in a young plantation), the application of Bordeaux mixture may be done. The mixture is poured into the bud region from a bottle, repeated once in two months. In one plantation, the cost of this treatment was approximately Rs. 5 per acre. Only three months records are available. Up to that time, the protection obtained has been satisfactory.

(7) Leaf Blights and their control

A comparative study of spraying a copper fungicide and fertilizing leaf blight affected palms, for curative purposes, was commenced. The trial is in progress. The copper spraying is showing to be controlling the disease faster than the fertilizer method.

(8) The Crop Protection Unit

The Crop Protection Service Unit was engaged in

(a) Spraying kerosene oil emulsion against the Coconut Scale pest.

(b) Spraying Endrex 20 against the Coconut Caterpillar pest in an Experimental Station.

(c) Control of the Red Weevil pest in an Experimental Station.

(9) Identifications

(a) *Bacterium*

Erwinia sp. isolated from root of 'Leaf Scorch' affected palm.
A soft rotting bacterium very close to *E. chrysanthemi* Burkholder *et al.*

(*b*) *Fungi*

Colletotrichum sp. isolated from root of 'Leaf Scorch' affected palm.

Fusarium oxysporum Sahlecht. ex Fr. isolated from root of 'Leaf Scorch' affected palms

Fusarium solani (Mart.) Sacc. —do—

Ceratocystis sp. probably *Ceratocystis paradoxa* (Dade) Moreau isolated from the trunk of the palm.

Phytophthora nicotianae var. parasitica (=*parasitica* Dastur) isolated from coconut bud.

(*c*) *Insect*

Xyleborus perforans Woll (Scolytidae), found boring into trunk of an adult dying palm.

(10) Advisory Leaflets

The following Leaflets were revised. The Coconut Scale insect and its control. The Coconut Caterpillar and its control. The Red Weevil and its control.

(11) Staff

The Crop Protection Officer Mr. U. B. M. Ekanayake was away on post-graduate studies at the University of Oxford England.

Mr. A. M. Chandrasena was transferred to Gonapinuwela in connection with the Tillex Trial.

(12) Talks and Papers

A talk on 'Leaf Scorch' decline was given at a meeting of the Negombo-Chilaw Planters' Association.

The L.C.P.A., was addressed on 'Leaf Scorch' and a note was also read which was later released to the Press.

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

Ceylon Cocon. Quart. (1966) 17, 162-165

REPORT OF THE CHIEF ADVISORY OFFICER

SECTION I

In the year under review the field staff of the Division have made a total of 10,251 visits to coconut holdings to advise owners and those in charge, on cultivation operations, correct management practice and for providing 'On land' demonstrations on methods of lining for planting, soil conservation, pests and diseases control and draining of water logged and low lying areas. Extension of information and guidance on new planting and under planting have been carried out through the preplanting service and the lands so planted have been followed up thereafter to render further advice regarding correct maintenance of young plants. In this respect 1365 visits have been made. Similarly on Pests and Diseases work 2813 visits have been made comprising 627 on Termite control, 563 on Black Beetle (*Oryctes rhynoceros*) 901 on Red Weevil (*Rhynchophorus ferrugineous*) 100 on Coconut Caterpillar (*Nephantis serinopa*) 220 on Grey Blight (*Pestalotsiopsis palmarum*) 24 on Coconut Scale (*Aspidiotus destructor*) and 378 on other less common pests and diseases. Under General Advisory service all other aspects of work have been included and 5,464 visits have been made in this connection. As regards 'On land' demonstrations, the field staff have where necessary trained owners and those in charge of coconut holdings, how lining, soil conservation and draining of water logged and low lying areas should be done, by demonstrating lining for planting on 1143 acres, tracing 21,015 chains of contour drains and pegging out 674 chains of drains for draining. They have also done 'On palm' demonstrations by showing how injection of chemical, should be done, for the control of Red Weevil. In addition the field staff have inspected 635 small holdings for the Commissioner of Coconut and Cocoa Rehabilitation, under the fertilizer subsidy scheme, where fertilizer had been bought by small holders through Co-operative Societies. During the year 115 meetings have been attended and advisory leaflets, seedling application forms and fertilizer application forms for obtaining fertilizer under the subsidy scheme distributed.

Demonstration Centres

Teaching by demonstrations has not been limited only to cultivator's lands. Demonstration centres have been established by the Institute at Koggala, Pallai, Mundel and Alampil to enable owners of coconut lands to see for themselves the results and advantages of carrying out correct management practice. During the year routine items of work have been carried out at all demonstration centres. The problem at Koggala which is 15 acres in extent has always been the difficulty of draining the land because of its situation. This has been done to some extent in Blocks A and B. Owing to the damp condition of the land, weed growth has been heavy and the cost of weeding has been rather high. Attempts to establish a cover crop to keep down weed growth have not been successful owing to serious damage caused by snails, and snail repellants have been of little value in controlling this pest.

In the 15 acre demonstration plot at Alampil, a mixed cover of *Centrosema pubescens* and *Calapagonium mucunoides* has been established. *Canavalia ensiformis* which was prevalent in the

land was continued to be maintained in Block B. A few palms in Blocks A and B planted in 1961 have flowered. Most of the seedlings which were tilted by the cyclone in December 1964 have straightened out on their own. Damage to the fence and buildings by the cyclone has been repaired.

Pallai demonstration centre is 31 acres in extent. *Canavalia ensiformis* which was present on the land and the mixed cover of *Centrosema pubescens* and *Calapagonium mucunoides* that had been established died, probably due to cultivation and the shade provided by both the adult and the young underplanted stand. Here, none of the seedlings that have been planted in 1961 have come into flower. 'Atlas tree killer' has been successfully used to kill the old stand. This is being tried out as an alternative to cutting the tree and to determine whether the dead trunk would fall in pieces and whether the chemical would keep off Black-Beetle in the decaying portions. In the fallen portions no Black-Beetle or their larvae have been detected. So far, instances of dead standing palms falling whole have not been observed.

The centre at Mundel is 5 acres. *Centrosema pubescens* and *Calapagonium mucunoides* have successfully kept down the thick growth of Illuk which was prevalent on the land. Nearly 50% of the underplantation in Block C consisting of T $\times$ D hybrids planted in 1960 was in fruit. The T $\times$ T artificially pollinated seedlings planted during 1960 in Blocks A and B commenced to bear nuts.

Of the 25 acres of scrub jungle land, set apart for the demonstration centre at Mylambavalley (Batticaloa), 5 acres that had already been planted was continued to be maintained. A further 5 acres was opened up during the year, but this could not be planted owing to heavy rains which flooded the area. Inspite of draining and manuring some of the seedlings planted in 1964 were yellowing. Seeds of *Centrosema pubescens* and *Calapagonium mucunoides* have been sown mixed in the planted area and the cover is coming up.

There have been complaints that our services are inadequate. Being mindful of this fact proposals for providing a better advisory and extension services have been submitted during the latter part of the year to the Board of Management. The inadequacy of the present field strength and absence of any equipment for film shows for mass instruction, have been especially emphasized in this memorandum. While we can never hope to have all the staff that would be necessary to provide the best possible advisory service to the Industry it must be said that the present cadre of 25 Advisory Field Officers is hardly sufficient, as the ranges apportioned to each of them are very large varying from approximately 31,000 to 51,000 acres in extent. The need for film equipment for shows has been stressed in this memorandum as it has been recognized, by institutions that operate agricultural extension services, that this form of visual aid does much to vitalize instruction and often tells the story quicker better and more effectively than words and literature alone. Besides these, the need to establish more demonstration units, publicity through posters in public places like Railway stations etc. and the production of a Planters' Guide have been proposed for improving the service to the best possible levels.

Staff

Messrs. E. N. Ratnam and R. M. A. P. Ratnayake, Temporary Advisory Field Officers were appointed into the permanent cadre on 1.10.65.

Transfers

The following transfers were effected during the early part of the year:—

Mr. S. B. Karunaratne, A.F.O. from Hettipola to Mirigama

Mr. W. J. P. M. Lowe A.F.O. from Mirigama to Madampe

Mr. W. L. H. M. Wijegunaratne A.F.O. from Madampe to Koggala

Mr. D. Weerasekera A.F.O. from Koggala to Godakawela

Mr. W. Weeraratne A.F.O. from Ambalantota to Hettipola

Mr. L. S. Karunagoda A.F.O. from Wennappuwa to Ibbagamuwa

Mr. E. N. Ratnam A.F.O. from Alampil to Mundel

Mr. S. Mahesan A.F.O. from Mundel to Alampil

Messrs. J. G. de Silva, J. B. Galagedera and K. N. L. P. Seneviratne who were temporarily at Head Quarters were transferred to Ambalantota, Giriulla and Wennappuwa respectively.

In May Mr. W. B. Dunston Fernando A.F.O. Head Quarters was transferred to Negombo and Mr. C.A. Fernando A.F.O. Negombo succeeded him.

Mr. P. A. Wijewickrama A.F.O. helped in the distribution of fertilizer in connection with the Subsidy Scheme for planting coconut on Citronella lands during May/June and October/November.

SECTION II

SUBSIDY SCHEME FOR PLANTING COCONUT ON CITRONELLA LANDS

Work in connection with the scheme was continued during the year. The field staff have inspected 6898 lands and of the 78,0074 seedlings declared by the applicants only 74,5925 seedlings have been recommended as properly maintained, for payment of the annual cash subsidy. There has however been much delays in the inspections due to the large number of lands involved, shortage of staff and the fact that the staff have been engaged during May/June and October/November in the distribution of fertilizer to applicants. In May/June, 226 Tons 13 Cwts. 28 Lbs. of fertilizer have been distributed among 1885 applicants out of a total of 2057 applicants to whom seedlings had been distributed for planting in May/June 1962. The remaining 172 applicants did not call for the fertilizer. In October/November the same year 361 Tons 1 Cwt. and 14 Lbs. of fertilizer have been issued among 2018 applicants of a total of 2176 to whom seedlings had been issued for planting in October/November 1962. The remaining 158 applicants did not call for the fertilizer.

During these inspections the field staff have also advised land owners on proper management practice, pests and diseases control and especially on the control of *Eupatorium odoratum* and other weeds. *Eupatorium odoratum* has invaded the majority of the plantations in the Matara and Hambantota districts offering severe competition to coconut plants. This is a noxious quick growing weed reaching such heights that even make it difficult sometimes for one to walk through the land. Another weed that has made its appearance in some areas is *Euphorbia geniculata*. But this is not so much of a problem as Eupatorium. Owners of land have been instructed to

have such weeds eradicated completely or at least to have the weeds removed up to a radius of 6 to 8 feet from the coconut plant. In some lands planted in coconut it has been observed that Citronella has been allowed to overgrow, without being cut. This, it is understood, has been due to the fall in price of Citronella oil.

The field staff, after distribution of fertilizer, also carried out test checks on lands to determine whether the fertilizer so distributed has been applied to the seedlings. This had become necessary in view of the fact that previously quite a number of applicants, had sold the fertilizer outside without applying same to their plants. The number of persons who had disposed of the fertilizer in this way was few.

In certain areas like Handugala, Warapitiya, Walgammulla, Beliatta and Walasmulla in Giruwa Pattuwa West and Parapanmulla and Katiyape in Kandaboda Pattu, the plants are generally good. In other areas like Kahandawa, Kahandamodara, Gurupokuna and Rekawa in the Giruwa Pattuwa East the plants are not doing too well owing to the severe droughts that prevail there. In the other areas the plants are generally satisfactory.

Staff

Mr. T. Gunadasa, Field Attendant was appointed Clerk/Typist (temporary) on 1.8.65.

Mr. P. A. Wijewickrama, A.F.O. was in charge of the fertilizer consignments at Matara during May/June and October/November. He was assisted by Mr. S. Liyanage Clerk/Typist during May/June and by Mr. S. Jayanetti A.F.O. during October/November.

At the Vitharandeniya fertilizer store and the distributing office Mr. R. M. P. A. Ratnayake A.F.O. was in charge during May/June and Mr. T. G. Ratnapala Clerk/Typist was in charge during October/November. They were assisted by Field Attendants.

Mr. K. H. A. Perera Field Attendant was transferred from Katuwana to Head Office and Mr. P. A. Hemapala from Head Office succeeded him.

Messrs. K. A. Silva and W. W. R. Fernando, Field Attendants were transferred to Vitharandeniya and Kirama ranges respectively from Head Office.

Messrs. J. M. S. Fernando and L. B. S. de Silva, Field Attendants were transferred to Walasmulla and Hakmana ranges from Vitharandeniya and Walasmulla ranges respectively. The vacancy at Vitharandeniya range was later filled by Mr. K. H. A. Perera, Field Attendant from Head Office.

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

Ceylon Cocon. Quart. (1966) 17, 166-170

REPORT OF BIOMETRICIAN

1. Statistical Service

The research divisions of the Institute continued to be served by this division, in their problems relating to the design of experiments, statistical analysis and interpretation of experimental data.

The "Composite design" for fertilizer experiments recently introduced is now being regularly used by the Agrostology division in their glass-house experiments. It has effected a considerable saving on time, material and personnel, because the size of an experiment is now cut down to about a sixth.

The strip-plot design for spacing trials and its analysis based on the response surface approach is also a recent innovation. The results of such a trial carried out on guinea grass under coconut are now available. The analytical procedure for this design suggested in our annual report for 1963, had to be changed due to the unexpected pattern of response.

Originally it was argued that "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 characterized by a polynomical equation of the type:

$$y = a \pm b_1x_1 \pm b_2x_2 \pm b_3x_1^2 \pm b_4x_2^2 \pm b_5x_1x_2$$

Where x_1 and x_2 are the column and row spacings respectively and y is the expected yield per unit area.

The yield data from the experiment, however, showed a clear S-shaped response. It was felt therefore that by fitting the emperical model suggested earlier we are unrealistically curbing the true response. A polynomical model of the third degree was clearly needed.

Observed yield data

(*gms/acre* $\times 10^{-2}$)

		Column spacing ($\times_1$)				
		1′	3′	5′	7′	9′
Row spacing (x_2)	1′	12542	10405	9532	7802	4396
	3′	10844	11211	8162	6611	5115
	5′	8419	10696	6327	4174	2949
	7′	7059	6351	3300	3308	2275
	9′	5814	3775	3768	2717	1083

After repeated analysis, it was decided to include the following components in the production function, giving a coefficient of determination (R^2) equal to 0.92.

Component		t
x_1	..	5.92+*
x_2	..	7.50+*
x_1^2	..	1.71
x_2^2	..	2.01
x_1^3	..	2.25+*
$x_1 x_2$	..	0.28
$x_1^2 x_2$	..	1.84
$x_1 x_2^2$	..	2.63+

The following production function was obtained.

$$y = 532665 + 321677\ x_1 + 158173\ x_2 - 63482\ x_1^2 - 19531\ x_2^2 + 3263\ x_1^3 - 45600\ x_1 x_2 + 1902\ x_1^2 x_2 + 2727\ x_1 x_2^2$$

By equating the partial derivatives of this production function to zero, and solving the resulting equations, the optimum column and row spacings were found to be 2.56 ft. and 2.14 ft. respectively.

This experiment may be repeated as the significant x_1^3 and the interaction $x_1 x_2^2$ and the nearly significant $x_2 x_1^2$ are not clearly understood under the circumstances. One would reasonably expect only the components x_1, x_2, x_1^2, x_2^2 and if x_1^3 is relevant, x_2^3 too should show up.

2. Biometrical Studies

Unlike the other years, there was hardly any free time in between work for the research divisions, to be devoted to biometrical studies. Specially with the introduction of the composite design in pot experiments, the computational staff were taxed to the utmost.

The following were however attended to:—

(*a*) Calibration trial.

The recordings in the calibration trial at Ratmalagara Estate was continued as per schedule. The data have not been subjected to statistical analysis yet.

(*b*) The nut yeilds of the 300-palm block of the Botanist's division were analysed with a view to determine the efficiency of pre-experimental yield as calibrating variates for experiments on adult coconut. This work is still in progress.

3. Agri-Meteorology

(*a*) Meteorological stations

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

(*b*) Rainfall 1965 and crop prospects 1966.

Rainfall and its Distribution in important Coconut Areas of Ceylon

Station	*Total Rainfall*			*Effective Rainfall*			*Distribution Indices*		
	1965	1964	*Av.* (1953-64)	1965	1964	*Av.* (1953-64)	1965	1964	*Av.* (1953-64)
Lunuwila (Bandirippuwa Estate)	67.97	77.47	81.05	61.30	74.25	76.44	(i) 1.6828 (ii) 1.9501	(i) 2.5013 (ii) 4.1800	(i) 1.9409 2.9792
Madampe (Ratmalagara Estate)	45.83	66.34	65.79	43.03	64.31	63.64	(i) 1.0625 (ii) 1.2503	(i) 2.1626 (ii) 2.6006	1.7386 2.3984
Chilaw	57.23	65.96	64.31	57.23	65.96	60.92	(i) 1.4088 (ii) 1.7346	(i) 1.9108 (ii) 1.9120	1.5617 2.1393
Puttalam	47.54	37.06	48.32	47.54	37.06	46.25	(i) 1.3265 (ii) 1.3971	(i) 1.4302 (ii) 1.5566	1.2834 1.5688
Kurunegala	81.61	73.67	85.15	78.98	73.67	79.14	(i) 2.1880 (ii) 2.7701	(i) 2.5419 (ii) 4.2748	1.9810 2.9137

In Lunuwila, Madampe and Chilaw areas, the effective rainfall has dropped considerably below that of 1964 or the average for the last 10 years. Puttalam and Kurunegala have registered a slight improvement over 1964 and is about average.

The distribution of rainfall has been very poor in all areas.

Accordingly all these areas must be prepared for very lean crops. The cumulative effect of the poor rainfall conditions of 1964 too will be reflected in this year's crop. Lunuwila, Madampe, Chilaw and Puttalam areas will record a severe decline in yield, whereas Kurunegala may not record such a heavy decline.

4. Production and Exports

(*a*) *Production:*

The estimated production of coconuts in Ceylon for the year 1965 is 2835 million nuts, which is 9.9% below the production in 1964 and 1.2% above the average for the last 5 years. This fall in production can be reasonably attributed to the unfavourable weather conditions that prevailed in 1964. These unfavourable conditions of 1964, coupled with the worse conditions in 1965 will give rise to lean crops in 1966 in the major coconut growing areas of Ceylon.

(*b*) *Exports:*

The total quantity (in nut equivalent) of the major coconut products exported in 1965 is 1278 million nuts—this being 21.4% lower than the 1964 exports and 5.0% lower than the last 5-year average.

The average value of exports in 1965 is Rs. 217.61 per 1000 nuts. This is 28.3% higher than 1964 and 32.7% higher than the last 5-year average.

5. Publications

(*a*) *Published during the year*

(i) "Seasonal variation of coconut crops" by V. Abeywardena & J.K.T. Fernando. (Ceylon Coconut Quarterly).

(ii) "Nutritional and Physiological studies on coconut water. Part 1. Further aspects of the nutritional content of nut water in relation to soil nutrients" by M.L.M. Salgado and V. Abeywardena (Ceylon Coconut Quarterly).

(iii) "Studies on biennial bearing tendency in coconut. 2. A minimum plot size for coconut" by V. Abeywardena (Ceylon Coconut Quarterly).

(iv) "The economic optimum in fertilizer application" by V. Abeywardena (Ceylon Coconut Planters' Review).

(v) "Economics of fertilizer Use" by V. Abeywardena (Tropical Agriculturist).

(*b*) *Pending Publications*

(i) "Growth standards for coconut seedlings in the Southern Province" by V. Abeywardena and W. V. Fernando.

(c) *Talks*

The Biometrician addressed the Low Country Products Association on the subject —"The economic optimum in fertilizer use".

6. Honorary Work

The Biometrician was consulted by the Research Officers of the Rubber Research Institute of Ceylon, the Department of Agriculture and the Kantalai Sugar Corporation, in their statistical problems.

7. Personnel

Biometrician	—	V. Abeywardena
Research Assistant	—	J.K.T. Fernando, B.Sc. (Ceylon).
Lab. and Field Assistants	—	G. Karunasena
		E. R. Fernando
Lab. and Field Attendants	—	D. T. Fernandopulle
		1 Post vacant.

V. ABEYWARDENA,
Biometrician,
Coconut Research Institute.

REPORT OF THE PLANTING OFFICER

NURSERIES

Seednuts:—1,811,647 seednuts were planted in the nurseries during the year. The distribution of seednuts in the nurseries is as follows:

Nursery	*May/June* 1965	*Oct./Nov.* 1965	*Total*
1. Rathmalagara	96,820	180,577	277,397
2. Hettipola	25,230	36,100	61,330
3. Walpita	90,026	88,160	178,186
4. Eraminigolla	40,000	35,000	75,000
5. Wilpotha	110,575	172,785	283,360
6. Ibbagamuwa	84,840	226,693	311,533
7. Kalawewa	—	87,376	87,376
8. Koggala	42,500	49,875	92,375
9. Handapangala	—	152,165	152,165
10. Mylambavely	—	76,000	76,000
11. Alampil	—	126,180	126,180
12. Kilinochchi	—	90,745	90,745
	489,991	1,321,656	1,811,647

Seedlings:—Orders for 1,161,939 seedlings were booked for both planting seasons i.e. May/June and October/November 1965 (up to 31.12.65). The demand for seedlings from May/June 1965 exceeded all expectations and orders for large quantities had to be reduced. The demand continued to be more than the available supply even in October/November season, 1965. The distribution of seedlings from the nurseries is as follows:—

Nursery	*May/June* 1965	*Oct./Nov.* 1965 *up to* 31.12.	*Total*
1. Rathmalagara	70,495	106,474	176,969
2. Hettipola	19,210	24,105	43,315
3. Walpita	58,443	39,379	97,822
4. Eraminigolla	28,130	29,050	57,180
5. Ibbagamuwa	63,878	122,509	186,387
6. Kalawewa	—	66,282	66,282
7. Wilpotha	67,515	139,765	207,280
8. Koggala	28,172	34,770	62,942
9. Kilinochchi	—	57,610	57,610
10. Alampil	—	75,272	75,272
11. Handapangala	—	90,920	90,920
12. Mylambavely	—	39,960	39,960
	335,843	826,096	1,161,939

P. D. L. FERNANDO,
Planting Officer.

REPORT OF THE PUBLICATIONS OFFICER

Following publications were issued during 1965.

Ceylon Coconut Quarterly Vol. XIV No. 3/4 & Vol. XV.

Ceylon Coconut Planters' Review Vol. IV No. 1.

C.R.I. Bulletins No. 22, 23.

Pol Pawath (Journal in Sinhala) Vol. 3. No. 2, 3.

Annual Reports (Sessional Papers) of 1962, 1963, 1964, 1965.

Five Advisory Leaflets in Sinhala and nine Advisory Leaflets in English were reprinted. Arrangements were made to issue new translations of advisory leaflets in Tamil.

Library

The publications available in the Library were classified and organised occarding to Dewey Decimal system by Mr. Christie Perera. An index of available publications on coconut is being prepared by him.

Radio and National Press

Efforts were made to make enhanced use of mass media for publicity. The heads of research divisions gave talks over the English National Service of Radio Ceylon on some important aspects work done in each division. Sinhala and Tamil versions of these talks were also broadcast. It appeared from the comments received from the listeners, that these talks were well received. Arrangements are now being made to broadcast a regular monthly programme on coconut cultivation and production. The National Press was kept informed of all events of interest, pertaining to the work done in the Institute. The Co-operation extended to us by the National Press and Department of Broadcasting is gratefully recorded.

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

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REPORT OF THE WELFARE OFFICER

The Staff position was as follows:—

	Senior	*Intermediate*	*Assistant*	*Minor*	*Total*
At the end of 1964	8	7	126	105	246
New appointments in 1965	—	—	7	—	7
	8	7	133	105	253
Less—Retirements	1	—	—	1	2
	7	7	133	104	251
Vacation of posts	—	—	1	—	1
	7	7	132	104	250
Resignations	—	—	2	—	2
	7	7	130	104	248
Dismissals	—	—	1	—	1
	7	7	129	104	247
Appointments from Minor Staff	—	—	3	—	3
Staff position as at 31.12.65	7	7	126	104	244

The cadre of the staff at the end of 1965 was 244 as against 246 in 1964. There were seven new Assistant Staff Grade appointments of which 2 were recruited from the Minor Staff Grade. The minor staff yet continues to benefit from the service qualification in lieu of academic qualifications while such concessions have still not been extended to some of the other grades in the staff and labour force. The Assistant and Minor Staff and the non-staff monthly paid and daily paid employees however enjoyed the priviledge of applying for posts internally before they are open for outside candidates by advertisement in the press. In fairness to all monthly paid workers the concession allowed to estate watchers who are eligible for promotion to the minor staff should be extended to all employees of that category.

The permanent labour force of the Institute as at 31.12.65 was as follows:—

On monthly pay	35
On daily pay	284

This excludes temporary gangs on daily pay and contract employed for casual work. The monthly paid workers are categorised as non-staff employees. They are not entitled to the privileges enjoyed by the staff but are entitled to Dearness and Special living allowances at Government rates. Daily paid workers are continued to be paid -/10 cts. above the respective trades of the Wages Board Ordinance they are classified. A service allowance of -/15 cts. for the first five years continuous service and another -/15 cents for the second five years continuous service is paid on completion of the respective periods of service.

Workmens Compensation:—There were 20 accidents during the year as against 10 accidents in 1964. All these were temporary disablement cases. There were no partial disablement and fatal cases during the year. The Institute pays an additional premium to cover the workers for the first seven days—"Waiting days". This is a special privilege allowed to them as it has been observed that in most of the temporary disablement cases the workers in addition to expenses they incur on minor injuries they have to be deprived of their wages for the days they are unable to work as a result of such minor accidents. First Aid materials were available for cases where hospital attention was not needed.

Housing:—A sum of Rs. 55,144.89 has been spent in the construction of buildings and a sum of Rs. 7504.90 on furniture during the year. 4 meetings of the Housing Committee were held during the year and 4 married officers were recommended for allocation of married quarters and 5 unmarried officers were recommended for allocation of Hostel Rooms, Canteen. Bath Room and Rest Room facilities have been well maintained and made common to all categories of employees without any discrimination.

Financial Aid:—(*a*) A Festival Advance of Rs. 100/- per head were paid to the monthly paid staff and non-staff employees drawing a basic salary of Rs. 300/- and less and Rs. 50/- to the daily paid employees. (*b*) A sum of Rs. 89,783/- was paid as loans for purchase of building sites and/or construction of houses from the Provident Fund. (*c*) A sum of Rs. 36,252/71 have been paid as Insurance premium on 98 Policies. (*d*) The total amount contributed to the Staff Provident Fund by the employees was Rs. 88,440/50 to which the Board contributed an equal amount on which Interest at 2½% on both contributions accrued to the credit of the employees. (*e*) The Officers' contributions to the Medical Aid Fund during the year was Rs. 14,370/52 to which the Board contributed an equal amount. 8 Meetings of the Fund were held during the year and a sum of Rs. 26,024/52 has been paid on claims approved. Loans under Rule 14 of the Fund were also approved in cases of special hardships and special concessions to members have been obtained from Doctors in the panel. As no members preferred to be elected to represent the four grades of the staff, the previous years' elected representatives continued to hold office in the Committee of Management.

General:—The necessary assistance was given to the Administration in carrying out the establishment work of the Institute and in particular, applications and complaints regarding Provident Fund, Festival Advances, Loans, Insurance, Employment and training have been dealt with.

Thrift, Savings and Stores Supplies:—The C.R.I. Co-operative Welfare Society Ltd., catered to the needs of members in the supply of food and curry stuff and a large variety of other articles, such as groceries, textiles, etc., were made available. A deep freezer has been purchased and fish has been made available at competitive prices. The canteen section catered to the day-to-day needs of the members. Thrift and savings were also a part of the Society's business. Besides the money provided for capital expenditure by the Board and the allocation of a Building, free supply of electricity and transport facilities, the Board still continues to give an annual grant of Rs. 1500/-.

A fully furnished Rest Room with Canteen facilities and radio music have been provided at Institute's expense. The Institute has also maintained the Labour rest rooms in outstations.

Recreational and Cultural Activities:—The C.R.I. Recreation Club participated in the "D" Division Government Service Cricket tournament and was eliminated in the first match played against the Department of Commerce. The Cricket team also participated in a few friendly matches during the year. Club nights were regularly arranged. The Annual Christmas Party was held and a sports meet, variety entertainment, distribution of gifts to children and the laying of the foundation stone for the Club House were the main features of the party. The Board was very generous in allocating a sum of Rs. 14,000/- for the Club House and increasing the Annual Grant from Rs. 500/- to Rs. 1200/- and from Rs. 65/- to 125/- per tournament Cricket match. The C.R.I. Art Circle participated in several excursions during the year. It started with the organisation of the Sinhalese New Year celebrations which included a variety entertainment and sports meet and transport facilities were provided to visit the Botanical Gardens at Gampaha, Religious Shrines at Anuradhapura and Madhu and to see a number of historical plays. The Art Circle has also expanded the issue of books and periodicals which were of literal value and the issue of the Annual Magazine is under preparation. This is the only recognised organisation in the Institute to which the Board has still not given any financial assistance and in view of the valuable service it renders on the cultural and literal sides and harmonious relationships it can bring about among all catogories of employees the need for Board's financial assistance for further development of this organisation is nevertheless essential.

Industrial Relations:—A section of officers in the Institute, including Intermediate, Assistant and Minor staff who were not members of any trade unions formed a new trade Union known and registered as the "Coconut Research Board Employees Association". There were no industrial disputes and the atmosphere was rather quiet during the year. The Institute allowed labour conferences with representatives of the respective trade unions and every effort was made to maintain cordial relationships between the employer and employee.

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

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REPORT ON THE ESTATES

I. BANDIRIPPUWA ESTATE

Acreage

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

The above acreage comprises as follows:—

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

Census

Census of palms as at February, 1965 is as follows:—

Particulars	1	2	3	4	5	6	*BB*	*GA*	*GB*	*A*	*B*	*C*	*Total*
Full bearing	1398	456	888	1926	688	117	67	296	242	5289	2840	1201	15408
Partial bearing	326	214	238	390	128	16	10	28	42	850	735	771	3748
Duds	102	153	106	124	64	35	6	3	10	138	125	104	970
In flower	2	5	2	95	18	—	—	82	—	51	—	1	256
With stem	3	104	1	44	77	—	—	88	—	1555	1	1	1874
Established plants	—	8	—	36	156	—	—	89	—	251	2	2	544
Supplies	146	—	246	19	10	—	—	—	—	19	—	—	440
Vacancies	55	2	32	100	65	6	—	9	6	665	244	239	1423
Total ..	2032	942	1513	2734	1206	174	83	595	300	8818	3947	2319	24663

Field Notes

Weeding:—The whole estate has been controlled of its heavy growth of noxious weeds *Eupatorium Odoratum* weed has been completely eradicated.

Drains:—3506 fathoms old drains have been cleaned and deepened.

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

Streams:—1143 fathoms streams have been deepened and cleaned for the year.

Pest and Diseases:—There was no incidence of Red Weevil attack reported for the year. The estate sanitation has been maintained well.

Cultivation: —Disc-harrowing the whole estate area has been undertaken for the year.

Husk Burying:—Husk burying in the estate area has been systematically carried out in large pits between two palms.

Rainfall

This compares with the previous year as follows:—

Average 1954/50	*Month*	1964 *Inches*	1964 *W/days*	1965 *Inches*	1965 *W/days*
2.20	January	2.75	5	0.44	2
2.17	February	3.00	6	0.62	3
5.38	March	9.55	11	1.26	3
8.40	April	1.99	8	4.78	9
10.31	May	16.74	14	9.03	13
7.42	June	7.04	15	1.61	9
2.82	July	4.87	17	2.09	6
3.45	August	4.45	13	11.97	15
4.28	September	5.71	15	4.24	12
12.56	October	11.93	18	18.29	20
12.92	November	6.76	13	3.42	12
4.81	December	1.76	6	8.42	14
76.72	Total	76.58	141	66.17	118

Crops

This compares as follows:—

Pick	1961	1962	1963	1964	1965	5 *year average*
1	132987	177091	136099	155216	142741	134723
2	234073	208157	245978	210927	218317	212950
3	338525	290938	302346	274377	268827	281799
4	288305	247566	258931	239159	254697	248131
5	185311	144433	152098	167098	182795	157190
6	120618	111280	129715	130820	120655	122436
Total ..	1299819	1179465	1225167	1177597	1188032	1157229

The total crop received for 1965 was 1,188,032 nuts from 1,9156 palms equivalent to 304.0 acres. Thus nuts per palm were 62.0 nuts and 3908.0 nuts per acre.

Disposal of nuts

	Nuts	
Sold on contract	144,800	
Sold to Research	505	
Sold to Staff	1,381	
Nursery	1,603	
Converted into copra	1,001,434	
Allowances to Staff	25,684	
Empties	12,625	1.1%
Total	1,188,032	

The 1,001,434 nuts cured into copra obtained 742 candies and 557 lbs. on an out-turn of 1,348 nuts to a candy. The percentage of No. 1 copra was 90.8%.

Manuring

The following palms have been manured with Fertilizer for the year:—

		Palms	
Estate Field No.	1	1525	*Dosage*: 3 lbs. Sulphate of Ammonia
	2	65	3 lbs. Saphos Phosphate
	3	971	3 lbs. Muriate of Potash 60%
	4	808	9 lbs.
	5	197	@7 lbs. per palm half circle
	6	188	
	BB	64	
	B	2185	
	C	559	
		6562	
Young palms	GA	110	Half the dose of adult palm
	4	147	
		257	
Research Blocks			
	Pasture plots	2743	
	Response Curve	2333	As per experimental requirement
	Botanist's Blocks	593	
		5669	
	Grant Total	12488	

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

Expenditure

The Estate expenditure for the year per 1000 nuts is as follows:—

General Charges	Rs. 37,392.13	@	Rs. 31/48	Rs. 41,779.00	@	Rs. 34/81
Upkeep	Rs. 8,935.92	@	Rs 7/52	Rs. 35,634.00	@	Rs. 29/70
Cultivation	Rs. 14,801.24	@	Rs. 12/46	Rs. 18,278.00	@	Rs. 15/23
Collection	Rs. 19,336.20	@	Rs. 16/28	Rs. 19,775.00	@	Rs. 16/48
Total	Rs. 80,465.49	@	Rs. 67/74	Rs. 115,466.00	@	Rs. 96/22

D. F. WITHANA,
Superintendent, Bandirippuwa Estate.

II. RATHMALAGARA ESTATE

Superintendent:—Mr. D. P. L. E. Silva.

Staff:—Mr. W.W.H.R.A. Fernando, F/A, Estate. Tractor Driver and four Watchers.

Acreage Statement

Block No. 1	—	30 acres
Block No. 2	—	7 acres
Block No. 3	—	9 acres
Block No. 4	—	31 acres
Block No. 5	—	21 acres
Block No. 6	—	26 acres
Block No. 7	—	31 acres
Block No. 8	—	6 acres
Botanist's Blocks	—	75 acres
		236

Rainfall

Months	1965	*Wet Days*	1964	*Wet Days*
January	—		2.50	3
February	1.78	2	1.44	4
March	.36	1	8.00	11
April	5.39	11	1.93	6
May	5.32	13	9.18	9
June	1.46	8	3.48	8
July	.09	2	2.97	7
August	1.69	13	1.22	3
September	.78	9	9.47	6
October	16.81	14	7.27	9
November	6.30	9	16.79	13
December	6.77	11	—	—
	46.75	93	64.25	79

It will be noted from above that it was a continuous period of drought from December 1964 to April 1965.

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Crops

Pick	1961	1962	1963	1964	1965
1	63476	103957	88806	93857	98290
2	123186	169045	154890	128764	162689
3	119706	177848	208134	181855	162985
4	107782	179191	175252	137397	175467
5	56500	109552	93738	116424	312521
6	63974	87732	72627	77865	62039
	534623	827325	793447	736162	793991

Disposal of Crops—Estate Section

Pick No.	*Cured*	*Sold*	*Allowances*	*Rejections*
1	51290	—	1696	1061
2	15680	75980	2234	1862
3	16929	80208	1188	1910
4	22168	75000	1552	1996
5	21346	59412	1710	1699
6	4624	26856	1710	618
	132037	317456	10090	9146

The nuts cured were nuts rejected by the buyers to whom the nuts were sold. Nuts of five crop had to be sold due to the kiln having caught fire accidentally.

Field Work

The following Field work have been carried out during the year:—

Weeding. 5570 squares all Fields.
Clearing. 9 acres all Fields.
Clearing Drains. 5428 Fathoms all Fields.
Husks Pits opened. 488 all Fields.
Road repairs. 547 Fathoms.
Repairing Boundary Fence. 1322 Fathoms.
Manuring. 3519 Palms all Fields.
Uprooting. Illuk 656 squares Block No. 7 Y.P.
Mulching. 1020 squares all Fields.
Closing Husks Pits. 314.
Ant Hills. 36 in Fields No. 7, 6 & 3.

Buildings

A new copra kiln planned by the Chemist, is being built, and when finished will be the first of its kind in Ceylon.

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