# CEYLON COCONUT QUARTERLY

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# ANNUAL REPORT OF THE COCONUT RESEARCH INSTITUTE FOR 1964

The present report is the 36th Annual Report of the Coconut Research Institute, which was established by Ordinance No. 29 of 1928, dated December 1928.

## REPORT OF THE CHAIRMAN

On January 1964 the Coconut Research Board consisted of the following:—

**Ex-Officio Members**

Director of Agriculture: Mr. A.T.M. Silva.

Treasury Representative: (Vacant).

Commissioner, Coconut Rehabilitation: Mr. C. Chanmugam.

Chairman, Low Country Products Association: Mr. P. Nadesan, *C.M.G., O.B.E.*

Director, Coconut Research Institute: Dr. M.L.M. Salgado.

**Nominated Members**

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

Mr. Lakshman Jayakody, *M.P.*

Mr. S.D.R. Jayaratne, *M.P.*

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.S. Samaraweera.

Mr. C.A.M. de Silva, (Chairman, Coconut Research Board).

Nominated by the Honourable Minister to represent the Small Holders.

Mr. M.M. Kumarakulasingham.

Mr. L.W.A. Fernando.

**Meetings.**—With the dissolution of Parliament on 17th December, 1964, the two Members of Parliament ceased to be members of the Board.

**Meetings.**—Five meetings of the Coconut Research Board were held on 25th January, 14th March, 13th June, 12th September, 19th December respectively. Special Board Meetings were held on 9th May, 4th July, 27th November, 10th December 1964 respectively.

*Administrative Committee* (Personnel as at 1st January 1964).

(1) Mr. C.A.M. de Silva.

(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. S.D.R. Jayaratne.

(8) Dr. M.L.M. Salgado.

The 46th, 47th and 48th meetings of the Administrative Committee were held on 25th April, 25th July, and 24th October respectively.

*Estates and Experimental Committee* (Personnel as at 1st January 1964).

(1) Mr. P. Nadesan, *C.M.G., O.B.E.*

(2) Mr. A.T. Mahinda Silva.

(3) Mr. B. Warusavitharne.

(4) Mr.C.A.M. de Silva.

(5) Mr. C.T. Van Geyzel, *J.P.*

(6) Mr. L.W.A. Fernando.

(7) Mr. M.M. Kumarakulasingham, (Chairman).

(8) Dr. M.L.M. Salgado.

(9) Mr. Lakshman Jayakody.

*Three Co-opted Members*

(1) Mr. K.V.M. Subramaniam.

(2) Mr. X. Jobin.

(3) Mr. R.H. de Mel.

The 47th, 48th, 49th and 50th meetings of the Estates and Experimental Committee were held on 21st February, 16th May, 15th August and 14th November respectively.

*Extension Committee* (Personnel as at 1st January 1964).

(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, *C.M.G., O.B.E.*

(7) Dr. M.L.M. Salgado.

The 38th, 39th and 40th meetings of the Extension Committee were held on 8th February, 29th August and 7th November respectively.

*Editorial Committee* (Personnel as at 1st January 1964).

(1) Mr. L.W.A. Fernando, (Chairman).

(2) Dr. M.L.M. Salgado.

(3) Dr. D.V. Liyanage.

(4) Dr. E. Abeyratne.

(5) Mr. M.M. Kumarakulasingham.

The 8th meeting of the Editorial Committee was held on 21st February, 1964.

C.A.M. DE SILVA,

*Chairman, Coconut Research Board.*

# REPORT OF THE DIRECTOR

## 1. STAFF

The Staff of the Coconut Research Institute at the end of 1964 was as follows:—

### Administration Division

Director—Dr. M.L.M. Salgado, Ph.D. (Cantab.), B.Sc. (Lond.), Dip. Agric. (Cantab.).
Acting Director—(From 1.12.64): Mr. C.A. Coorey, B.Sc., C.A.S.
Chief Administrative Officer and Secretary to the Board—Mr. S.C. Kahawita, B.Com. (Lond.).
Assistant Secretary—Mr. T.T.A.J.C. Samarasinghe, LL.B. (Ceylon).

### Soil Chemistry Division

Soil Chemist—Dr. D.A. Nethsinghe, D.Phil. (Oxon.), B.Sc. (Ceylon), A.R.I.C.
Research Assistant—Mr. T.S. Balakrishnamurti, B.Sc. (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, Ph.D. (Manch.), B.Sc. (Lond.).
Research Assistant—Mr. M.A.P. Manthriratne, B.Sc. (Lond.).

### Agrostology Division

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

### Planting Division

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

### Advisory Division

Chief Advisory Officer—Mr. C.A. Wickramasuriya, 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

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

Dr. D.V. Liyanage, (Botanist) proceeded to the University of Birmingham to follow a course in Biometrical Genetics under the Colombo Plan Technical Co-operation Scheme.

Mr. U.B.M. Ekanayake, (Crop Protection Officer) was awarded the Ceylon University Science Scholarship and was granted study leave to proceed to the University of Oxford for post-graduate studies.

Mr. T. Ganarajah, (District Coconut Instructor) served an assignment in East Pakistan as Coconut Extension Specialist for a period of 3 months, under the Colombo Plan Technical Co-operation Scheme.

## 2. RESEARCH CONFERENCES

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

(i) Mr. U.B.M. Ekanayake, Crop Protection Officer led a discussion on "Some Aspects of the lesser known insects associated with Coconut in Ceylon".

(ii) Mr. C.A. Wickremasuriya, Chief Advisory Officer led a discussion on "Some Problems of Extension Work on Coconuts".

## 3. TRAINEES

Mr. K. Ahamed, Deputy Director of Agriculture, Coconut Development (East Pakistan), a trainee under the Colombo Plan Technical Co-operation Scheme received instruction for 3 weeks at the Institute.

Mr. H. Sudasrip, Coconut Technologist from Indonesia, sent under the Colombo Plan Technical Co-operation Scheme for a period of one year, commenced his training in Coconut Technology towards the end of the year.

## 4. VISITORS

The visitors during the year included the following:—

Delegates to the Second Session of the F.A.O., Technical Working Party on Coconut Production, Protection and Processing (held in Colombo), visited the Institute on 7th December.

Dr. W.O. McCarthy, F.A.O.
Mr. F.J. Hall of the Tropical Products Institute, London.
Mr. F.H. Wright of the Tropical Stored Products Centre, U.K.

## 5. PUBLICATIONS

Articles entitled "Coconuts in 1964" and "Activities of the Coconut Research Institute in 1964" were contributed by the Chemist to the Annual Report of the Planters' Association of Ceylon.

An article entitled "Statistical Control of Variability in Coconut Experiments" by Mr. V. Abeywardena was published in the Empire Journal of Experimental Agriculture, Vol. XXXII, No. 126 (April 1964).

The Ceylon Coconut Quarterly, Volume XIV (combined Nos. 1 and 2) was published during the year.

The Ceylon Coconut Planters' Review, Volume III No. 3 and Volume III No. 4 were 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

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

In continuation of previous work, the problem of oil exudation from Ceylon Desiccated Coconut was studied further. A satisfactory plate-method has been evolved and is being applied for the routine testing of oil exudation.

On the basis of a series of experiments, the drying principles underlying the Standard Ceylon Kiln are being critically examined and appropriate factual information consolidated for publication.

Coconut treacle is a product that varies very much in chemical composition and keeping qualities. On the basis of studies now in progress it is hoped to be able to recommend quality standards for this product.

After a cessation of about five years, experimental toddy tapping was resumed during the year. Chemical studies are being projected mainly with the object of enhancing the fermentation efficiency of coconut toddy and improving the flavour and quality characteristics of the arrack produced therefrom by distillation.

## Botany

Controlled Pollination work for the production of Tall × Tall (prepotent) and tall × dwarf seed was carried out at 5 stations. A programme for the production of dwarf × tall seednuts was initiated on the Seed Garden, Ambakelle. 8,100 tall × tall and 3,565 tall × dwarf seedlings were issued to the industry during the year.

The 29 progenies of tall × dwarf crosses planted at Ratmalagara estate in 1950 continued to give high yields, averaging 148 nuts per palm per year.

A pool of 50,597 mother palms has been built up through palm selection. During the year 1,358,472 selected seednuts from these palms were supplied to the Planting Division for the purpose of raising seedlings.

The field trials on Planting Techniques, and the Progeny Trials at Marandawila, Walpita and Bandirippuwa were maintained throughout the year.

The results of a progeny trial indicate that mass selection on the basis of husked nut weight is effective. A further interesting correlation is that the leaf production of the progeny during the first 40 months is an index of the relative breeding status of the parent palms. This may prove a useful index for the identification of palms of high breeding value.

## Soil Chemistry

Two new long-term field trials were initiated in 1964—one to compare the efficiency of different forms of nitrogenous fertilizers on adult palms, and the other a similar study on nitrogenous and phosphatic fertilizers on young palms.

The experiment on organic vs. inorganic fertilizers has again shown that there is no advantage to be gained by the use of expensive organic fertilizer mixtures. The new $4^8$ NPK trial at Bandirippuwa has indicated that increased yields can be obtained by raising the levels of nitrogen to 1.5 lbs. as N (7.5 lbs. sulphate of ammonia) and potash to 1.5 lbs. as $K_2O$ (3 lbs. muriate of potash) per palm annually.

There has been no response to phosphate in this experiment. At Ratmalagara estate on the other hand, the largest yield response has been obtained to the application of the complete NPK fertilizer mixture (C.R.I. mixture 'A') at the rate of 9 lbs. per palm per annum.

Trials at Walahapitiya estate, Nattandiya combined with experiments using radio-active phosphorus have shown that the application of fertilizers in the entire area round the palm up to a distance of about $5\frac{1}{2}$ feet from the bole is the most economical and efficient method of fertilizer placement.

Laboratory investigations have shown that the processes of nitrification in acid lateritic soils can be enhanced by raising the soil pH to near neutrality through the application of dolomite.

Estimation of soil phosphate availability using radio isotopic methods and sodium bicarbonate extraction has satisfactorily explained the pattern of response to phosphate manuring at Pothukulama.

**Agrostology**

The nutrient status of samples of Gonapinuwela gravel, Walahapitiya loam and the coastal sands of Iranawila was evaluated by the Soil Pot Culture technique using indicator plants.

Experiments on the growth of pastures under coconut were continued. These included studies on pasture management for soil moisture conservation, and grass-legume competition for nitrogen.

An experiment to determine the effect of concentrate feeding on the milk yield of cattle was commenced during the year. The interim data have not indicated any significant advantage from such feeding.

**Crop Protection**

The biological control project started in 1960, was continued during the year. Parasites were bred both at the station in Batticaloa and the Unit at Lunuwila. It was possible to breed and issue parasites in sufficient numbers to all estates that made application for them. Observations were kept on selected estates to study the effect of parasite liberation and the extent of control.

Outbreaks of the pest Aspidiotus destructor (Coconut Scale) occurred in the Western, North-Western and Southern Provinces. They were all brought under control by spraying kerosene oil emulsion.

Observations on the mode and pattern of spread of "Leaf Scorch" decline of coconut palms in the Southern province were recorded. Fungicidal and nematocidal trials were initiated during the year. Studies on nematode assay were continued and two more species viz. Aphelencoides and Rhabditis were isolated.

**Biometry**

Apart from routine statistical work for the Research Divisions, a series of biometrical studies pertinent to Coconut Research were initiated. A survey was also made with a view to determining the growth standards for coconut seedlings under Citronella.

The agri-meteorological stations at Bandirippuwa, Ratmalagara and Ambakelle were maintained satisfactorily during the year.

The Biometrician was consulted by the Rubber Research Institute of Ceylon regarding the design of certain experiments and the statistical analyses of data.

**Advisory**

A new Demonstration Centre was opened at Mylambavelly in the Eastern Province, where five acres of jungle were cleared and planted. The proposition is to extend this plantation annually by five acres until the entire extent of 25 acres is planted up. The Demonstration Centres at Pallai, Alampil and Mylambavelly were affected by the cyclone of 22nd December.

1,002 tons of free fertilizer were issued during the year, in respect of 646,006 seedlings planted under the Citronella Subsidy Scheme during 1960 and 1961.

**Planting**

2,000,244 seednuts were planted in the 12 Planting Division Nurseries. The demand for seedlings in May/June continued to be poor and there was a surplus left in the nurseries. The demand however exceeded the available supply during October/November.

**General**

An all-time record in coconut production estimated at 3,148 million nuts was registered in 1964. The cumulative effects of manuring under the Fertilizer Subsidy Scheme combined with satisfactory rainfall (both in intensity and distribution) during the preceding year would probably account for this peak. The new production figure actually represents an increase of 16.4% over 1963 and 5.2% over the previous record reached in 1962.

The supply of fertilizers under the Government Subsidy Scheme on permits issued by the Commissioner of Coconut Rehabilitation continued during 1964. The subsidy rate remained the same, viz. 50% of the cost of fertilizer for estates under 20 acres in extent and 33⅓% for those of higher acreage.

Ceylon has achieved complete success in the elimination of Salmonella infection as regards desiccated coconut.

The laboratories set up by the Ceylon Coconut Board for the examination of D.C. samples have been extended with a view to stepping up the scope of chemical and bacteriological control on D.C. manufacture, in the island.

Through the generosity of the Government of Ceylon, the F.A.O. Technical Working Party on Coconut Production, Protection and Processing was enabled to hold its Second Session in Colombo from 30th November to 8th December 1964. Delegates and Observers from thirteen countries and five organizations participated in the meeting.

D.C.L. AMERASINGHE,
*Acting Director, Coconut Research Institute.*

# REPORT OF THE SOIL CHEMIST


## SUMMARY

The field experimental programme of 1963 was continued in 1964. In addition, two new long-term field trials were initiated in 1964—one to compare the efficiency of different forms of nitrogeneous fertilizers on adult palms, and the other, a similar study of nitrogenous and phosphate fertilizers on young palms. A simple observation trial on soil applications of different combinations of major and minor elements on "leaf scorch" problem palms at Elpitiya was also commenced early in 1964. Pre-treatment records were maintained on palms exhibiting immature nut fall at Bingiriya with a view to laying down a similar trial with major and minor elements.

The experiment on organic vs. inorganic fertilizers at Bingiriya has again showed that there is no advantage to be gained by the use of expensive organic fertilizers. In this experiment, biennial full circle manuring was found to be as effective as annual half circle manuring.

The experiment on fertilizer placement and liming on acid lateritic gravelly soil at Nattandiya showed that the surface application of fertilizers is as effective as the more expensive traditional method of trench manuring, while broadcast application is less efficient. Using radioactive phosphorous, it was found that full circle application is about 40% more efficient than application in semicircles. It now seems that the surface application of fertilizers in the entire area round the palm up to a distance of about $5\frac{1}{2}$ feet from the bole is the most economical and efficient method of fertilizer placement.

In the NPK factorial experiments, significant yield responses to all three elements were obtained at Ratmalagara and Bandirippuwa, while at Pothukulama, growth responses in young palms were obtained only for N and K. The new $4^3$ NPK trial at Bandirippuwa has shown that increased yields can be obtained by raising the levels of nitrogen to 1.0 lbs. N (5 lbs. sulphate of ammonia) and potash to 1.5 lbs. $K_2O$ (3 lbs. muriate of potash) per palm annually. The results of the experiment on an acid lateritic soil at Nattandiya indicate that liming would lead to increased crop production.

Estimation of soil phosphate availability using radio-isotopic methods sodium bi-carbonate extraction and equilibration with dilute calcium chloride solution has satisfactorily explained the lack of response to phosphate manuring at Pothukulama.

Chemical analysis of leaflet samples from the N.P.K. trial at Pothukulama confirmed that the lack of response to phosphate application was due to adequate availability of soil phosphate. Foliar analysis was also done on samples taken from the trials on magnesium deficiency and "leaf scorch" problem with a view to studying the effects of application of magnesium and boron respectively on leaf composition.

A soil survey of coconut growing areas in the Galle-Ambalangoda districts was done to ascertain whether the problem of "leaf scorch" was associated with any particular soil type. Such an association was not observed.

# DETAILED REPORT

## A. FIELD EXPERIMENTS

### 1. 3 × 3 × 3 NPK Factorial Experiment (Bandirippuwa Estate)

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

This experiment completed its 29th year in 1964. The response to the various manurial treatments was similar to that obtained in 1963. The main effects are given in Table 1. The potash response continues to be highly significant, and phosphate has shown a significant response for the third year in succession. The lack of response to nitrogen is in marked contrast to the results obtained in the other manurial experiments (see below). The reasons for this remains to be determined. However, there is some indication of the NP and NK interactions reaching statistical significance. This experiment will be concluded in 1965 after taking leaf samples from the different plots for foliar analysis.

**TABLE I**

**Yield data (main effects) for 1964—$3^3$ NPK Experiment, Bandirippuwa (66 palms/acre)**

| *Treatment (biennial)* | *lbs. copra/acre* | % | *Difference lbs. copra/acre* |
|---|---|---|---|
| $N_0$ (0.0 lbs. N) | 2,026 | 100 | — |
| $N_1$ (0.5 lbs. N) | 2,074 | 102 | + 48 |
| $N_2$ (1.0 lbs. N) | 1,982 | 98 | - 44 |
| $P_0$ (0.0 lbs. $P_2O_5$) | 1,909 | 100 | — |
| $P_1$ (1.0 lbs. $P_2O_5$) | 2,048 | 107 | +139* |
| $P_2$ (2.0 lbs. $P_2O_5$) | 2,125 | 111 | +216* |
| $K_1$ (0.75 lbs. $K_2O$) | 1,766 | 100 | — |
| $K_2$ (1.5 lbs. $K_2O$) | 2,091 | 118 | +325*** |
| $K_3$ (2.25 lbs. $K_2O$) | 2,225 | 126 | +459*** |

Significant difference at P .05 = 138 lbs. copra/acre.

*— Significant at P .05

***— Significant at P .001.

### 2. Manurial × Cultivation Experiment (Ratmalagara Estate)

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

This experiment completed its 21st year in July 1964. As in the previous years, the response to phosphate continued to be highly significant, but the yield response to potash failed to reach statistical

significance. Ploughing has shown a significant response after a lapse of two years. (See Table II). This experiment will be modified in 1965 with a view to assessing (i) the effects of deep ploughing annually, and (ii) the effects of suspending phosphate and potash applications.

TABLE II

**Yield data for 1962/63—Manurial × Cultivation Experiment, Ratmalagara Estate (60 palms/acre)**

| *Treatment (biennial)* | *lbs. copra/acre* | % | *Difference lbs. copra/acre* |
|---|---|---|---|
| $P_0$ (0.0 lbs. $P_2O_5$) | 1,239 | 100 | — |
| P (1.0 lbs. $P_2O_5$) | 1,977 | 154 | +738*** |
| $C_0$ (No ploughing) | 1,538 | 100 | — |
| C (ploughing) | 1,678 | 109 | +140* |
| | Significant difference at P .05 = 128 lbs. copra/acre. | | |
| $K_0$ (0 lbs. $K_2O$) | 1,522 | 100 | — |
| $K_1$ (1 lbs. $K_2O$) | 1,614 | 106 | + 92 |
| $K_2$ (2 lbs. $K_2O$) | 1,686 | 111 | +164 |

*— Significant at P .05.

***— Significant at P .001.

### 3. 3 × 3 × 3 NPK Experiment on Young Palms (Ratmalagara Estate)

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

These palms are now 16 years old. The 16th annual manuring was done in December 1964. The yield data for the main effects of N, P and K are shown in Table III(*a*). All three nutrients have continued to produce highly significant increases in crops (P .001). The NP interaction was also significant at the 0.1% level, while the NK interaction showed statistical significant at P .05.

The first order interactions are seen in Table III(*b*). The pattern of response to fertilizer is similar to that obtained in 1963. The response to potash increases with increasing levels of nitrogen—the $N_2K_2$ combination giving highest yields (2,213 lbs. copra/acre). In the absence of potash, there is no gain in increasing the level of nitrogen from 1½ lbs. to 3 lbs./palm/annum.

The NP interactions is also positive—the response to phosphate rising with increasing levels of nitrogen. The combination $N_2P_2$ gave the highest yield—2,410 lbs. copra/acre.

The plots receiving no fertilizers gave a yield of 38 nuts/palm, those receiving the treatment combination $N_1P_1K_1$ (4½ lbs. CRI mixture "A") gave 65 nuts/palm, while the plots treated with $N_2K_2P_2$ (9 lbs. CRI mixture "A") gave 86 nuts/palm (at 55 palms/acre).

TABLE III (*a*)

**Yield data for 1964—$3^3$ 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) | 1,460 | 100 | — | 954 |
| $N_1$ (1½ lbs. Ammonium sulphate) | 1,874 | 128 | + 414*** | 960 |
| $N_2$ (3 lbs. Ammonium sulphate) | 1,933 | 132 | + 473*** | 985 |
| $P_0$ (No phosphate) | 1,128 | 100 | — | 963 |
| $P_1$ (1½ lbs. Saphos Phosphate) | 2,092 | 185 | +964*** | 953 |
| $P_2$ (3 lbs. Saphos Phosphate) | 2,046 | 181 | +918*** | 985 |
| $K_0$ (No potash) | 1,610 | 100 | — | 1,014 |
| $K_1$ (1½ lbs. Muriate of Potash) | 1,718 | 107 | +108 | 962 |
| $K_2$ (3 lbs. Muriate of Potash) | 1,938 | 120 | +328*** | 934 |

Significant difference at P .05.

***— Significant at P .001.

TABLE III (*b*)

**lbs. Copra/acre**

| | $N_0$ | $N_1$ | $N_2$ |
|---|---|---|---|
| $K_0$ | 1,470 | 1,682 | 1,678 |
| $K_1$ | 1,375 | 1,872 | 1,907 |
| $K_2$ | 1,534 | 2,066 | 2,213 |

| | $P_0$ | $P_1$ | $P_2$ |
|---|---|---|---|
| $K_0$ | 1,056 | 1,880 | 1,894 |
| $K_1$ | 1,047 | 2,027 | 2,080 |
| $K_2$ | 1,281 | 2,369 | 2,163 |
| $N_0$ | 1,117 | 1,683 | 1,579 |
| $N_1$ | 1,195 | 2,277 | 2,148 |
| $N_2$ | 1,073 | 2,316 | 2,410 |

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

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

This experiment completed its 6th year in June 1964. The yield data for the various treatments for the year 1963/64 is given in Table IV. All fertilizer treatments were significantly better than the control (no fertilizer), while for the 6th successive year the inorganic fertilizers have proved to be as effective as the more expensive organic manures on this sandy loam soil.

There has been no difference between the biennial application of fertilizers in full circles and annual application in half circles. Placement studies using radioactive phosphorus (see below) indicated that full circle application leads to more efficient uptake than half circle application. Hence, for a valid comparison of annual vs. biennial manuring, it would be necessary to adopt a similar method of placement for both frequencies. Accordingly, in the 7th annual manuring, and 4th biennial manuring, which were done in June 1964, all fertilizer applications were in full circles.

**TABLE IV**

**Yield data for 1964, Experiment on Organics vs. Inorganics, Marandawila Estate**

(*Copra yields adjusted by co-variance analysis*) (60 *palms/acre*)

| *Treatment* | *lbs. copra/acre* | % | *Difference in lbs. copra/acre* | *Nuts/Acre* | *Copra out-turn nuts/ candy* |
|---|---|---|---|---|---|
| Control .. .. .. | 2,335 | 100 | — | 4,585 | 1,098 |
| Inorganics annually .. .. | 2,955 | 126 | +620 | 5,615 | 1,065 |
| Inorganics biennially .. .. | 2,830 | 121 | +495 | 5,240 | 1,038 |
| Organics annually .. .. | 2,892 | 124 | +557 | 5,350 | 1,036 |
| Organics biennially .. .. | 2,930 | 125 | +595 | 5,325 | 1,018 |
| Cattle manure with supplements .. | 2,980 | 127 | +645 | 5,326 | 990 |

**5. 4 × 4 × 4 Experiment on Adult Palms (Bandirippuwa Estate)**

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

The 5th annual manuring of this experiment was carried out in December 1964. The yield data of main effects for 1964 (adjusted by co-variance analysis) is given in Table V(*a*). The main effects of both nitrogen and potash have proved to be highly significant, but phosphate has failed to show any response yet. The NK interaction, which also showed significance at the 1 % level, is given in Table V(*b*).

TABLE V (*a*)

**Yield data for 1964—4³ NPK Experiment on Adult Palms (Bandirippuwa Estate)**
(*Copra yields adjusted by co-variance analysis*) (66 *palms/acre*)

| *Treatment (Annual)* | *lbs. copra/acre* | % | *Difference in lbs. copra/acre* |
|---|---|---|---|
| $N_0$ (0.0 lbs. N) | 1,768 | 100 | — |
| $N_1$ (0.5 lbs. N) | 2,010 | 113 | +242*** |
| $N_2$ (1.0 lbs. N) | 2,060 | 117 | +292*** |
| $N_3$ (1.5 lbs. N) | 2,035 | 115 | +267*** |
| $P_0$ (0.0 lbs. $P_2O_5$) | 1,945 | 100 | — |
| $P_1$ (0.5 lbs. $P_2O_5$) | 1,954 | 100.5 | + 9 |
| $P_2$ (1.0 lbs. $P_2O_5$) | 1,920 | 98.5 | - 25 |
| $P_3$ (1.5 lbs. $P_2O_5$) | 2,056 | 106 | +111 |
| $K_0$ (0.0 lbs. $K_2O$) | 1,752 | — | — |
| $K_1$ (0.5 lbs. $K_2O$) | 1,988 | 113 | +236*** |
| $K_2$ (1.0 lbs. $K_2O$) | 2,055 | 117 | +303*** |
| $K_3$ (1.5 lbs. $K_2O$) | 2,090 | 119 | +338*** |

Significant difference P .05 = 125 lbs. copra/acre

***— Significant at P .001.

TABLE V (*b*)

**Adjusted NK Interaction**

| | $N_0$ | $N_1$ | $N_2$ | $N_3$ |
|---|---|---|---|---|
| $K_0$ | 1,814 | 1,853 | 2,052 | 1,939 |
| $K_1$ | 1,999 | 2,138 | 2,178 | 2,363 |
| $K_2$ | 1,828 | 2,522 | 2,390 | 2,203 |
| $K_3$ | 2,079 | 2,268 | 2,386 | 2,394 |

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

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

This experiment completed its 3rd year in December 1964. The fourth annual manuring was done at the end of 1964. The previous applications of lime which amounted to a total of about 45 cwts./acre had reduced the acidity of the top soil (0-9″) of the limed plots from pH 4.2 to pH 6.8. But the sub-soil

remained acid at pH 4.3. A further application of lime was therefore done at the rate of about 13½ cwts./acre (30 lbs./square) in September 1964. After application the whole of the experimental area was ploughed to a depth of about 8 inches in order to facilitate liming the sub-soil.

The yield data for 1964 (adjusted by co-variance analysis) is given in Table VI. Once again it is seen that the cheaper method of applying fertilizer on the surface (in a 3 ft. wide circular strip 3 ft. away from the palm) and digging it over into the soil is as efficient as the method of application in circular trenches on this lateritic soil type. Broadcast application was significantly less efficient than placement round the palms.

There are indications that the effects of liming, though not statistically significant yet, is promoting higher crop production.

**TABLE VI**

**Yield data for 1964—Experiment on fertilizer placement and liming, Walahapitiya Estate**

*(Yields adjusted by co-variance analysis)* (50 *palms/acre*)

| Treatment | *lbs. Copra/acre* | % | *Difference lbs. Copra/acre* |
|---|---|---|---|
| O (no fertilizers) | 1,474 | 100 | — |
| B (broadcast) | 1,622 | 110 | +148** |
| C (circular trenches) | 1,722 | 117 | +248*** |
| S (spread on surface in circular strip) | 1,726 | 117 | +252*** |
| | Significant difference P .05 = 78.5 lbs. copra/acre | | |
| **— Significant at P .01. | | | |
| ***— Significant at P .001. | | | |
| $L_0$ (no lime) | 1,590 | 100 | — |
| $L_1$ (lime) | 1,682 | 106 | + 92 |
| O (no fertilizer) | 1,474 | 100 | — |
| $F_1$ (3½ lbs. NPK mixture) | 1,670 | 113 | +196 |
| $F_2$ (7 lbs. NPK mixture) | 1,708 | 116 | +234 |

**7. 4 × 4 × 4 NPK Experiment on Young Palms, Pothukulama Estate**

(See C.R.I. Annual Report 1961 and 1963 for details of treatment and design).

The palms in this experiment were 4 years old at the end of 1964. The half yearly manuring was done in June 1964. But owing to an unprecedented spell of dry weather, the manuring which was due in December 1964 could not be done. At the age of 4 years 207 plot palms and 219 guard row palms were in flower. This amounts to about 16% of the total number of palms in the experiment.

Nitrogen and potash has had a positive effect on the number of palms in flower, but phosphate has had no appreciable effect. N and K had a significant effect on leaf production as well, but the effect of phosphate has not reached statistical significance yet. The lack of response to phosphate was apparently due to adequate availability of soil phosphate, as indicated by soil and leaf analytical data (see below).

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

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

These trials completed their 7th year in 1964. As in the previous years, the application of magnesium both in the form of magnesium sulphate and dolomitic limestone continued to give marked increase in yields. The trials will be concluded in 1965.

**9. Leaf Scorch problem, Gonapinuwela area**

(See also C.R.I. Annual Reports for 1961, 1962 and 1963).

Early in 1964 healthy and affected palms at Kirimetiya Estate were subject to the following differential treatments with and without lime (lime was applied at 25 lbs./palm):—

(1) 5 lbs. NPK mixture (ammonium sulphate, saphos phosphate and muriate of potash in ratio 5 : 5 : 6 and 1½ lbs. Keiserite.
(2) 10 lbs. elemental sulphur with treatment (1).
(3) 1 lb. borate with treatment (1).
(4) 1 lb. copper sulphate with treatment (1).
(5) 1 lb. ferrous sulphate, 1 lb. zinc sulphate and 1 lb. manganese sulphate with treatment (1).

The treatments are repeated at six monthly intervals, the nutrient application being done in the entire area round each palm up to a distance of 5½ feet from the bole. This trial was laid down to determine (*a*) whether the application of any nutrient combination would restore diseased palms back to normal health, and (*b*) whether healthy palms can be made less susceptible to disease by the application of any particular nutrients.

A census of the treated palms is taken at six monthly intervals and the following observations recorded:— total fronds, affected fronds (indicating degree—whether intense, moderate or slight), tapering, nut elongation, bearing status and condition of crown. In addition, records are maintained on female flowers, nuts, and weight of copra at each pick.

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

The object of this experiment is to compare the efficiency of different sources of nitrogen—urea, sodium nitrate, ammonium sulphate nitrate, and ammonium sulphate—on adult coconut palms at two frequencies of application—half yearly, and yearly.

The experimental layout consists of a 2 × 4 complete factorial randomised block design, replicated five times. A zero nitrogen plot is included in each block, so that there are in all 5 blocks of 9 plots each, with 18 palms in each plot.

The 1st differential manuring was done in November 1964, after the completion of 2 years pre-treatment recording of yields on individual palms. All palms are given a basal dose of 3⅓ lbs. each of muriate of potash (60%) and Saphos phosphate annually. The rates of nitrogen application, given half yearly, and annually are as follows:

Urea 1.49 lbs./palm/annum.
Sodium nitrate 4.29 lbs./palm/annum.
Ammonium sulphate nitrate 2.75 lbs./palm/annum.
Ammonium sulphate 3.33 lbs./palm/annum.

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

The clearing burning and stumping of 30 acres jungle land at Pothukulama Research Station was completed in October 1964. But owing to complete failure of the N.E. monsoon rains, the planting of this experiment had to be postponed for 1965.

### 12. Observation trials on immature nutfall, Bingiriya

Pre-treatment recording of mature nuts, female flowers and immature fallen nuts on individual palms on a block of about 1,000 palms (where round the year immature nutfall has been reported) was continued through 1964. A study of the first year's treatment records gave no indication that the fall of immature nuts was associated with heavy production or setting of female flowers. There was no indication of insect damage or fungal infestation being the cause of immature nutfall—but this aspect needs further study. It is proposed to lay down a simple trial on soil applications of micro-nutrients in 1965. Leaflet samples will also be taken from healthy and nutfall palms for chemical analysis of both major and micro-nutrients.

## B. LABORATORY INVESTIGATIONS

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

(See also C.R.I. Annual Reports for 1960, 1961, 1962 and 1963).

An experiment to compare full circle and half circle application of fertilizer round the palm up to a distance of 6 ft. from the bole, was carried out in 1964 on adult bearing palms growing on a sandy soil type. As in the previous experiment, the surface soil was carefully removed up to a depth of 4 inches in the area of placement. 5 litres of solution containing 50 grms. ammonium dihydrogen phosphate tagged with 4.7 millicuries $P^{32}$ was applied uniformly to each palm. Each treatment was replicated five times. One replicate of each treatment was grouped together so as to form a block. Palms of similar vegetatives growth, height, and bearing status were selected for the treatment comparisons within each block.

Analysis of leaflets from frond No. 6 sampled 10, 39 and 70 days after application of the labelled phosphate showed that a greater quantity (about 40% more) of labelled phosphate was absorbed by the palm when application was done in full circles (Table VII).

In the full circle application, the same quantity of labelled phosphate was spread over double the area of soil surface as that in the semi-circular application. The extent of isotopic dilution would therefore have been considerably greater and hence the uptake of labelled phosphate under estimated to a larger extent in the full circle application. The higher concentration of phosphate in the semi-circles would have enhanced the rate of absorption from the semi-circle placements. But the availability of greater area of active root surface in the full circles has more than compensated for the disadvantages of lower nutrient concentrations in the full circles.

The earlier experiments showed that both in young palms and adult palms the density of active root surface is considerably higher in the area immediately surrounding the palms up to a distance of about $5\frac{1}{2}$ feet from the bole than either in the traditional manure circle (3 ft. wide, 3 ft. away from palm) or in the centres of squares between rows of palms. All these experiments have been carried out on light textured, well drained soils—conditions ideally suited for the development of extensive root systems. It can be assumed therefore that these results would be applicable to the heavier soil types such as clay loams and lateritic gravels where physical impediments to extensive root development are likely to occur.

## TABLE VII

**Comparison of placement in full and half circles. Specific activities (Counts/mt/mg.P) in 6th frond leaflets**

| | *REPLICATE NOS.* | | | | | | | | | | | | *Mean* | | | % *Efficiency* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | | 2 | | | 3 | | | 4 | | | 5 | | | | | |
| Time after $P^{32}$ application (days) .. | 10 | 39 | 70 | 10 | 39 | 70 | 10 | 39 | 70 | 10 | 39 | 70 | 10 | 39 | 70 | 10 | 39 | 70 | 10 | 39 | 70 |
| **Method of placement** | | | | | | | | | | | | | | | | | | | | | |
| *A.* Full Circles .. .. | 82.5 | 161 | 183 | 105.5 | 222 | 240 | 50.8 | 128 | 188 | 37.0 | 104 | 166 | 62.5 | 140 | 175 | 67.6 | 151 | 190 | 100 | 100 | 100 |
| *B.* Half Circles .. .. | 53.5 | 126 | 154 | 84.0 | 158 | 196 | 34.8 | 82 | 138 | 26.6 | 91.4 | 76 | 24.5 | 73.7 | 96 | 44.7 | 106 | 131 | 66 | 70 | 69 |

On the basis of these experiments, it is concluded that for maximum efficiency of fertilizer utilisation by bearing coconut palms, fertilizers should be applied round the palm in the entire area up to a distance of about $5\frac{1}{2}$ feet from the bole.

## 2. Leaf and soil phosphate analysis—$4^3$ NPK experiment on young palms, Pothukulama

In this experiment, which was planted in December 1960, and on which the first annual manuring was done in December 1961, significant growth responses have been hitherto obtained only for nitrogen and potash. Unlike in the experiment on young palms at Ratmalagara there has been no response to phosphate up to the end of the 3rd manurial year. Previously (Annual Report 1961) we reported that the Pothukulama soil was poor in available phosphate on the basis that its content of available phosphate as measured by Truog's method (extraction with 0.002 N, $H_2SO_4$ buffered at pH 3) was only 20-30 ppm. $P_2O_5$—at which level significant responses to phosphate manuring had been obtained at Ratmalagara and Southern Province experiments (Annual Report 1953). Further studies were therefore carried out on leaf and soil analysis to determine the reason for the lack of response to phosphate application.

Leaflet samples were taken in May 1964 from the 1st, 4th, and 7th fully opened frond of each experimental palm and composite samples of leaflets made for each of the 64 plots. Chemical analysis of the leaflets for N, P, K, Ca, Mg were commenced. The phosphate contents of leaflets from the 4 year old palms are given in Table VIII (*a*).

**TABLE VIII (*a*)**

**Mean % $P_2O_5$ in leaflets on ovendry sample from $4^3$ NPK Experiment on Young Palms, Pothukulama (sampled May, 1964)**

| *Treatment* | *1st Frond* | *4th Frond* | *7th Frond* |
|---|---|---|---|
| $P_0$ | 0.347 | 0.314 | 0.301 |
| $P_1$ | 0.363 | 0.338 | 0.317 |
| $P_2$ | 0.372 | 0.337 | 0.314 |
| $P_3$ | 0.408 | 0.351 | 0.334 |

In the Ratmalagara experiment, 1st frond leaflets sampled from $P_0$ plots in 1952 (4 year old palms) had 0.262% $P_2O_5$, while the leaflets from the $P_1$ and $P_2$ plots had 0.326 and 0.343% $P_2O_5$ respectively (Annual Report 1953). It seems therefore that the availability of soil phosphate at Pothukulama is higher than that at Ratmalagara contrary to what was indicated by the Truog soil test for phosphate availability. This was confirmed by other soil tests for phosphate availability—isotopically exchangeable phosphorus, Olsen's 0.5 molar sodium bicarbonate extraction, and $10^{-2}$ molar calcium chloride extraction. A comparison of phosphate availability determined by these different methods in the Ratmalagara and Pothukulama soils is given in Table VIII (*b*).

TABLE VIII (*b*)

**Soil phosphate availability in Ratmalagara and Pothukulama top soils (0-9")**

| | *Truog's $H_2SO_4$ (ppm. $P_2O_5$)* | *$10^{-2}$ molar $CaCl_2$ ($10^{-1}$ molar P)* | *Olsen's .5 molar $NaHCO_3$ (ppm. P in soil)* | *Isotopically exchangeable P in Mg (P/100 gms. soil)* |
|---|---|---|---|---|
| Ratmalagara .. .. | 30 | 2 | 4.6 | 0.5 |
| Pothukulama .. .. | 23.5 | 20.7 | 8.8 | 7.4 |

### 3. Foliar analysis—Magnesium trials

Leaflets sampled from the 6th frond of yellowed palms (now turned green where magnesium had been applied) of the magnesium trials at Walgama Estate were analysed for K, Mg and Ca, to study the effects of the different fertilizer treatments on leaf composition.

The mean analytical data for samples taken from groups of five palms receiving the various treatments are given in Table IX.

TABLE IX

**Chemical analysis of leaflets from magnesium trials at Walgama Estate (oven dry basis)—6th frond leaflets—mean for 5 palms in each group**

| *Treatment* | *% K* | *% Ca* | *% Mg* | *me. K/me. Mg* | *%* |
|---|---|---|---|---|---|
| Control | 0.785 | 0.5449 | 0.0693 | 4.196 | 100 |
| 5 lbs. NPK mixture | 1.818 | 0.3353 | 0.0481 | 13.63 | 325 |
| 5 lbs. NPK + 1 lb. $MgSO_4$ | 1.283 | 0.3942 | 0.1749 | 2.416 | 58 |
| 5 lbs. NPK + 2 lbs. $MgSO_4$ | 1.360 | 0.2501 | 0.1843 | 2.494 | 59 |
| 5 lbs. NPK + 3 lbs. $MgSO_4$ | 1.270 | 0.2280 | 0.1651 | 2.457 | 59 |

It is seen that the magnesium content of leaflets from palms receiving NPK fertilizers is lower than that of the control plots, while magnesium applications have reduced the potash content of leaflets. This illustrates the K-Mg antagonism. It is interesting to note that in the absence of Mg, applications of NPK has given a very high K/Mg ratio of 13.63. Although yields increased with the higher levels of Mg application (Annual Reports 1961 and 1962), there has been no appreciable change in the Mg content and K/Mg ratios in the leaflets.

### 4. "Leaf Scorch" problem—boron content in Coconut leaflets

Previously (Annual Report for 1963) it was shown that the palms affected by leaf scorch at Kirimetiya Estate had a lower boron content (9 ppm. B in 1st frond leaflets) than healthy palms in the same area (11 ppm. B in 1st frond leaflets). The boron content of 1st frond leaflets of palms at Bandirip-

puwa where there was no "leaf Scorch" was in the order of 16-20 ppm. B. There seemed to be some possibility that the problem of leaf scorch might be associated with boron deficiency. But boron treatment of affected palms both as fortnightly foliar sprays of 0.3% borax solution, and soil applications of borate at 2 lbs./palm/annum during 1962/63 has not brought about any noticeable improvement in the condition of the palms. 1st frond leaflets sampled from boron treated palms early in 1964 were found to have increased their boron content to 16 ppm. B. This increase is small, indicating that boron absorption by the palm is rather slow. It was decided therefore that the trials with boron be further continued before conclusions are drawn.

## C. SOIL SURVEYS

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

The Soil Survey Unit, which was functioning independently under the Director, was amalgamated with the Soil Chemistry Division as from 1st July 1964.

The chief project for 1964 was the survey of coconut growing areas in Ambalangoda and Hikkaduwa with a view to determining whether there is any association of soil type with the incidence of "leaf scorch" problem in coconut palms. The area surveyed covered the coastal region demarcated in the Ambalangoda and part of the Galle one inch sheet, extending in land to the pediment of the south western ranges.

The land form consists of mature rounded lateritic edges alternating with broad valleys filled with alluvium. Drainage is largely through the Ginganga which flows into the sea at Gintota. There are also minor streams in the west which flow into lagoons such as the Madampe, Hikkaduwa and Ratgama lakes.

The annual rainfall is 100-125 inches.

The main feature of the coastal belt is the presence of a littoral facies consisting of shells of marine fauna extending inland for about 1-2 miles. The rocks are pre-Cambrian, consisting mainly of charnokites, granulitic gneisses, and calc rocks.

*Soil Classification*

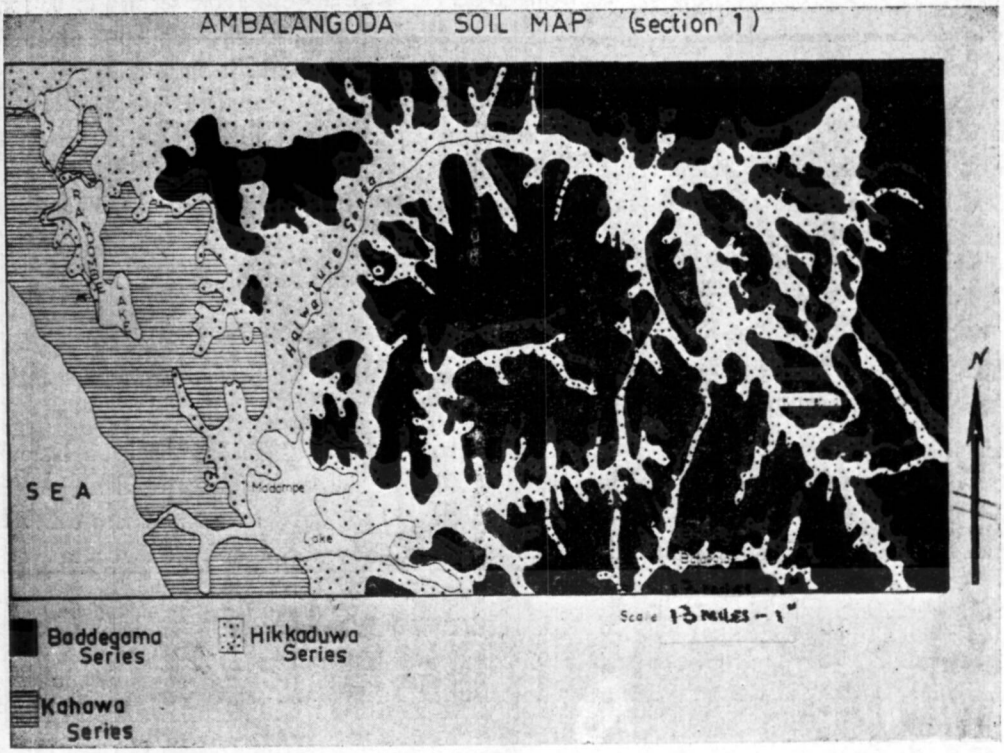
(i) *Kahawa series:*—These are the deep sandy soils of the coastal belt containing calcereous marine deposits.

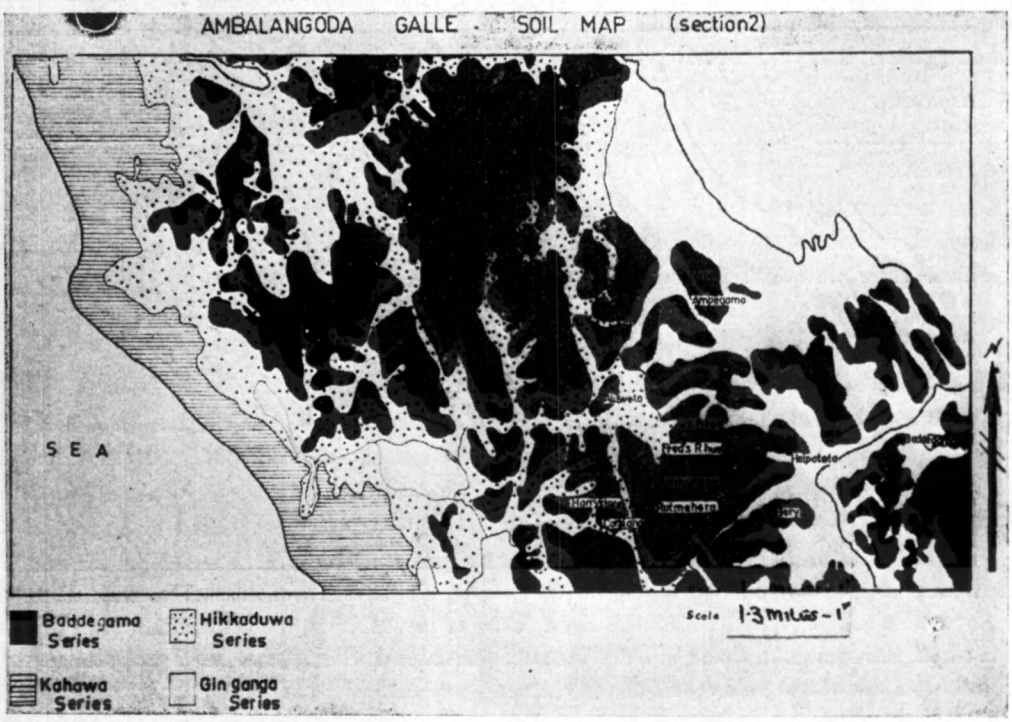
(ii) *Hikkaduwa series:*—This series consists of bleached white loamy sands, or sands, passing into black sandy clays. It is developed in the basins of the minor streams which flow into the lagoons. Drainage is imperfect. The following is a profile description of this series:—

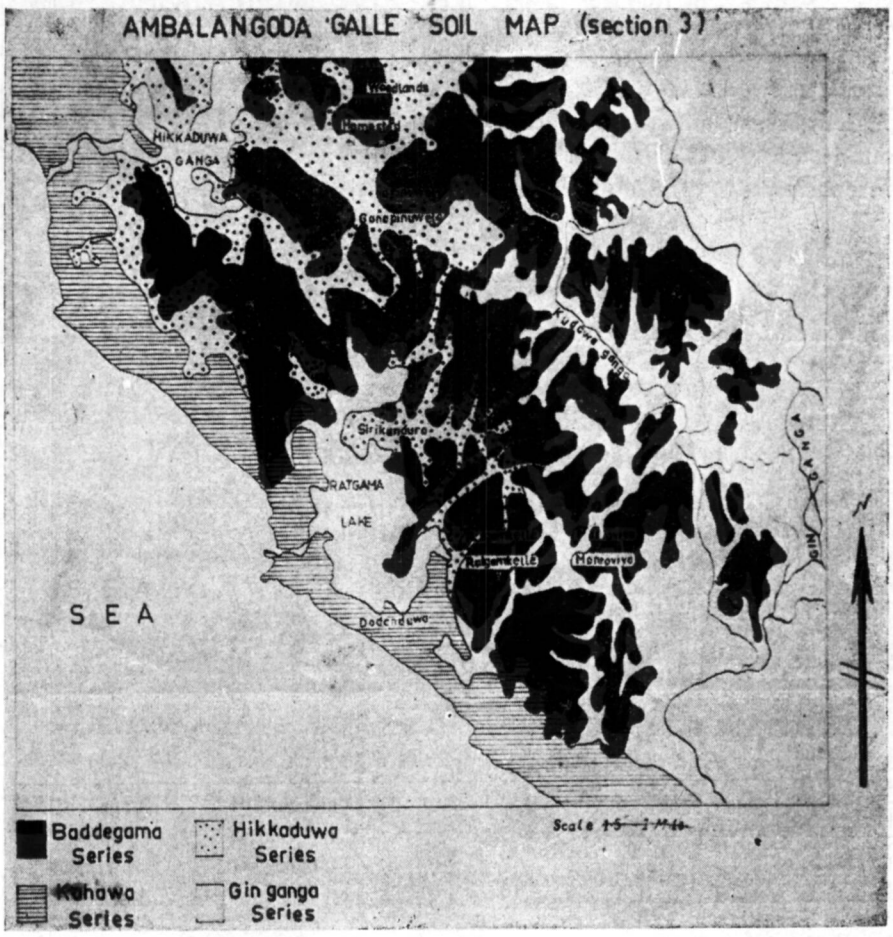
0-9" White (10 YR. 8/1) loamy sand; slightly plastic and sticky; structureless; moist.
9-42" Greyish white (10 YR. 7/1) coarse sandy clay loam; sticky, plastic; wet.
below 42" Black (10 YR. 3/1) fine sandy clay loam; peds massive.

(iii) *Ginganga series:*—This is the poorly drained heavy textured alluvial soils of the Ginganga basin, probably derived by denudation of the lateritic hills. The soil consists of a sandy clay loam passing into a sandy clay. The white sands of the A horizon and dark humid B horizon which characterise the Hikkaduwa series are absent in this series. The water table is high.

(iv) *Baddegama series:*—This consists of well drained lateritic soils characterised by the presence of a stoneline at about 9 inches consisting of rounded highly polished ferrugineous nodules. These are probably sedimentation products from the higher lateritic hills. During the droughts the soil dries up to a hard impenetrable consistency. However, since the internal drainage is good and rainfall high, the soil is workable for a greater part of the year.


AMBALANGODA SOIL MAP (section 1)
SEA
Madampe
Lake
Scale 1·3 MILES - 1"
Baddegama Series
Hikkaduwa Series
Kahawa Series


AMBALANGODA GALLE SOIL MAP (section2)
SEA
Scale 1·3 MILES - 1"
Baddegama Series
Hikkaduwa Series
Kahawa Series
Gin ganga Series


AMBALANGODA GALLE SOIL MAP (section 3)
HIKKADUWA
GANGA
RATGAMA
LAKE
SEA
Dodanduwa
Hotagiwa
Baddegama Series
Hikkaduwa Series
Kahawa Series
Gin ganga Series
Scale 1 5 1 Mile

The following is a profile description at Kirimetiya Estate:—

0-12″—10 YR. (brown); coarse sandy clay loam; blocky structure, sticky plastic; roots common; fine gravel.

12-17″—10 YR. gravelly clay loam; blocky structure; gravel rounded, coarse ferrugenous, pebbles.

17-30″—5 YR. (reddish brown); blocky; very sticky and plastic; gravel angular quartz grains.

30″-36″—5 YR. (reddish yellow) clayey lateritic gravel.

*"Leaf Scorch" problem and soil type:*—Visual observations during the course of the soil survey indicated that the incidence of "leaf scorch" problem in coconut palms was not associated with any particular soil type. It occurred on the well drained lateritic soils of the Baddegama series, as well as on the imperfectly or poorly drained alluvial soils of the Hikkaduwa and Ginganga series, and calcereous sandy marine deposits of the Kahawa series. However, there was some indication that under neglected conditions the incidence of diseased palms was higher in the poorly drained soils.

## D. MISCELLANEOUS

The Soil Chemist Dr. D.A. Nethsinghe delivered the following papers during the course of the year:—

(i) "Fertilizer placement studies on the coconut palm using radio isotopic methods"—to the 1964 Peking Symposium held in Peking.

(ii) "Coconut fertilizers"—to the Low Country Products Association.

(iii) "A study on the root activity (in soil) of Coconut palms using radioactive phosphorus"—to the FAO Coconut Conference held in Colombo.

## E. PERSONNEL

Dr. D.A. Nethsinghe, the Soil Chemist, attended the 1964 Peking Symposium held at Peking in August 1964 as a member of a delegation from the Ceylon Association for the Advancement of Science. During the five weeks he was abroad, he also took the opportunity of visiting coconut plantations and research institutions in Malaysia.

Mr. T.S. Balakrishnamurthie, Research Assistant, continued with his post graduate studies in Soil Science at the University of Aberdeen.

Mr. V. Nalliah, Technical Assistant, followed a six month International training course in the maintenance and repair of electronic radio isotopes instruments conducted by UNESCO and the International Atomic Energy Agency at the Radio Isotopes Centre, Colombo.

D.A. NETHSINGHE,

*Soil Chemist, Coconut Research Institute.*

# REPORT OF THE CHEMIST

## 1. DESICCATED COCONUT

In continuation of the work reported last year, the problem of oil exudation from Ceylon Desiccated Coconut has been pursued further. The plate-method that has been evolved for testing oil exudation, has been tried out on further experimental samples of desiccated coconut.

Apart from dehydrating all samples for test to bone-dryness in a vacuum desiccator, it has been found that incremental pressures for the lower range 10-5-40 constitute a more sensitive index of sample differences than the higher range 20-10-60. The results obtained on 5 *individual* bone-dry samples tested in this manner over the lower pressure range have been reported last year. Twenty more random samples of "fine" desiccated coconut passing through B.S. (10 mesh) sieve were tested individually during the course of the year. These were examined in four batches of 5 samples each. The average values obtained for each batch along with Batch I (already reported) are charted in Table I (*a*) and (*b*).

TABLE I (*a*)

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

| 1 | 2 | 3 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *WEIGHT* (*lbs./27.4 sq"*) | *PRESSURE* 1 *lb./sq"* *for* 1 *hour* | *BATCH* (*Each Batch is mean of 5 samples*) *Oil exuded as % of bone dry weight* | | | | | | |
| | | *I* | *II* | *III* | *IV* | *V* | *Overall Mean* | *C.V.* (%) |
| Plate only = 10 (P) | 0.36 | 15.29 | 16.89 | 17.01 | 15.61 | 14.16 | 15.79 | 6.72 |
| P + 5 = 15 | 0.55 | 9.81 | 7.26 | 7.98 | 8.18 | 7.83 | 8.21 | 10.42 |
| P + 10 = 20 | 0.73 | 6.63 | 4.33 | 4.88 | 5.07 | 5.41 | 5.26 | 14.59 |
| P + 15 = 25 | 0.91 | 4.72 | 3.28 | 3.38 | 3.60 | 3.80 | 3.76 | 13.68 |
| P + 20 = 30 | 1.09 | 3.73 | 2.42 | 2.80 | 2.88 | 2.98 | 2.96 | 14.47 |
| P + 25 = 35 | 1.28 | 2.63 | 1.85 | 2.31 | 2.21 | 2.38 | 2.28 | 11.15 |
| P + 30 = 40 | 1.46 | 2.30 | 1.50 | 1.87 | 1.94 | 2.07 | 1.94 | 13.54 |
| Total Oil Exuded (%) | | 45.11 | 37.53 | 40.23 | 39.51 | 38.63 | 40.20 | 6.50 |

TABLE I (*b*)

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

| 1 | 2 | | | | | | |
|---|---|---|---|---|---|---|---|
| *WEIGHT lbs./27.4 sq."* | *BATCH (Each Batch is mean of 5 samples) Oil exuded as % of bone-dry weight* | | | | | | |
| | *I* | *II* | *III* | *IV* | *V* | *Overall Mean* | *C.V. (%)* |
| (*A*) Plate only (P) = 10 | 15.29 | 16.89 | 17.01 | 15.61 | 14.16 | 15.79 | 6.72 |
| (*B*) P, P + 5 } 1 hour each | 25.10 | 24.15 | 24.98 | 23.79 | 21.99 | 24.00 | 4.42 |
| (*C*) P, P + 5, P + 10 } 1 hour each | 31.72 | 28.48 | 29.86 | 28.87 | 27.40 | 29.27 | 4.98 |
| (*D*) C—plus P + 15 — 1 hour | 36.45 | 31.76 | 33.24 | 32.47 | 31.19 | 33.02 | 5.59 |
| (*E*) D—plus (P + 20) — 1 hour | 40.17 | 34.18 | 36.04 | 35.35 | 34.18 | 35.98 | 6.14 |
| (*F*) E—plus (P + 25) — 1 hour | 42.81 | 36.03 | 38.36 | 37.57 | 36.56 | 38.27 | 6.30 |
| (*G*) F—plus (P + 30) — 1 hour | 45.11 | 37.53 | 40.23 | 39.51 | 38.63 | 40.20 | 6.50 |

These experiments on Desiccated Coconut are being continued.

## 2. THE STANDARD CEYLON COPRA KILN

The Standard Ceylon Copra kiln has well known merits and has the advantage that it can be adapted to small and large-scale processing.

In general, four factors have been found to affect the quality and keeping properties of copra. They are (1) maturity of the drupe (2) method of Pre-treatment (3) Dehydration procedure and (4) Precision of kiln design.

Some experiments have been initiated in order to make an intensive study of all these factors in relation to copra quality using the Standard Ceylon kiln. As the process in vogue combines sun-drying with kiln-drying, some preliminary experiments are also being conducted in order to determine the quality and drying time of copra produced by solar drying alone.

**Experiments on Solar-drying**

Six lots in all, 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 drying. The copra produced from each of the six lots was classified, and graded for quality. The results obtained from the six lots are summarised in Table II (*a*) and (*b*).

The experiments on solar-drying of copra are being continued.

## 3. STUDIES ON THE COCONUT ENDOSPERM

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 four following predetermined physiological growth stages, during germination:—

*Stage I:*—Sprout just emerging out of husk ("Crow's beak" stage).
*Stage II:*—One leaf emerging but not fully open. No appearance of second leaf.
*Stage III:*—First leaf fully exerted. Second leaf emerging.
*Stage IV:*—First and second leaves fully exserted. Third leaf emerging.

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

This study on the coconut endosperm is being continued.

## 4. EXAMINATION OF COCONUT TREACLE

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

As the Public Health Branch of the Department of Health Services is contemplating to fix quality standards for "Coconut treacle", a range of samples from various sources were examined during the year. The results that have been obtained on 23 samples are charted in Table IV (*a*) and (*b*).

## TABLE II (*a*)

### Sun-drying Experiment on 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* | *11th 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 | — |
| Mean .. .. | | | 46.9* | 43.8* | 33.1 | 22.9 | 16.2 | 12.0 | 10.3 | 8.5 | 7.2 | 6.8 | 6.0 | 5.5 | — |
| *WASHED NUTS* | | | | | | | | | | | | | | | |
| I .. .. | 4 | 250 | — | — | 36.7 | 22.4 | 16.7 | 13.5 | 10.1 | 7.7 | 7.0 | 7.1 | 5.6 | 5.4 | — |
| II .. .. | 5 | 250 | — | — | 32.9 | 22.7 | 16.0 | 12.4 | 9.5 | 8.1 | 7.1 | 6.3 | 5.8 | 5.5 | — |
| III .. .. | 6 | 250 | — | — | 31.7 | 22.5 | 19.5 | 13.2 | 10.7 | 8.2 | 7.1 | 7.1 | 6.0 | 5.7 | — |
| Mean .. .. | | | 46.9* | 43.8* | 33.8 | 22.5 | 17.4 | 13.0 | 10.1 | 8.0 | 7.1 | 6.8 | 5.8 | 5.5 | — |

\+ From dead-ripe fallen nuts.

* From separate experiment.

## TABLE II (*b*)

### Sun-drying Experiment on 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 "Dhiya Madha"* | *Immature "Kalati"* | *Spoiled "Kanu"* | *Good Copra* | *Total* |
| *UNWASHED NUTS* | | | | | | | | | | | | | | |
| I .. | 1 | 250 | 1,097 | 97.7 | 1.2 | 1.1 | 100.0 | nil | 5.2 | nil | 1.4 | 0.9 | 92.5 | 100.0 |
| II .. | 2 | 250 | 1,034 | 93.0 | 5.6 | 1.4 | 100.0 | nil | nil | nil | 6.5 | 1.8 | 91.7 | 100.0 |
| III .. | 3 | 250 | 1,003 | 95.0 | 4.8 | 0.2 | 100.0 | nil | nil | nil | 5.8 | 0.3 | 93.9 | 100.0 |
| Mean .. | | | 1,045 | 95.2 | 3.9 | 0.9 | 100.0 | nil | 1.7 | nil | 4.6 | 1.0 | 92.7 | 100.0 |
| **WASHED NUTS* | | | | | | | | | | | | | | |
| I .. | 4 | 250 | 1,105 | 97.2 | 2.0 | 0.8 | 100.0 | nil | nil | nil | 2.4 | 0.8 | 96.8 | 100.0 |
| II .. | 5 | 250 | 951 | 93.2 | 3.5 | 3.3 | 100.0 | nil | nil | nil | 7.5 | 0.8 | 91.7 | 100.0 |
| III .. | 6 | 250 | 1,155 | 94.3 | 4.1 | 1.6 | 100.0 | nil | nil | nil | 5.6 | 0.7 | 93.7 | 100.0 |
| Mean .. | | | 1,070 | 94.9 | 3.2 | 1.9 | 100.0 | nil | nil | nil | 5.2 | 0.8 | 94.0 | 100.0 |

* Visually the copra from the WASHED nuts was superior to the unwashed.

\+ 1 candy = 560 pounds.

**TABLE III (*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 of Apple* | *Weight of Shoot* | *Weight of Roots* | *Volume of Water (ml.)* | *COPRA PER SEEDLING* | |
| | | | | | | | | *Embryo End* | *Distal End* |
| I .. .. .. | 2,799 | 1,007 | 1,792 | 60 | 37 | — | 200 | 128 | 132 |
| II .. .. .. | 2,786 | 900 | 1,886 | 88 | 46 | 4 | 86 | 117 | 115 |
| III .. .. .. | 2,668 | 800 | 1,868 | 132 | 69 | 7 | 31 | 92 | 108 |
| IV .. .. .. | 2,603 | 785 | 1,818 | 143 | 97 | 14 | nil | 91 | 114 |

**TABLE III (*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 |

**TABLE III (*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 |

## TABLE IV (*a*)

**Composition of Sweet Toddy [samples $STV_1$ to $STV_{12}$] used for the preparation of 12 samples of coconut treacle in the laboratory**

| 1 | 2 | 3 | | 4 | | | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Sample* | *Volume (ml.)* | *DENSITY* | | *SOLIDS* | | | *% ASH (Sulphated) G/100 ml.* | *% ACID (as Acetic) G/100 ml.* | *% TREACLE* | |
| | | $\frac{30°C}{30°C}$ | $\frac{30°C}{4°C}$ | *Tot. Sugars (as Sucrose)* | *Non-fermentable solids* | *Total solids* | | | *W/V* | *V/V* |
| $STV_1$ .. | 8,770 | 1.0673 | 1.0633 | 15.01 | 3.93 | 18.94 | 0.50 | 0.07 | 20.7 | 14.1 |
| $STV_2$ .. | 9,220 | 1.0653 | 1.0616 | 13.78 | 4.61 | 18.39 | 0.45 | 0.12 | 19.4 | 13.7 |
| $STV_3$ .. | 5,340 | 1.0686 | 1.0646 | 14.16 | 5.16 | 19.32 | 0.46 | 0.09 | 20.5 | 14.6 |
| $STV_4$ .. | 7,240 | 1.0665 | 1.0624 | 13.92 | 4.85 | 18.77 | 0.44 | 0.09 | 20.7 | 14.7 |
| $STV_5$ .. | 5,920 | 1.0688 | 1.0648 | 14.16 | 5.71 | 19.87 | 0.42 | 0.09 | 21.5 | 15.0 |
| $STV_6$ .. | 7,210 | 1.0670 | 1.0629 | 14.01 | 5.11 | 19.12 | 0.40 | 0.15 | 20.0 | 14.7 |
| $STV_7$ .. | 7,820 | 1.0658 | 1.0619 | 12.68 | 5.64 | 18.32 | 0.42 | 0.12 | 19.6 | 14.1 |
| $STV_8$ .. | 7,620 | 1.0628 | 1.0594 | 12.40 | 5.22 | 17.62 | 0.46 | 0.21 | 19.3 | 14.3 |
| $STV_9$ .. | 6,020 | 1.0671 | 1.0630 | 13.25 | 5.78 | 19.03 | 0.44 | 0.13 | 21.5 | 16.5 |
| $STV_{10}$ .. | 5,980 | 1.0640 | 1.0601 | 12.40 | 5.77 | 18.17 | 0.49 | 0.16 | 19.0 | 13.7 |
| $STV_{11}$ .. | 7,000 | 1.0679 | 1.0633 | 13.40 | 5.81 | 19.21 | 0.49 | 0.13 | 22.0 | 15.8 |
| $STV_{12}$ .. | 4,700 | 1.0646 | 1.0607 | 11.83 | 6.82 | 18.65 | 0.48 | 0.15 | 20.3 | 14.3 |
| Mean .. | 6903.3 | 1.0663 | 1.0623 | 13.42 | 5.37 | 18.78 | 0.45 | 0.13 | 20.3 | 14.6 |
| CV (%) .. | 18.9 | 0.17 | 0.15 | 6.64 | 13.02 | 3.06 | 6.78 | 28.8 | 4.51 | 5.43 |

TABLE IV (*b*)

**Analytical Characteristics of 23 samples of Coconut Treacle**

(*NOTE:*—Samples $STV_1$ to $STV_{12}$ were analysed *after* six months' storage from date of preparation)

| *$STV_1$ to $STV_{12}$ (Prepared in the Laboratory)* | *% Moisture* | *% ASH (Sulphated) W/W* | | *% POTASH (as $K_2O$) W/W* | | | *% TOTAL Sugars (as Sucrose) W/W* | *REMARKS* |
|---|---|---|---|---|---|---|---|---|
| | | *Wet basis* | *Dry basis* | *Wet basis* | *Dry basis* | *As % of ASH* | | |
| $STV_1$ .. | 18.6 | 1.95 | 2.40 | 0.97 | 1.19 | 49.6 | 63.7 | Small amount of crystals |
| $STV_2$ .. | 16.8 | 2.14 | 2.58 | 0.88 | 1.06 | 41.1 | 62.9 | Fair amount of crystals |
| $STV_3$ .. | 17.5 | 2.04 | 2.47 | 0.94 | 1.14 | 46.2 | 62.8 | Fair amount of crystals |
| $STV_4$ .. | 18.2 | 2.02 | 2.47 | 0.92 | 1.13 | 45.7 | 64.3 | Small amount of crystals |
| $STV_5$ .. | 23.2 | 2.12 | 2.76 | 0.94 | 1.23 | 44.6 | 59.8 | Large amount of crystals |
| $STV_6$ .. | 16.9 | 2.42 | 2.91 | 0.79 | 0.96 | 33.0 | 62.7 | Large amount of crystals |
| $STV_7$ .. | 19.9 | 2.10 | 2.63 | 1.08 | 1.35 | 51.3 | 62.7 | Very large amount of crystals |
| $STV_8$ .. | 19.5 | 2.36 | 2.94 | 1.12 | 1.39 | 47.3 | 64.2 | No crystals |
| $STV_9$ .. | 23.4 | 1.97 | 2.57 | 0.84 | 1.10 | 42.8 | 62.4 | No crystals |
| $STV_{10}$ .. | 18.1 | 2.17 | 2.65 | 1.00 | 1.22 | 46.0 | 65.4 | No crystals |
| $STV_{11}$ .. | 22.5 | 1.92 | 2.48 | 0.72 | 0.93 | 37.5 | 62.6 | No crystals |
| $STV_{12}$ .. | 20.1 | 2.10 | 2.64 | 0.84 | 1.06 | 40.2 | 63.9 | No crystals |
| Mean .. | 19.5 | 2.11 | 2.63 | 0.92 | 1.15 | 43.8 | 63.1 | — |
| C.V. (%).. | 11.5 | 7.0 | 6.2 | 12.0 | 11.6 | 11.3 | 2.1 | — |
| **R I TO R IV** | **RETAIL SAMPLES FROM MARAWILA** | | | | | | | |
| R I .. | 28.0 | 2.66 | 3.70 | 0.94 | 1.31 | 35.4 | 54.5 | No crystals |
| R II .. | 27.1 | 2.01 | 2.75 | 0.84 | 1.16 | 42.2 | 53.4 | No crystals |
| R III .. | 31.9 | 2.35 | 3.44 | 0.79 | 1.17 | 34.0 | 47.4 | No crystals |
| R IV .. | 29.3 | 2.34 | 3.32 | 0.97 | 1.38 | 41.6 | 48.9 | No crystals |
| R V .. | 29.7 | 2.24 | 3.18 | 0.75 | 1.06 | 33.3 | 49.9 | No crystals |
| R VI .. | 28.0 | 2.21 | 3.07 | 0.99 | 1.43 | 46.6 | 49.6 | No crystals |
| Mean .. | 29.0 | 2.30 | 3.24 | 0.88 | 1.25 | 38.8 | 50.6 | — |
| C.V. (%).. | 5.4 | 8.5 | 9.2 | 10.4 | 10.5 | 12.7 | 4.1 | — |
| **M I TO M V** | **LABORATORY SAMPLES PREPARED FROM MUCILAGINOUS SWEET TODDY** | | | | | | | |
| M I .. | 23.2 | 2.00 | 2.60 | 0.97 | 1.26 | 48.5 | 60.7 | Small amount of crystals |
| M II .. | 25.8 | 2.14 | 2.88 | 1.09 | 1.47 | 51.0 | 55.2 | Small amount of crystals |
| M III .. | 30.8 | 1.72 | 2.49 | 0.91 | 1.32 | 53.0 | 49.7 | No crystals |
| M IV .. | 41.8 | 1.34 | 2.31 | 0.80 | 1.38 | 59.7 | 38.0 | No crystals |
| M V .. | 47.1 | 3.64 | 7.06 | 1.76 | 3.40 | 48.2 | 56.0 | Fair amount of crystals |
| Mean .. | 33.7 | 2.17 | 3.47 | 1.11 | 1.77 | 52.1 | 51.9 | — |
| C.V. (%).. | 27.39 | 36.1 | 52.0 | 30.6 | 46.3 | 8.1 | 15.0 | — |

It is proposed to continue the study in order to consolidate sufficient factual information with the object of formulating appropriate standards for this product.

## 5. ARRACK

After a cessation of about five years, experimental toddy tapping was resumed during the year.

Chemical studies are being projected mainly with the object of:—

(*a*) Enhancing the fermentation efficiency of coconut toddy.

(*b*) Improving the flavour and quality characteristics of the arrack produced therefrom by distillation.

## 6. VINEGAR

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

With a view to installing a second generator and increasing his production, the vinegar maker is now in communication with the Excise authorities for licensing more palms for tapping.

(*b*) Negotiations are in progress for erecting a new vinegar factory in Wadduwa using the "Generator" process. The prospective vinegar maker has been given all possible co-operation and advice regarding the construction, operation and maintenance of the proposed factory.

## 7. POT CULTURE EXPERIMENT

(*a*) The fifth sand pot-culture experiment on 288 seedlings laid down in August 1963 was maintained during the year.

The main objective of the experiment is to ascertain the concentration gradients of the nutrients (for the two groups—amputated and non-amputated) in the laminae of different ranks (*a*) six months and (*b*) 12 months from date of planting. The amputation of half the number of seedlings under each of the treatments (+ALL, -ALL, -N, -P, -K, -Ca and -Mg) was done three months from the date of planting in the pots. The samples prepared from this experiment await analyses.

(*b*) The chemical examination of 186 plant samples prepared from the earlier pot-culture experiments was completed during the year.

## 8. MISCELLANEOUS WORK

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

(*b*) A sample for 'Kapu pol' sent by the Superintendent, Bandirippuwa Estate, was examined for moisture and oil contents. The extracted oil-free meal was examined for the mineral constituents.

(*c*) Some hybrid palm coconuts sent by an estate Superintendent were examined fully for weight characteristics. The copra prepared from these nuts were analysed for moisture and oil contents.

W.R.N. NATHANAEL,

*Chemist, Coconut Research Institute.*

# REPORT OF THE ACTING BOTANIST

## BREEDING AND SELECTION WORK

1. *Controlled pollination work:*—Controlled pollination work for the production of seed was carried out at five stations. Two types of crosses were done—*typica* × *pumila* and *typica* × *typica*, where the male parent is a prepotent. Over 37,500 female flowers were pollinated consisting of 35,000 *typica* × *typica* crosses and 2,500 *typica* × *pumila* crosses. 9,800 *typica* × *typica* and 4,165 *typica* × *pumila* seednuts resulting from crosses done in 1963 were harvested and planted in the nursery. 8,100 *typica* × *typica* and 3,565 *typica* × *pumila* seedlings were issued to the Industry this year.

*Pumila* × *typica* crosses were attempted on selected palms in a five acre block of dwarfs at the Coconut Seed Garden, Ambekelle. It was observed that the percentage setting of female flowers was very low. This may be attributed in part to the intense heat within the pollination bags. This is a factor to contend with, as in the dwarfs 10 - 14 days may elapse between the date of emasculation and date of bag removal following pollination of the last receptive female flower. The use of aluminium foil over the pollination bags to help reduce the temperature within was not very successful. This programme was abandoned as it proved to be uneconomical.

Commencing in October, the inflorescences on all the dwarf palms within the block were emasculated and the female flowers left for natural cross-pollination with pollen from within the seed garden. Unopened inflorescences are kept covered with polythene tubular film to minimise contamination of the seed garden with dwarf pollen subsequent to opening of spathes. During the first two months of this trial 33 per cent set of female flowers was obtained which figure is fairly satisfactory considering the prolonged drought in the area.

The resulting seednuts will be planted in the nursery, and any pure dwarfs that may result from faulty emasculation will be removed at the nursery stage. As it is difficult to meet even a fraction of the demand for *typica* × *pumila* hybrids through hand pollination alone, it is hoped to supplement the issue with these natural hybrids.

2. *Pollen collection, storage and issue:*—A method was described (Annual Report of the Botanist, 1963) by which about 9.0 grammes of pollen could be obtained from each inflorescence. However, during the course of extensive field trials at the Institute's pollination stations, it was observed that the viability of the pollen samples collected by this method decreased rapidly with storage, although the initial viability was high.

The method which is in use at present is to dissect anthers from unopened male flowers and leave them in petridishes placed in desiccators maintained at 10 - 25 per cent relative humidity at laboratory temperatures. The humidity is controlled by the use of appropriate concentrations of sulphuric acid. After about 20 hours the anthers dehisce and the pollen can be separated from the debris by sieving through a BS/410 100—mesh sieve. The pollen is then tested for viability using standard germinating media, adulterated with lycopodium powder in the ratio 1 of pollen: 8 of lycopodium, sealed in narrow glass tubes and stored at 0°C.

During the year, 4,541 pollen samples were issued to the Institute's pollination stations as well as to 8 private estates to help them to implement their programmes of controlled pollination. Each sample is sufficient to pollinate 3 inflorescences (about 90 female flowers) once.

3. *Intervarietal crosses:*—(*a*) *Typica* × *pumila*—The 22 progenies of *typica* × *pumila* crosses planted at Ratmalagara in 1950 continue to give good yields; their mean yield this year being 148 nuts with a husked nut weight of 278.9 lbs. per palm.

As the experimental material was limited to only 22 palms, this cross was given an extended trial, and the fields planted at Ratmalagara in 1958 and Bandirippuwa in November, 1957, give encouraging results. In the former plantation, out of 188 *typica* × *pumila* 96.4 per cent were in full bearing at the end of the year. ($6\frac{1}{2}$ years). In the trial at Bandirippuwa all the *typica* × *pumila* palms were in full bearing at the end of 7 years and their mean yield of 66 nuts with a husked nut weight of 133.8 lbs. is very satisfactory. The field experiment laid down at Pothukulama in November, 1962 should yield interesting information on the relative merits of *typica* × *typica*, *typica* × *pumila* and *typica* (open-pollinated).

(*b*) *Breeding an improved strain of the variety—Aurantiaca* (king coconuts):—This variety is in great demand for beverage purposes. It suffers from the disadvantage in that it is seasonal in bearing, and improved planting material from this variety is not yet available.

Two palms were identified at Ratmalagara Research Station, and Muwanhela Estate, Kirimetiyawa, which do not show the seasonal bearing character. Crosses were done using pollen from these two palms on phenotypically superior king coconut palms growing at Bandirippuwa, and 34 seedlings planted at Bandirippuwa in November.

The form *gon-thembili* of the variety *typica* is characterised by ivory-yellow nuts. This was crossed with pollen from the *regia* form of the variety *nana*. The resulting hybrid is likely to be early bearing and may exhibit hybrid-vigour. As the ivory-yellow colour is recessive the nuts of the $F_1$ may resemble the king-coconut in colour of epicarp. 35 seedlings of this cross were planted at Bandirippuwa. Petiole colours of the above 69 seedlings were recorded using a Munsell colour chart.

4. *Diallel Crosses:*—The 10 best palms from the Latin Square Experiment at Ratmalagara were crossed in a diallel manner in 1962. Seednuts were harvested in 1963 and the resulting seedlings from palm numbers 69, 78, 96, 183, 283, 337 and 418 were transplanted at Pothukulama in December, with a fully randomised distribution. Sufficient seedlings could not be obtained from palm numbers 1, 93 and 241, and the progeny of these palms were used in the guard rows.

5. *Coconut Seed Garden:*—125 acres have been planted to date, and routine cultural operations manuring yield-recording etc. were carried out in the planted area.

The crop figures for the different fields are given below.

| *Date of Planting* | *Field No.* | *No. of bearing palms* | *Yield of nuts* |
|---|---|---|---|
| December, 1955 | 1 | 322 | 24,256 |
| November, 1956 | 2 | 304 | 14,309 |
| November, 1956 | 3 | 302 | 14,552 |
| November, 1956 | 4 | 1427 | 83,056 |

Field No. 1 ($4\frac{1}{2}$ acres) has given 24,256 nuts and yield per acre is 5,390 nuts on an area basis. This is very satisfactory considering the fact that the palms are only 9 years old. 90 mother palms selected from this field are used as female parents for controlled pollination work.

6. *Pothukulama Research Station:*—Routing cultural operations, manuring, leaf counts etc. were carried out in all the field experiments.

7. *Progeny Trials:*—The Progeny trials at Marandawila (5 acres), Walpita (44 acres) and Bandirippuwa (20 acres) were maintained, and routine cultural operations, yield recording, leaf counts etc. were carried out.

An analysis of the Walpita Progeny Trial indicates that mass selection on weight of husked-nuts is effective although the magnitude of gain is not unusually large during the first generation. A higher frequency of palms of high breeding value could be obtained if the best 10 per cent palms of a population selected on a basis of yield of copra are tested rather than palms taken at random. Another valuable correlation is that the leaf production of the progeny during the first 40 months is an index of the relative breeding status of the parent palms. This may possibly afford a quick method of isolating palms of high breeding value.

Further testing of progenies of mother palms at Bandirippuwa and Walpita may yield more pre-potent palms.

8. *Mother Palm Seed Supply:*—A pool of 50,597 mother palms has been built up through palm selection. During the year, 1,358,472 selected seednuts from these palms were supplied to the Planting Division, C.R.I. for raising seedlings.

## PLANTING TECHNIQUES

The observation trials on Hedge Planting (Annual Report 1956), Depth of Planting a coconut seedling (Annual Report 1956) and Size of Seed-hole prepared to transplant a coconut seedling (Annual Report 1955) were maintained throughout the year. Some of the preliminary results obtained from these trials were given in the Annual Report for 1963.

*Planting Distance Trial:*—The optimum planting distance suitable for coconut is a controversial subject, and queries are often raised as to the optimum density. As experimental data on planting distances are not available, a field trial was laid down at Pothukulama in May to study this subject.

Rows were spaced 25, 30, 35 and 40 feet and within the rows seedlings were planted at distances varying from 15, 18,.21 and 24 feet. With the above spacing, the density varies between 45 and 116 palms to the acre. Selected seedlings of *typica* × *pumila* (where the dwarf male parent is common to all crosses) were planted in the experimental area consisting of 16 plots with 6 seedlings per plot and two replicates.

## CYTOLOGY

Chromosome counts were done on 4 of the 5 species of *Brachiaria* supplied by the Agrostologist, Coconut Research Institute, and they are listed below.

| *Specimen* | *Botanical name* | *Somatic number* | *Published somatic number* |
|---|---|---|---|
| 1 | *B. brizantha* | 2n = 36 | 2n = 54* |
| 2 | *B. mutica* | 2n = 36 | 2n = 36** |
| 3 | *B. distachya* | 2n = 36 | 2n = 36* |
| 4 | *B. miliiformis* | 2n = 36 | — |

* The Chromosome Atlas of Flowering Plants. Darlington & Wylie.

** The Grasses of Ceylon—Senaratna.

Specimens 1, 2, 3 and 4 have a somatic chromosome complement of 2n = 36. However, the figure for specimen (1), (2n = 36) appears to differ from that given for *B. brizantha* (2n = 54) by Moffett and Hurcombe (1949).

Specimen (1) has since been identified as *B. brizantha* (Hochst.) Stap f. at the Royal Botanic Gardens, Kew, and the observed variation in chromosome number is interesting. B. miliiformis has a somatic complement of 2n = 36. This has not been reported previously.

## CONFERENCES

The Second Sessions of the FAO Technical Working Party on Coconut Production, Protection and Processing was held in Colombo from 30th November to 8th December. A paper on "Mass selection and progeny testing in Coconut" prepared by Dr. D.V. Liyanage, Botanist, was presented at the above conference.

## PERSONNEL

Dr. D.V. Liyanage, Botanist, proceeded on overseas study leave on 10th November. He will be away for about six months to follow a course in Biometrical Genetics at the University of Birmingham, and will also visit research institutions. Mr. M.A.P. Manthriratne, Research Assistant was appointed Acting Botanist for this period. Mr. H.A. Ranasinghe, Superintendent, Coconut Seed Garden, Ambekelle was transferred to Pothukulama Research Station in the same capacity, and Mr. S.T. Braine, Superintendent, Pothukulama Research Station assumed duties as Superintendent, Coconut Seed Garden, Ambekelle in March this year.

Mr. K.A. Ariyadasa, was appointed Clerk/Typist in January, in place of Mr. P.A. Nonis, Clerk/Typist who relinquished his duties subsequent to his appointment as an Accounts-Clerk in the Administration Division.

M.A.P. MANTHRIRATNE,
*Acting Botanist, Coconut Research Institute.*

# REPORT OF THE OFFICER-IN-CHARGE— CROP PROTECTION DIVISION

## A. PEST

### 1. The Red Weevil pest (*Rhyncophorus ferrugineus* OL) and its control

(*a*) *Laboratory trials* were conducted to ascertain the efficacy of some insecticides in (*i*) killing adult weevils (*ii*) repelling female weevils from egg laying. The results are tabulated below (Table I):—

TABLE I

| *Treatment* | 24 *hrs.* % *kill* | 48 *hrs.* % *kill* | 72 *hrs.* % *kill* | 96 *hrs.* % *kill* | *Total No. of eggs laid by 5th day* |
|---|---|---|---|---|---|
| Dieldrin .. .. | 0 | 40 | 100 | — | 7 |
| Aldrin .. .. | 0 | 0 | 100 | — | 2 |
| Lebacide .. .. | 20 | 100 | — | — | 0 |
| Dipterex .. .. | 0 | 100 | — | — | 3 |
| Hexidole .. .. | 0 | 20 | 100 | — | 0 |
| DDT .. .. | 0 | 20 | 20 | 100 | 7 |
| Gammexone .. .. | 20 | 40 | 100 | — | 0 |
| Malacide .. .. | 0 | 100 | — | — | 0 |
| Sevin .. .. | 20 | 100 | — | — | 0 |
| Control .. .. | 0 | 0 | 0 | 0 | 18 |

The results thus indicate that Lebacide, and Sevin are most effective among the range of insecticides tried out, in killing adult weevils.

(*b*) Field observations have indicated that phytosanitation yet remains the most effective and cheap method of control. The pest gets built up in areas where young plantations are not looked after whereas under good management the incidence is certainly less.

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

The biological control project which was begun in 1960 was followed up. Parasites were bred at the Parasite Breeding Station in Batticaloa and at the Parasite Breeding Unit at Lunuwila. Large numbers of these parasites were liberated in the field where the pest was present.

TABLE II

| *Parasite* | *No of parasites produced* | *No. of parasites liberated N.W.P.* |
|---|---|---|
| *Microbracon brevicornis* W. | 1,173,422 | 656,000 |
| *Perisierola nephantidis* M. | 2,530 | — |
| *Tetrastichus israeli M & K.* | 215,200 | 25,000 |
| *Trichospilus pupivora* F. | 135,250 | 39,850 |

## TABLE III

**Production and despatches of parasites from P.B.S. Batticaloa**

| *Parasite* | *No. of parasites produced* | *No. of parasites liberated* | | |
|---|---|---|---|---|
| | | *N.P.* | *E.P.* | *N.W.P.* |
| *Microbracon brevicornis* W. | 400,240 | 11,200 | 243,700 | 1,400 |
| *Perisierola nephantidis* M. | 156,490 | 600 | 19,165 | 200 |
| *Stomatomyia bezziana* Bar. | 12,237 | — | 160 | 65 |
| *Trichospilus pupivora* F. | 110,400 | — | 20,300 | — |
| *Tetrastichus israeli* M. | 594,150 | — | 141,400 | 7,200 |

The production of parasites at the Parasite Breeding Unit at Lunuwila, received a set back due to failures of the temperature controlling unit.

Cultures of the laboratory host insects *Podinia litura* and *Corcyra cephalonia* were maintained.

Parasites were supplied to estates when requests were received during various times of the year. The figure 1 illustrates the distribution of these parasites. Estates are listed out but the names are deliberately omitted.

Liberations of parasites have been done on infestations reported during the year. If all the infestations have thus reported for supply of parasites then the illustration indicates fairly the pest position in the Batticaloa district during the year. New infestations appeared during the end of the year.

Life cycle studies of parasites were done. Table IV below gives a summary of the studies on *Microbracon brevicornis*, done at the Parasite Breeding Unit at Lunuwila.

## TABLE IV

**Life cycle studies on *Microbracon brevicornis*, larval parasites of *Nephantis serinopa***

| *Trial* | *Paralysing hrs.* | *Egg laying hrs.* | *Hatching hrs.* | *Grub period hrs.* | *Pupal period* | *Adults M : F* | *Duration of life cycle* |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 19 | 24 | 96 | 74 | 9 : 9 | 8 |
| 2 | 4 | 18 | 24 | 94 | 72 | 6 : 7 | 8 |
| 3 | 5 | 19 | 24 | 95 | 72 | 5 : 9 | 8 |
| 4 | 4 | 21 | 24 | 96 | 73 | 10 : 9 | 8 |
| 5 | 6 | 17 | 24 | 96 | 72 | 10 : 9 | 8 |
| 6 | 4 | 19 | 24 | 96 | 73 | 13 : 7 | 8 |
| 7 | 4 | 19 | 24 | 96 | 72 | 4 : 14 | 8 |

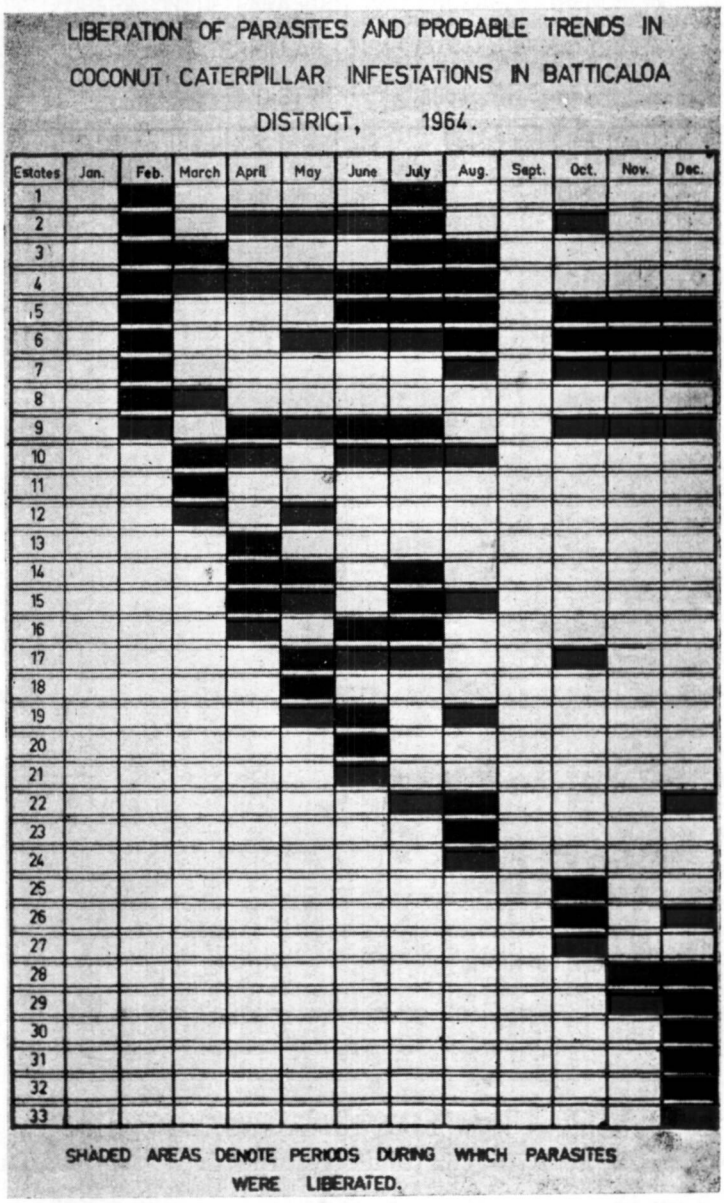
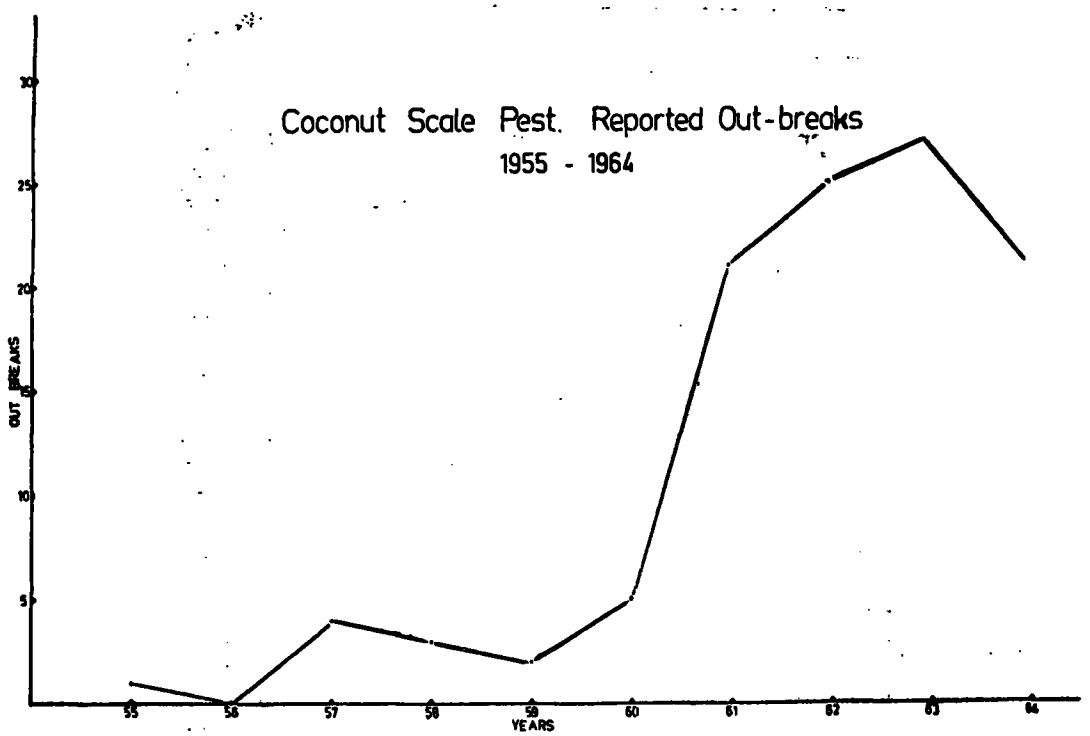

LIBERATION OF PARASITES AND PROBABLE TRENDS IN COCONUT CATERPILLAR INFESTATIONS IN BATTICALOA DISTRICT, 1964.
Estates
Jan.
Feb.
March
April
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
SHADED AREAS DENOTE PERIODS DURING WHICH PARASITES WERE LIBERATED.

Fig. 1

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

(*a*) *Incidence:*—The annual out-break of this pest has been plotted in a graph since 1955. The graph in Figure II below indicates the trends up to the current year.

Coconut Scale pest reported out-breaks 1955-1964.




(*b*) *Distribution:*—The out-breaks that appeared in the year 1964 occurred in the following Provinces:—

| | |
|---|---|
| North Western Province | 16 |
| Sabaragamuwa Province | 1 |
| Southern Province | 3 |
| Eastern Province | 1 |

(*c*) *Control:*—Coconut Scale pest out-breaks were controlled successfully, by spraying kerosene oil emulsion. The Crop Protection Service Unit was responsible in handling the spraying operations.

### 4. The Nettle Grub pest *Parasa lepida*, and its control

There was only one out-break during the year. It occurred in the Coconut Seed Garden at Ambekelle in the Chilaw District. The pest was brought under control by spraying DDT.

### 5. The pest control service unit

The pest Control Service Unit was engaged in Coconut Scale pest control work and in some trial sprayings in the control of Bud-rot disease on young palms.

## B. DISEASES

### 6. "Leaf Scorch" decline

*Symptoms:*—In addition to the symptoms so far described, it has been noted that scorched leaves tend to remain on the palm for a longer time than is usual and when they fall the abscission is such that prominent leaf scars are left on the trunks.

The following investigations were conducted—

(1) *Nematological*

(i) *Isolations* from roots of affected palms yielded two more species of nematodes

*Aphelencoides* sp.

*Rhabditis* sp.

(ii) *A Proof of pathogenicity* trial was conducted using the indicator plant. *Medicago sativa* which was grown in pots containing soil collected from leaf scorch affected area. The soil was inoculated, with *Caloosia longicaudata* Loos (originally termed *Hemicycliophora longicaudata*. The experiment was conducted under controlled conditions in the phyto-solarium.

Discolouration of leaves, degeneration of shoot, decay of root tips, and black lesions on older regions of the roots were observed on the test plants.

(iii) *A nematocidal field trial* was begun in Gonapinuwela on palms in the moderate stage of decline. Treatments were done with Shell DD soil fumigant. Nematode assay from soil and roots was done, periodically for future study.

*Histological work:*—Transverse and longitudinal sections of roots from affected and unaffected palms were examined. The purpose of this examination was to study some deposits found lodged in the vascular system, as observed earlier. It was later found that these deposits were present in roots of both, affected and unaffected palms without any significant association with either.

**Field Trials**

(i) Fungicidal trials, spraying moderately affected palms with copper oxide and dispersible sulphur were continued. Upto now there is no visible change in the palms treated.

(ii) The nematocidal trial mentioned above was commenced this year.

(iii) Mode of spread observations were kept in few estates in Gonapinuwela. In these blocks records of individual palms are being maintained.

(iv) The spread of "Leaf Scorch" to neighbouring palms and the incidence of yellowing of palms due to Magnesium deficiency near "Leaf Scorch" affected palms are studied in groups of palms in three estates in Gonapinuwela.

(v) Experimental seedlings planted in places where palms that died with "Leaf Scorch" symptoms in the Gonapinuwela area, were kept under observation.

### 7. Advisory Leaflets

The following advisory leaflets were prepared—

(i) Coconut Scale and its control (revised edition).

(ii) The Black beetle and its control.

**8. F.A.O. Coconut Conference**

Two papers were presented one on the present situation of pests and diseases of coconut palms and their control in Ceylon and the other on "Leaf Scorch" on coconut palms.

**9. Scientific Papers and Talks**

Two papers were read by the Crop Protection Officer at the Sessions of the Ceylon Association for the Advancement of Science. viz.

(i) *Hemicycliophora longicaudata* Loos 1948. (Criconematidae) a parasitic nematode associated with roots of coconut palms showing symptoms of "Leaf Scorch".

(ii) Some indegenous parasites, predators and pathogens in the control of Blue stripped Nettle grub *Parasa lepida* Cram. (Limacodidae).

The Crop Protection officer delivered a talk to the Planters Association, Kurunegala on "Some lesser-known insect pests on the Coconut Palm".

**Staff**

The following recruitments were done during the year:—

1. Mr. A.M. Chandrasena, Field Assistant.

2. Mr. G. Themapala, Lab/Field Attendant.

Mr. U.B.M. Ekanayake, Crop Protection Officer left for Great Britain in September, for post graduate studies at the University of Oxford.

J.K.F. KIRTHISINGHE,
*Officer-in-Charge, Crop Protection Division,*
*Coconut Research Institute.*

# REPORT OF THE BIOMETRICIAN

## 1. STATISTICAL SERVICE

All the Research Divisions of the Institute continued to be served by this division in their problems relating to the design of experiments, statistical analyses, and interpretation of data.

A step forward in field experimentation was taken in this Institute, when for the first time in Ceylon, the recently developed "composite design" for fertilizer experiments was introduced. Also termed the "Box design" (Box 1951), this design includes within a replicate only some of the treatment combinations given in a complete factorial arrangement; but from the point of view of estimating coefficients for characterising a quadratic response surface, it is found to be more efficient on a per plot basis than even a complete factorial experiment.

The three factors N, P and K are tested at 5 levels each and at specific combinations with only 15 plots per replicate while the complete factorial needs 125 plots.

With the relatively low error in experiments on coconut as compared to other perennials and also with the further appreciable reduction of error permissible by means of the "calibration" approach, it is confidently hoped that this new design will establish itself well in fertilizer experiments on coconut and thereby solve what has been perhaps the biggest problem in coconut experiments viz. the large extent of land required for fertilizer experiments.

The design aims at determining certain points on a response surface and characterising this surface by means of a polynomial equation to be derived through multiple regression techniques. Such a polynomal equation will be—

$$Y = a \pm b_1N \pm b_2N^2 \pm b_3P \pm b_4P^2 \pm b_5K \pm b_6K^2 \pm b_7NP \pm b_8NK \pm b_9PK$$

Such a production function will be amenable to the application of the modern principles of profit maximisation and cost minimisation of production economics.

## 2. BIOMETRICAL STUDIES

### (a) *Calibration Trial*

The recordings in the calibration trial at Ratmalagara Estate continued uninterruptedly. A full cycle of crop progress (i.e. 2 years) is still not available. As such no data can be published.

### (b) *Production functions*

More work was done during the year on the quantitative reconciliation of the fertilizer responses from different soil types with a view to obtaining a "generalised fertilizer equation".

### (c) *Repeatability Index for milk yield of cattle*

The index of repeatability for milk yield (i.e. within animals over the lactations) calculated on absolute values as is customary, may not be satisfactory so long as mean yield per day in respect of each lactation exhibits a trend over the lactations, which is infact what has been observed. Any such

trend is bound to inflate the variability with time, with the result that the repeatability would be underestimated. A more meaningful index which would indicate the repeatability unaffected by any time trend, was suggested by this division. If there are 12 animals, the milk yields of the animals are ranked from 1 to n within each lactation. The repeatability index (i.e. Intra animal correlation) is then calculated in the usual manner for these ranked data, after these have been transformed into "normal scores" (Table XX. Fisher & Yates).

## 3. AGRI-METEOROLOGY

### (*a*) *Meteorological Stations*

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

### (*b*) *Rainfall* 1964 *and crop prospects* 1965

**TABLE I**

**Rainfall and its distribution in important coconut areas of Ceylon**

| *STATION* | *TOTAL RAINFALL* | | | *EFFECTIVE RAINFALL* | | | *DISTRIBUTION INDICES* | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1964 | 1963 | *Avr.* ('53-63) | 1964 | 1963 | *Avr.* ('53-63) | 1964 | 1963 | *Avr.* ('53-63) |
| Lunuwila (B/E) | 77.47 | 101.20 | 81.38 | 74.25 | 96.00 | 76.64 | (i) 2.5013 | 2.61 | 1.89 |
| | | | | | | | (ii) 4.1800 | 3.46 | 2.87 |
| Madampe (R/E) | 66.34 | 77.28 | 65.75 | 64.31 | 72.38 | 63.58 | (i) 2.1626 | 1.60 | 1.70 |
| | | | | | | | (ii) 2.6006 | 1.89 | 2.38 |
| Chilaw | 65.96 | 85.76 | 64.16 | 65.96 | 79.11 | 60.46 | (i) 1.9108 | 1.85 | 1.53 |
| | | | | | | | (ii) 1.9120 | 2.32 | 2.16 |
| Puttalam | 37.06 | 64.70 | 49.34 | 37.06 | 62.04 | 47.09 | (i) 1.4302 | 1.85 | 1.27 |
| | | | | | | | (ii) 1.5560 | 2.32 | 1.57 |
| Kurunegala | 73.67 | 90.06 | 86.19 | 73.67 | 86.01 | 79.64 | (i) 2.5419 | 1.95 | 1.93 |
| | | | | | | | (ii) 4.2748 | 2.42 | 2.79 |

The total and effective rainfall in 1964 in the main coconut growing areas were very much lower than in 1963—infact except in Madampe and Chilaw areas the rainfall has been below the average for the last 10 years.

The distribution of rainfall however has been good in all areas except in Puttalam. But the severe drop in the effective rainfall will offset whatever advantages that may be expected from the good distribution.

Accordingly Puttalam area has to be prepared for a lean crop in 1965. Lunuwila, Madampe, Chilaw and Kurunegala areas may not be affected badly and will keep up to average production.

## 4. PRODUCTION AND EXPORTS

*(a) Production*

The estimated production of coconuts in Ceylon for the year 1964 is 3148 million nuts, which is 16.4% higher than the previous year and 17.9% higher than the last 5 years' average. This constitutes the highest production ever recorded by the coconut industry.

In recent years, there has been an unmistakable rising trend in coconut production due to the increased use of fertilizers brought about by the Government fertilizer subsidy scheme and also by the adoption by coconut growers of scientific methods of coconut cultivation as popularized by the Advisory service of the Coconut Research Institute of Ceylon. However the production in 1964 is over and above what would have been expected from this rising trend alone. The chief cause for this sharp increase in production is the extremely favourable weather conditions of 1963.

*(b) Exports*

The total quantity (in nut equivalent) of the major coconut products exported in 1964 is 1626 million nuts—this being 33.7% above that of 1963 and 30.3% above the last 5 years' average.

The average value of exports per 1000 nuts in 1964 is Rs. 169.62. This is 2.7% higher than 1963 and 1.9% lower than the last 5 years' average.

## 5. PUBLICATIONS

*(a) Papers read*

1. "Economics of Fertilizer Use" by V. Abeywardena (Second Technical Conference of the FAO on coconut production, protection and processing held in Ceylon in December 1964.

2. "The relationship between coconut yields and fertilizer application" by V. Abeywardena (Talk delivered before the Chilaw-Negombo Planters' Association).

3. "The Sinhala Cattle. 1. Lactation characteristics' by K. Santhirasegaram, V. Abeywardena and G.C.M. Goonesekera. (Ceylon Association for the Advancement of Science).

*(b) In print*

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

2. "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).

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

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

5. "Economics of Fertilizer Use" by V. Abeywardena (Tropical Agriculturist).

(c) *Submitted for publication*

1. "Growth Standards for coconut seedlings in the Southern Province" by V. Abeywardena and W.V. Fernando (Ceylon Coconut Planters' Review).

## 6. HONORARY WORK

The Biometrician was consulted by the Rubber Research Institute of Ceylon in the design of experiments and statistical analysis of data.

## 7. PERSONNEL

The Lab. and Field Attendant Mr. A.M. Chandrasena left this Division, on his being appointed Lab. and Field Assistant of the Crop Protection Division. The present cadre is as follows—

| *Designation* | *No.* |
|---|---|
| Biometrician | — 1 |
| Research Assistant | — 1 |
| Lab. and Field Assistants | — 2 (one vacant) |
| Lab. and Field Attendants | — 2 |

V. ABEYWARDENA,

*Biometrician, Coconut Research Institute.*

# REPORT OF THE PLANTING OFFICER

## 1. STAFF

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

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

*Clerk/Typists* Messrs. E.M.S. Fernando
H.W. Molligoda
W.A.W. Wijesooriya

*Accounts Clerk:*— Mr. R. Panchawarnam

*Field Assistants:*— Messrs. J.A. Cadelis (S.F.A.)
Ernest de Silva (S.F.A. Ibbagamuwa)
H.W. Fernando (Rathmalagara)
D.P. Jayamanne (Wilpotha)
C.H. de Alwis (Koggala)
J.L.D. Fernando (Walpita)
W.A. Sivappragasam (Alampil)
S. Nandagobal (Mylambavely)
Y.V. Sirisena (Handapangala)

*Nursery Attendants:*— Messrs. K. Edmund Perera (Head Office)
D.C. Karunasekera (Walpita)
A.M.K. Mohamed (Mylambavely)
B.D.G. Weerasooriya (Koggala)
B.M. Jayanayake (Eraminigolla)
D.L. Karunanayake (Wilpotha)
R.B. Wawelpola (Hettipola)
K.W. Kithsiri (Walpita)
S.L. Sumanasiri (Rathmalagara)
I. Joseph Fernando (Head Office)
K. Austin Silva (Head Office)
W.B.E. Fernando (Head Office)
A.T. Fernando (Rathmalagara)
W.G. Fernando (Wilpotha)
P.P. Jayasundera (Wilpotha)
J.B. Fernando (Kilinochchi)
J. Mathews (Head Office)

Messrs. K.D. Jathiratne (Head Office)
P.P. Sumanatillake (Kalawewa)
J.K.D.W. Siriwardene (Handapangala)
S.T. Fernando (Rathmalagara)
J.S. Roberts (Alampil)
S.D. Mullevitane (Ibbagamuwa)

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

*Recruitments:*—Nil.

*Promotions:*—Mr. Y.V. Sirisena—N.A., was promoted as Field Assistant in 1964.

*Transfers:*—Mr. G. Themapala—N.A., was transferred to the Crop Protection Division.

*Resignations:*—Mr. R. Panchawarnam—Accounts/Clerk left the services of the Institute during the year.

## 2. NURSERIES

*Seednuts:*—2000, 244 seednuts were planted in the nurseries during the year. The distribution of seednuts in the nurseries is as follows:

**SEEDNUTS PLANTED IN 1964 FOR ISSUE OF SEEDLINGS IN**

| *Nursery* | *May/June '64* | *Oct./Nov. '64* | *Total* |
|---|---|---|---|
| 1. Rathmalagara .. .. .. | 131,431 | 175,960 | 307,391 |
| 2. Eraminigolla .. .. .. .. | 35,000 | 40,930 | 75,930 |
| 3. Ibbagamuwa .. .. .. .. | 109,875 | 261,550 | 371,425 |
| 4. Walpita .. .. .. .. | 81,625 | 94,846 | 176,471 |
| 5. Hettipola .. .. .. .. | 25,000 | 36,000 | 61,000 |
| 6. Handapangala .. .. .. | — | 175,003 | 175,003 |
| 7. Mylambavely .. .. .. .. | — | 99,797 | 99,797 |
| 8. Kalawewa .. .. .. .. | — | 99,400 | 99,400 |
| 9. Wilpotha .. .. .. .. | 96,325 | 193,665 | 289,990 |
| 10. Kilinochchi .. .. .. .. | — | 100,212 | 100,212 |
| 11. Mullaitivu .. .. .. .. | — | 150,000 | 150,000 |
| 12. Koggala .. .. .. .. | 45,000 | 48,625 | 93,625 |
| | 524,256 | 1,475,988 | 2,000,244 |

**Seedlings**

Orders for 1,291,966 seedlings were booked for both planting seasons i.e. May/June and October/November 1964. Although the demand for seedlings in May/June was poor, there was a marked improvement in the issue of seedlings during the October/November season. The demand for seedlings during this season exceeded the available supply. Distribution of seedlings from the nurseries is as follows:

| Name of Nursery | Total No. of seedlings booked for May/June | Total No. of seedlings booked for Oct./Nov. up to 31st Dec. 1964 | Total No. of seedlings booked for both seasons |
|---|---|---|---|
| 1. Rathmalagara .. .. .. | 59,627 | 139,679 | 199,306 |
| 2. Hettipola .. .. .. .. | 26,325 | 21,660 | 47,985 |
| 3. Wilpotha .. .. .. .. | 67,380 | 137,730 | 205,110 |
| 4. Ibbagamuwa .. .. .. .. | 49,673 | 183,211 | 232,884 |
| 5. Walpita .. .. .. .. | 58,780 | 51,650 | 110,430 |
| 6. Koggala .. .. .. .. | 29,295 | 39,401 | 68,696 |
| 7. Eraminigolla .. .. .. .. | 9,520 | 40,081 | 49,601 |
| 8. Kalawewa .. .. .. .. | — | 73,765 | 73,765 |
| 9. Alampil .. .. .. .. | — | 77,050 | 77,050 |
| 10. Kilinochchi .. .. .. .. | — | 61,755 | 61,755 |
| 11. Handapangala .. .. .. | — | 115,778 | 115,778 |
| 12. Mylambavely .. .. .. .. | — | 49,606 | 49,606 |
| | 300,600 | 991,366 | 1,291,966 |

## 3. INSPECTIONS

The nurseries were inspected by the Planting Officer, Assistant Planting Officer and the Senior Field Assistant.

P.D.L. FERNANDO,

*Planting Officer, Coconut Research Institute.*

# REPORT OF THE CHIEF ADVISORY OFFICER

## SECTION I

This Division, through its extension organization, comprising of advisory field officers and district coconut instructors, continued to advice and guide coconut growers on improved methods of coconut cultivation on lines recommended by the research divisions of the institute. In this connection the field staff have made 10,065 visits to coconut lands, and delivered talks at a number of meetings. This division also participated in two agricultural exhibitions held at Alawwa and Galle.

Free advice and guidance have been made available to coconut growers through the pre-planting service, follow-up service, general advisory service and the pest and disease control service. The pre-planting service is provided to those who intend to carry out new planting or replanting. Such lands are visited by the field staff to demonstrate lining for planting, advice on preparation of planting holes, method of planting and care of seedlings. The follow-up service consists of visiting such lands, thereafter, to provide guidance on soil and moisture conservation, manuring, weeding and on any other matters necessary for the proper maintenance of the plantation. Under the general advisory service the field staff visit poorly or inadequately maintained coconut lands to explain and show owners or those in charge of them, the methods that should be adopted to improve their plantations. Pest and disease control service consists of visiting lands to advice and outline operations for the prevention and control of pests and diseases.

In respect to the above, the field staff have, during the period under review advised in 3838 instances on manuring; 663 on replanting; 1521 on husk burying; 627 on estate sanitation and weeding and in 390 instances on other items such as catch cropping, cover cropping, harrowing, mulching, filling vacancies. They have also trained persons in charge of coconut lands on the technique of lining for planting, tracing of contour drains and methods of draining low-lying lands. In doing so, they have lined for planting 804 acres traced 4214 chains of contour drains and 672 chains for draining of water logged soils. In connection with pest and disease control the field staff have visited, 591 lands in relation to termites; 150 in relation to coconut caterpillar; 770 in relation to black beetle; 1071 in relation to red weevil; 133 in relation to grey blight; 81 in relation to coconut scale and 334 in relation to other pests and diseases. Of these, the incidence of red weevil has been reported to be high particularly in the highland colonization schemes where young coconut plantations have been established.

Besides the above, the field staff have also carried out for the Commissioner of coconut rehabilitation, manure subsidy inspections on small holdings where fertilizer had been purchased, through co-operative societies. In the course of their work, advisory leaflets of the institute, seedling application forms and forms for the purchase of fertilizer under the Fertilizer Subsidy Scheme have also been distributed.

During the year, routine items of work on manuring and other cultivation operations have been carried out in the five demonstration centres at Koggala, Mundel, Hettipola, Pallai and Alampil maintained by the division and a sixth at Mylambavelly has been initiated in October. The cyclone that

occurred in December hit the entire new plantation of 15 acres, in the Alampil demonstration centre, causing much damage to the seedlings which were 1 to 4 years old. At Pallai, on the other hand, the damage was mild. Result demonstrations through these centres have been found to be a very effective method of impressing coconut growers on the advantage of adopting improved techniques. It would therefore be desirable if more such centres could be established as these would, undoubtedly, serve as valuable aids to a wider planting public.

It must however be said that, although the goal of extension service is to induce coconut growers to adopt improved methods, the final decision always rests with the grower. The acceptance and adoption of recommended practice by coconut growers is influenced by certain factors, chief and most important of which is money. Fortunately, the fertilizer subsidy scheme, which enable large and small holders to purchase fertilizer at 1/3 and 1/2 price respectively, and the seedling subsidy scheme, which provides selected seedlings at -/25 cts. to coconut growers, have to a considerable extent helped land owners to manure and replant their lands more profitably. However in view of the fact that manuring and underplanting alone, without adequate soil and moisture conservation and draining of land where necessary, cannot be expected to produce the desired results, the field staff have by planned demonstrations attempted to persuade land owners to carry out such measures.

Unfortunately, the response to the adoption of such measures particularly by small holders have been poor and rather discouraging. The chief reason for this apathy has been the cost, as cutting of drains and husk pits are expensive items of work. To my mind therefore a scheme of assistance, to help the small holder to adopt such soil and moisture conservation practices as are necessary, deserves very serious consideration. If this is done, the advice and guidance of this free advisory service could be utilised to a greater measure by a larger number of small holders, who own nearly 70% of the total acreage of coconuts in this country.

In conclusion it must be mentioned that this division, while recommending improved and scientific methods to coconut growers, also brings their problems to the research divisions of the institute for investigation and solution. In the absence of sufficient information on problems such as immature nut fall caused by factors other than soil moisture and Leaf Scorch, this division has not been in a position to advice owners of coconut lands with respect to such inquiries. It would also be of immense value, if in view of what has already been stated elsewhere in this report, further research could be carried out on the control of the red weevil pest, with a view to evolving an alternative method to the present technique of injecting insecticide into the trunks of affected palms. The reason being that this injection is a slow, expensive and tedious process which has been found, all the more difficult and impracticable to use when red weevil infestation is detected in more than a few young palms in a plantation.

**Staff Matters**

(1) Mr. T. Ganarajah, District Coconut Instructor was away for three months in East Pakistan on an assignment as Coconut Extension Specialist. His services were lent to that country under the Technical Co-operation Scheme of the Colombo Plan.

(2) Mr. J. G. de Silva, Advisory Field Officer, Ibbagamuwa and Mr. J. B. Galagedera, Advisory Field Officer who had been temporarily attached for work in connection with the scheme for planting coconuts in citronella lands have been transferred to Headquarters.

## SECTION II

## SUBSIDY SCHEME FOR PLANTING CITRONELLA LANDS IN MATARA AND HAMBANTOTA DISTRICTS WITH COCONUT

Under the scheme the issue of free seedlings and fertilizer to those who applied to plant their lands in coconut has been completed in 1963 with 11,333 applicants being issued planting material and free fertilizer for 21,848 acres and 2 roods. In addition these applicants have also been given 122,603 ozs. of Aldrex for application in planting holes at the time of planting as a protective measure against termite damage.

During the period under review the field staff carried out inspections of lands for recommending payment of the annual cash subsidy and for advising owners of lands on after-care of seedlings. In this connection 5,923 lands have been visited, and of the 713,094 declared by the applicants only 646,006 seedlings have been reported by the field staff as satisfactorily maintained on the lands.

The field staff have in the course of advising land owners on after-care of seedlings particularly emphasised on the importance of eradicating the weed Eupotorium oderatum by uprooting and burning same, as this noxious weed has been found to affect the young seedlings in practically every land, owing to its very quick and profuse growth.

As the Government had decided to also issue free fertilizer at the rate of 4½ lbs., 7½ lbs., and 10½ lbs. per seedling during the 3rd, 5th and 7th year to those applicants who have planted 10 acres and under in coconut, 1,001 tons 16 cwts. and 70½ lbs. of fertilizer have been distributed among 4,281 applicants. The quantity of fertilizer issued has been made only in respect of the number of seedlings that have been satisfactorily maintained on the land.

In March Mr. C. A. M. de Silva, Chairman of the Coconut Research Board, Mr. C. T. Van Geyzel, *J.P.*, Chairman Extension Committee, Mr. C. Chanmugam, Commissioner of Coconut Rehabilitation cum Board Member, Mr. L. W. A. Fernando, Board Member and the Director of the Institute inspected a number of areas that had been planted in coconuts under the scheme.

**Staff Matters**

Messrs. D. G. M. Weerasinghe, M. W. F. W. Fernando and Miss M. Jenette Fernando were appointed as temporary Clerk/Typists.

Mr. R. M. A. P. Ratnayake, Advisory Field Officer who had been released from the F.A.O. Coconut Pilot Survey has been transferred to the range. Messrs. K. N. L. P. Seneviratne, J. B. Galagedera, Advisory Field Officers and D. E. P. Perera, Field Attendant have been transferred to Head Office. Messrs. A. Randeniya, E. V. M. M. Edirisinghe and M. M. A. Abeyratne, Field Attendants have been transferred from Head Office to the field. Messrs. I. Joseph Fernando and K. Austin Silva, Nursery Attendants have been temporarily released by the Planting Officer for work under the scheme.

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

# REPORT OF THE AGROSTOLOGIST

## 1. INTRODUCTION

With the reroofing of the old glass house, studies on soil fertility were brought to full capacity and analysis of three new soils were commenced. In addition to routine studies, an experiment on forms of phosphates on two soil types was carried out at the request of the Soil Chemist; facilities were provided in the glass house for the Crop Protection Officer. A comparative study of the response of indicator plants in pots, and coconuts in the field, to different nutrients on the various soils was also undertaken.

In the field of pasture experimentation, emphasis was laid on the competition for the major nutrients (N, P, and K) and soil moisture between the two crops—pastures and coconuts. In addition to this, problems in pasture ecology were undertaken for study.

The lactation data of the Sinhala herd collected over the past twelve years were studied and some worthwhile information has emerged. In addition to crossing these cows to the tropical Scindhi, systematic artificial insemination to tropicalised Jersey and temperate Fresian were also undertaken.

## 2. SOIL FERTILITY STUDIES

### (*a*) *Gonapinuwela gravel*

Preliminary studies on this soil have been completed. It was found to be deficient in N, P, K, Mg and B. Experiments to determine the optimum requirements of P, K and Mg at five levels of each nutrient in a composite design are in progress.

### (*b*) *Bandirippuwa soils*

The lateritic gravel from a newly acquired portion was sampled and a $4^3$ factorial experiment of N, P and K was planted in 1963 (see Annual Report for 1963). The response to the various nutrients was essentially similar to that record with the gravel from the main Estate (C.R.I. Bulletin, No. 11 and 20).

This pattern of very high early response to added P which decreased with time, has now been recorded with many soils. This would mean that with air-drying of the soils there was fixation of phosphate which was later released with prolonged wetting. It may also be that in the pots there was insufficient aeration, and this anaerobic condition caused the release. The pattern of response to K was reverse—little or no response at the early stages, which increased with time culminating in death of all plants that did not receive an application of the nutrient.

### (*c*) *Walahapitiya soils*

The lateritic loamy soils opposite the Soil Chemist's experiment in this Estate was sampled early in the year and three preliminary experiments to detect nutrient deficiencies were completed.

The first experiment was designed to study the effect of N, P, K, Ca and Mg at two levels of each nutrient on the growth of *P. commersonii, P. lathyroides* and *S. indicum.*

The soil was found to be deficient in N, P and K at all stages of growth while Ca increased yields during the latter stages.

The second experiment studied the effect of Fe, Cu, Zn, Mn and Mo on the growth of these three species.

None of the nutrients had any effect on *S. indicum.* Fe and Mn on *P. commersonii* and Mo on *P. lathyroides* increased yields, but the responses lacked consistency. Zn had entered into a number of negative interactions. Confirmatory experiments will be undertaken.

The third experiment studied the effect of B and Mo at two levels and four forms of Ca (nil, $Ca(OH)_2$, $CaCO_3$ and $CaSO_4.2H_2O$) on the growth of *P. lathyroides* and *M. sativa.*

Both B and Mo were without effect, while the basic forms of Ca increased yields considerably; Ca $SO_4$ however, was without effect. This effect of lime is similar to that recorded by *Nethsinghe* (personal communication) with coconuts on this soil.

An experiment to study the effect of forms of sulphur was commenced late in the year, and is in progress. Early indications are that this soil is deficient in this nutrient.

*(d) Irranawila soils*

The Estate is bounded on the west by the ocean and east by the Chilaw lagoon. The soil is on a catenary sequence of yellowish sand near the ocean followed by greyish white sand, which is of major importance, leading to a dark clayey alluvium inland.

(i) *Grey sand:*—Three experiments were commenced to establish nutrient deficiencies.

The first experiment studied the effect of the major nutrients (N, P, K, Ca, Mg and S) by the subtractive technique on the growth of *P. commersonii* and *P. lathyroides.*

The results up to the completion of three harvests in both species showed deficiencies of all nutrients tested except Mg. In the legume there was progressive decrease in the response to N indicating effective nodulation. With the grass the early high response to P decreased with time, and at the third harvest, minus-P yielded more than those receiving all nutrients.

The second experiment studied the effect of Fe, Cu, Zn, Mn and Mo at two levels of each nutrient on the growth of *P. commersonii.*

No definite information is yet available from this experiment.

The third experiment studied the effect of Ca, Mg, S, B and Mo at two levels of each nutrient on the growth of *P. lathyroides* and *M. sativa.*

The data indicate a deficiency of all nutrients tested except Mg, with both species. In the case of *M. sativa* however, there appears to be a late response to Mg.

(ii) *Yellow sand:*—Two experiments, one to assess deficiencies of the major nutrients (N, P, K, Ca, Mg and S) and the other to assess minor nutrients (Fe, Cu, Zn, Mn and Mo), were planted.

The results of the first experiments appear to be similar to that with the grey sand, except that there was no decrease in the response to P with the grass. It is too early to comment on the results of the second experiment.

A field trial was carried out on the grey sand at Irranawila where plots 2' × 2' spread over an acre avoiding drains, husk pits, manure circles and other atypical areas were demarcated. The treatments were N, P, K, S, Mo and B on a subtraction basis and planted to rows of *Calapagonium mucinoides.*

At the first harvest taken in December there was significant response to N, P, S and B. The experiment is in progress.

*(e) Phosphate response on the Ratmalagara loam and Pothukulama sand*

With coconut seedlings in the field *Salgado* observed an almost immediate response to phosphate on the Ratmalagara loam while *Nethsinghe* could not obtain significant response even after three years on the Pothukulama sand. Using indicator plants in pots *Santhirasegaram* on Ratmalagara loam and *Santhirasegaram et al* on Pothukulama sand obtained very high response to added phosphate. In both field trails referred to phosphate was applied as saphos while in the pot experiments it was applied as $NaH_2PO_4$. $2H_2O$.

It was therefore, decided to compare the response to forms of phosphate on these two soils. To this end an experiment was set up with nil and three forms of phosphate ($NaH_2PO_4.2H_2O$, super phosphate and saphos phosphate). In each instant the amount of P added was 66.8 lbs/acre. All other deficient nutrients were applied at optimum levels. The species tested were *P. commersonii, P. lathyroides* and *S. indicum* with 4 replicates of all treatments. Two harvests with the grass and two plantings with the other species were recorded.

The total dry matter yield is shown in Table I.

**TABLE I**

**Total dry matter yield (gms.) from the three species on the two soils to forms of phosphate and control treatments**

| | | *Nil* | *P. sod.* | *P. sup.* | *P. sap.* | *L.S.D. at 5 %* |
|---|---|---|---|---|---|---|
| Pothukulama | P.c. | 13.10 | 32.05 | 30.24 | 23.57 | 4.54 |
| | P.l. | 8.64 | 21.13 | 19.97 | 19.32 | 4.35 |
| | S.i. | 5.78 | 17.88 | 22.10 | 18.40 | 7.79 |
| | Total | 27.52 | 71.06 | 72.31 | 61.29 | 16.68 |
| Ratamalagara | P.c. | 4.66 | 20.03 | 18.85 | 16.02 | 4.54 |
| | P.I. | 3.00 | 21.09 | 24.38 | 14.47 | 4.35 |
| | S.i. | 0.11 | 8.19 | 10.60 | 3.48 | 7.79 |
| | Total | 7.77 | 49.31 | 53.83 | 33.97 | 16.68 |
| | G. Total | 35.29 | 120.37 | 126.14 | 80.24 | 33.36 |

The results may be summarised as follows:

(i) In absence of added phosphate the total dry matter produced by the three species on Pothukulama sand was more than three-fold compared to the Ratmalagara loam, indicating much higher availability of P in the former than in the latter soil.

(ii) Yields from saphos phosphate was on the average less than from the two soluble forms. There was no difference between the two soluble forms.

(iii) This reduced availability of P from saphos phosphate was more marked at Ratmalagara than at Pothukulama.

It may then be said that while both soils are deficient in phosphate the Pothukulama sand is less so, and in the field with unrestricted volume of soil for plant growth any response to added phosphate would take more time than with Ratmalagara loam.

*(f) Gaseous loss of nitrogenous fertilizers from soils*

Gaseous loss from three forms of nitrogenous fertilizers ($NH_4NO_3$, $(NH_4)_2SO_4$ and $CO(NH_2)_2$) was studied on a sandy soil (Pothukulama) and a loamy soil (Bandirippuwa), in glass jars covered with petri-dishes and the evolved gases absorbed in dilute sulphuric acid for a week. The nitrogenous compounds were applied as powders sprinkled on the surface or $\frac{1}{4}$ inch below. The soils were kept moist at field capacity.

There was no significant difference due to depth of application though loss was consistently higher from surface application. The sandy soil lost more than the loam (Table II).

**TABLE II**

**Weight of ammonia lost (milligrams/pot) from the two soils without (control) and with application of three forms of nitrogenous compounds**

| | *Control* | $(NH_4)_2SO_4$ | $NH_4NO_3$ | $CO(NH_2)_2$ |
|---|---|---|---|---|
| B/E loam .. | 0.3 | 0.4 | 0.2 | 6.2 |
| P/E sand .. | 0.5 | 1.1 | 4.7 | 9.4 |

*(g) Comparision of the response of coconuts and indicator plants to various nutrients on different soils*

A comparative study of the responses to various nutrients obtained with indicator plants in pots and those with coconuts in the field was undertaken and is in progress. The position may be tentatively summarised as in Table III.

## TABLE III

**Comparison of the response of coconuts and indicator plants to some nutrients on different soils**

| | *N* | | *P* | | *K* | | *Mg* | | *B* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *C* | *I* | *C* | *I* | *C* | *I* | *C* | *I* | *C* | *I* |
| 1. Pothukulama .. | + | + | + ? | + | + | + | – | 0 | – | 0 |
| 2. Irranawila .. | + ? | + | + ? | + ? | + ? | + | – | 0? | – | + |
| 3. Ratmalagara .. | + | + | + | + | + | + | 0? | 0 | 0 ? | 0 |
| 4. Horrekelle .. | + | + | + | + | + | + | + | + | + ? | + |
| 5. Bandirippuwa .. | + | + | 0 | 0 | + | + | 0? | 0 | 0 ? | 0 |
| 6. Mattegoda .. | + ? | + | + ? | + | + ? | + | + | + | + ? | + |
| 7. Gonapinuwela | + ? | + | + ? | + | + ? | + | + | + | + ? | + |

C = Coconuts; I = Indicator plants;
+ = Positive response; 0 = No response;
? = Needs information; – = No information.

The quantitative aspects and the possible implications are being studied.

### 3. PASTURE STUDIES

(*a*) *Cultivation experiment* ($P_4$) R/E.

During the year the intensity of grazing was doubled. Nut yields from sub-soiled plots were slightly superior to the non-cultivated plots as reported in 1962. The experiment is being continued.

(*b*) *Intensity of grazing trial* ($P_5$) R/E.

This is in progress according to the modifications reported in 1963.

(*c*) *Type of grazing experiment* ($P_6$) R/E.

The results are similar to that reported in 1963.

(*d*) *Pasture* × *Manurial experiment on coconuts* ($P_7$) B/E.

This is a 3 × 2 × 2 factorial, of N, P and K in main plots and divided into 3 sub-plots of *B.brizantha, B.miliiformis* and weed (control), experiment on the yield of coconuts.

(i) *Coconut yields:*—Both N and K increased yields as reported last year. The beneficial effect of P recorded last year assumed significance in 1964. The N, P, K, interaction was also significant. The types of vegetation also had significant effects, and the interaction of vegetation with N and K were also of importance though they have not assumed significance.

*Nitrogen:*—Nitrogen had significant effect on the number of nuts and had almost similar effect on the yield of copra (Table IV).

TABLE IV

Number of nuts and copra (lbs.) per acre at the three levels of N.

| | *No. of Nuts* | *Copra (lbs.)* |
|---|---|---|
| $N_1$ .. | 3176.96 | 1646.08 |
| $N_2$ .. | 3246.72 | 1688.96 |
| $N_4$ .. | 3557.76 | 1784.96 |
| L.S.D. ($P < 0.05$) | 301.74 | 146.73 |

*Phosphate:*—Phosphate had a beneficial effect in 1963. This year it was significant for weight of copra, and just failed to assume significance in the number of nuts (Tabel V).

TABLE V

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

| | *No. of Nuts* | *Copra (lbs.)* |
|---|---|---|
| $P_1$ .. | 3217.92 | 1635.20 |
| $P_2$ .. | 3435.52 | 1778.56 |
| L.S.D. ($P < .05$) .. | 249.40 | 122.01 |

The effect of P evident so early in the experiment (5 years) is contrary to the results reported by *Eden et al* (1963) for Bandirippuwa with coconuts. The present response to $P_2$ over $P_1$ (both being phosphate-added levels) would show that the lack of response in the trial, reported by *Eden et al* was due to the phosphate applied to the soil prior to the commencement of the experiment, and not due to the presence of any phosphate mineral in the soil parent material.

*Potash:*—Significant response was obtained for both yield characters (Table VI).

TABLE VI

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

| | *No. of Nuts* | *Copra (lbs.)* |
|---|---|---|
| $K_1$ .. | 3167.36 | 1603.84 |
| $K_2$ .. | 3486.72 | 1809.92 |
| L.S.D. ($P < 0.05$) .. | 243.24 | 116.95 |

*Vegetation:*—Both species of *Brachiaria* depressed the number of nuts and copra per acre compared to the weed control, *B.brizantha* more so than *B.miliiformis* (Table VII).

TABLE VII

**Number of nuts and weight of copra (lbs.) per acre for the three vegetations**

| | *No. of Nuts* | *Copra (lbs.)* |
|---|---|---|
| Weed (control) .. .. .. | 3847.68 | 1958.40 |
| B. miliiformis .. .. .. | 3261.44 | 1687.68 |
| B. brizantha .. .. .. | 2871.68 | 1474.56 |
| L.S.D. ($P < 0.05$) | 214.93 | 126.43 |

*Vegetation × Nitrogen interaction:*—In the weed control plots highest yield of number of nuts and copra was attained at $N_2$ and there was a drop at $N_4$ (Table VIII).

TABLE VIII

**Number of nuts and weight of copra (lbs.) per acre for the vegetation and nitrogen combinations**

| | | $N_1$ | $N_2$ | $N_4$ |
|---|---|---|---|---|
| No. of Nuts | Weed (control) .. .. | 3732.48 | 3957.12 | 3853.44 |
| | B. miliiformis .. .. | 3066.88 | 3135.36 | 3582.08 |
| | B. brizantha .. .. | 2730.88 | 2634.24 | 2349.92 |
| Copra (lbs) | Weed (control) .. .. | 1933.44 | 2043.52 | 1899.52 |
| | B. miliiformis .. .. | 1614.72 | 1641.60 | 1805.44 |
| | B. brizantha .. .. | 1389.44 | 1378.56 | 1655.04 |

In pasture plots however highest yields were recorded at $N_4$ and these were still much less than that recorded for weeds at $N_2$. This would indicate that the pastures utilised the nitrogen even at 4 cwts sulphate of ammonia causing loss of yield of coconuts.

*Vegetation × Potash interaction:*—There was very high increase both in the yield of number of nuts and copra due to $K_2$ over $K_1$ in the weed control plots while the increase in the pasture plots was very much less in comparison (Table IX.)



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TABLE IX

**Number of nuts and weight of copra (lbs.) per acre due to the three vegetation types at the two levels of K**

| | *No. of Nuts* | | *Copra (lbs.)* | |
|---|---|---|---|---|
| | $K_1$ | $K_2$ | $K_1$ | $K_2$ |
| Weed (control) .. | 3538.56 | 4156.80 | 1774.08 | 2143.36 |
| B. miliiformis .. | 3182.08 | 3341.44 | 1632.64 | 1742.08 |
| B. brizantha .. | 2780.16 | 2963.20 | 1404.16 | 1544.96 |

These data would indicate that there was competition for N and K between coconuts and pastures relative to weeds. These interactions were not evident in 1963. It is hoped that they will assume statistical significance during the next year or so.

(ii) *Herbage yield:*—The dry matter yield of weeds (control) and the two pasture species were determined prior to commencement of grazing during the S-W and N-E monsoons.

Both the type of vegetation and the levels of introgen were significant, alone and in combination (Table X). In the weed (control) plots there was a slight increase from $N_1$ to $N_2$ and then a decrease. In the two pastures there was an almost linear increase in yield with increase in the level of N; there was no appreciable difference between the two pastures.

TABLE X

**Dry matter yeild (lbs./acre) of the three vegetations at the three levels of N**

| | $N_1$ | $N_2$ | $N_4$ | *Mean* |
|---|---|---|---|---|
| Weed (control) .. .. | 1,646 | 1,901 | 1,745 | 1,764 |
| B. miliiformis .. .. | 1,908 | 2,313 | 3,179 | 2,466 |
| B. brizantha .. .. | 1,893 | 2,497 | 2,977 | 2,455 |
| Mean .. .. | 1,815 | 2,237 | 2,633 | *310 \ 228* |

*L.S.D. ($P < 0.05$) of respective means. L.S.D. ($P < 0.05$) of interaction = 395.

(*e*) *Rate of nitrogen application to coconut cum pasture association* ($P_{12}$) B/E

This is a modification of $P_1$ as reported in 1963. It is in progress.

(*f*) *Interspecific competition for nitrogen* ($P_{13}$) R/E

The experiment in the form planted in 1963 (2 ft. row spacing) was completed in July this year. Two harvest data, taken at the end of the first season (December 1963) and another at the end of the second season (July 1964), are summarised below:—

1. *Brachiaria brizantha* responded less to added nitrogen than *B.miliiformis.*
2. Both species yeilded similar amounts when grown alone (cf. $P_{17}$).
3. The total yield of the association was not significantly higher than the yield of either species when grown alone.
4. In association *B.miliiformis* yielded more than *B. brizantha.* This is shown in Table XI.

**TABLE XI**

**Dry matter yield (gms/m$^2$) of *B.brizantha* and *B.miliiformis* grown alone and in mixture and harvested on two occasions**

| | *Alone* | | | *Mixture* | | |
|---|---|---|---|---|---|---|
| | *B.b.* | *B.m.* | *Mean* | *B.b.* | *B.m.* | *Total* |
| December 1963 .. .. | 65.8 | 75.7 | 70.7 | 26.3 | 52.3 | 78.6 |
| July 1964 .. .. | 149.8 | 155.3 | 152.6 | 31.1 | 151.0 | 182.1 |

5. The dominance of *B.miliiformis* over *B.brizantha* increased with increase in the level of nitrogen. This is shown in Table XII.

**TABLE XII**

**Percentage dry matter yield of *B.miliiformis* in the association at the three levels of N**

| | $N_0$ | $N_2$ | $N_4$ |
|---|---|---|---|
| December 1963 .. | 30 | 40 | 80 |
| July 1964 .. .. | 66 | 81 | 84 |

These and other data, not considered here, are being studied and would be prepared for publication; and the experiment has been replanted on a checker-board pattern.

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

After the preliminary establishment period, four harvests were taken between June and December this year. The mean yield for the four harvests are summarised in Table XIII.

TABLE XIII

**Dry matter yield of *P.maximum* at two levels of nitrogen and four distances of row spacing**

| | | 1 *ft.* | 2 *ft.* | 4 *ft.* | 8 *ft.* |
|---|---|---|---|---|---|
| gm./plant | $N_0$ | 13.20 | 23.45 | 40.63 | 48.71 |
| | $N_4$ | 30.28 | 56.35 | 88.01 | 92.52 |
| gm./$m^2$ | $N_0$ | 76.84 | 68.21 | 59.09 | 35.42 |
| | $N_4$ | 176.18 | 163.94 | 128.01 | 67.28 |

These data show that there was very high response to added nitrogen with maximum response at 2 ft. row spacing. Maximum yield per unit area was obtained at the closest row spacing tested. The experiment is being continued.

(*h*) *Rate and frequency of nitrogen application* ($P_{16}$) B/E

This experiment planted to *B.miliiformis* could not be continued due to break down of machinery. It is hoped to recommence it in 1965.

(*i*) *Intensity and frequency of defoliation of B.miliiformis* ($P_{16}$) B/E

This was not commenced due to lack of machinery.

(*j*) *Interspecific competition between B.brizantha and B.miliiformis at varying proportions of plants* ($P_{17}$) R/E

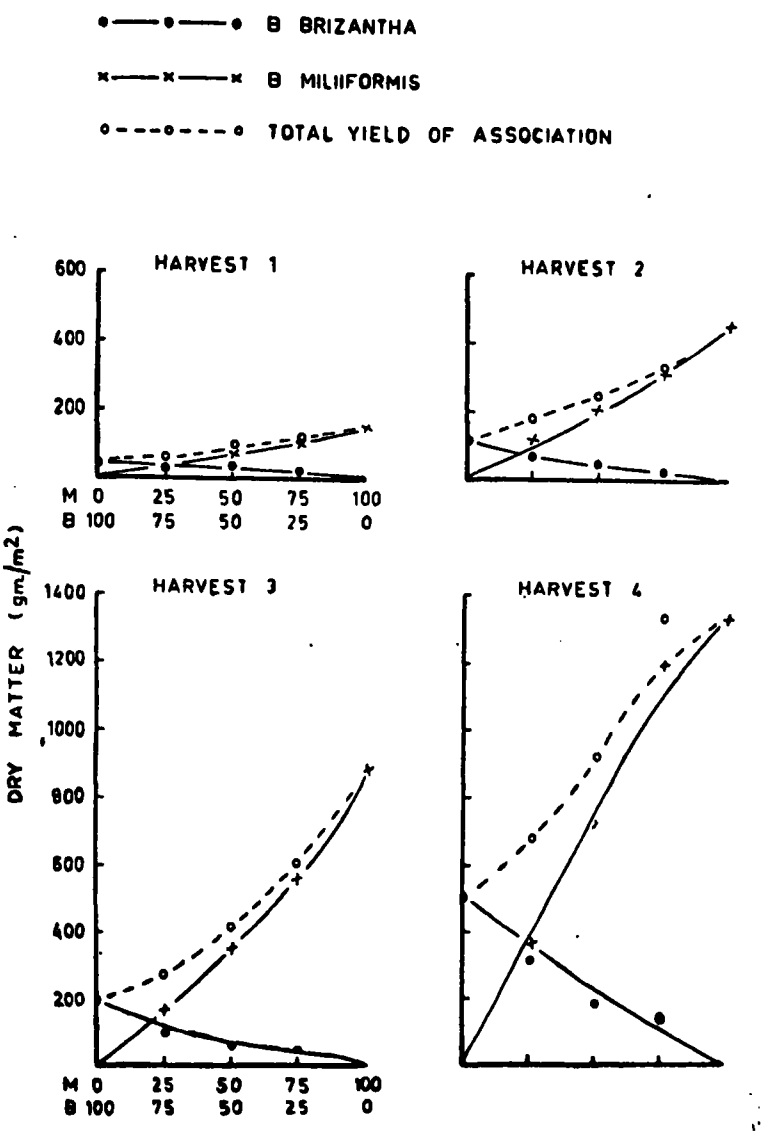
This experiment was concluded in July. Some of the data were studied and are shown in Fig. 1. The main findings may be summarised as follows:—

1. In pure culture *B.miliiformis* yielded more than *B.brizantha* (cf $P_{13}$).

2. The total yield of the various associations was always less than the yield of *B.miliiformis* in pure culture and always more than that of *B.brizantha* in pure culture.

3. At the proportion of 80% *B.brizantha* and 20% *B.miliiformis* in the association, the yields of the two species were equal. Further aspects will be dealt with in a separate publication when all data collected have been studied.

## Figure 1




Dry matter yield of B. brizantha and B. miliiformis in the various associations at the four harvests.

(*k*) *Interspecific competition between grass and legume* ($P_{18}$) R/E.

Due to poor establishment and growth of the legume (*Centrosema pubescens*) much time was lost. However, two harvests were taken during the latter part of the year. Mean yields of the two harvests are shown in Table XIV. In this experiment the mixed culture was a simple addition of the number of plants of each species in pure culture.

TABLE XIV

**Dry matter yield (gms./16 sq. ft.) of *Panicum maximum* and *Centrosema pubescens* grown alone and in mixture, with and without application of nitrogen**

| | *Alone* | | *Mixture* | | *Total of Mixture* |
|---|---|---|---|---|---|
| | *P.m.* | *C.p.* | *P.m.* | *C.p.* | |
| $N_0$ | 89.9 | 71.8 | 75.4 | 64.0 | 139.4 |
| $N_4$ | 135.8 | 68.3 | 136.2 | 21.3 | 157.5 |

The results may be summarised as follows:—

1. *Panicum maximum* responded to added N both in pure and mixed culture, while *Centrosema pubescens* was not affected by added N in pure culture, but showed very much reduced growth in the association.
2. In association the yield of both species was slightly less than in pure culture, but the total yield from the association was superior even to the higher yielding pure culture *P.maximum* in the absence of added N (cf $P_{17}$).
3. In presence of added N the yield of *P.maximum* was unaffected by the type of culture, while that of *C.pubescens* was much less in association compared to pure culture, and the total yield of the association, though higher than the high yielding pure culture, was less marked than in absence of N.

The effect of the association of grass in presence of N on the legume was probably due to the shade cast by virtue of its greater stature. The superiority of the yield of the association over the high yielding pure culture may well be due to the incomplete utilisation of the environment by *P.maximum* at planting distances of 3 ft. square (cf $P_{14}$). This afforded some of the environmental factors for the creeping legume to grow, whose competition for N with the grass would have been little or non-existent.

The experiment is in progress and would help to examine further the tentative views expressed here.

(*l*) *Exhaustion of soil moisture due to time and frequency of defoliation of B.brizantha* ($P_{19}$) R/E.

With the establishment of the grass, soil moisture blocks were laid at two depths (6 and 12 ins.) at three positions within a square formed by four palms. The following defoliation treatments will be commenced with the S-W monsoon in 1965:

| | |
|---|---|
| Time of commencement of defoliation | $T_1$ with the monsoon. |
| | $T_2$ two weeks after $T_1$. |
| | $T_4$ four weeks after $T_1$. |
| Frequencies of defoliation | $F_2$ every two weeks. |
| | $F_4$ every four weeks. |
| | $F_8$ every eight weeks. |

These shall be in factorial combination with four replicates.

(*m*) *Method of establishment of grass/legume mixture* ($P_{20}$) R/E.

This experiment planted during the S-W monsoon studies the establishment and growth of *B. miliiformis* and *Centrosema pubescens* alone and in mixture in three methods of planting, viz. broadcast, rows and in hills or patches. Each plot was divided into halves. From one half three samples from different positions, at monthly intervals, commencing two months from planting were taken. At the end of the season the other half was grown at 2 ins. height and allowed to regrow during the N-E monsoon for further observations.

The data from the three harvests following planting do not show any significant difference in the yield of legume in the association due to the methods of planting.

(*n*) *Manurial experiment on coconut cum pasture associations* ($P_{21}$) R/E.

This is a modification of the main plots of $P_5$ reported in 1963. In addition to the broadcast application of 2 cwts. sulphate of ammonia, 1 cwt. saphos phosphate and 1 cwt. muriate of potash per acre per year, plots of eight palms receive a further application of the three nutrients, in a factorial combination, to study the response of both pasture and coconuts to the additional level of the nutrients. A full cycle of these treatments were completed during the year. It is too early to comment on the results.

(*o*) *Manurial* × *pasture management experiment on coconuts* ($P_{22}$) R/E.

After the satisfactory establishment of *Brachiaria miliiformis* pasture and necessary pre-experimental recording of nuts, treatments were commenced with the S-W monsoon this year. The treatments were:

| | |
|---|---|
| Manurial treatments | $N_{\frac{1}{2}}$ : 1 cwt. S.A. + $\frac{1}{2}$ cwt. S.P. + $\frac{1}{2}$ cwt. M.P. |
| | *N : 2 cwts. S.A. + 1 cwt. S.P. + 1 cwt. M.P. |
| | $N_2$ : 4 cwts. S.A. + 2 cwts. S.P. + 2 cwts. M.P. |
| | $N_4$ : 8 cwts. S.A. + 4 cwts. S.P. + 4 cwts. M.P. |

These are applied per acre per year in half doses each season.

Pasture management (i) Grazing only, one month after manuring.

(ii) Mowing one month after manuring for hay. The plots grazed to keep down regrowth and during the dry weather feeding the hay in the plots.

The treatments are in factorial combination with three replicates. It is too early to comment on the results.

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

*N = Normal, the quantity of fertilizer applied to pasture and coconut associations at Rathmalagara Estate.

In this experiment commenced in May 1964 the effect of applying 2 cwts./acre sulphate of ammonia in one dose at the beginning of the season, in two half doses with a month's interval, and in four quarter doses at fortnightly intervals, with, monthly and two monthly defoliations in factorial combination on the yield of green panic are being studied.

The experiment is in progress. It is too early to comment on the results. In addition to dry matter yield, recovery of nitrogen is also being followed by chemical analysis of the herbage.

(*q*) A few experiments to study the management of grass/legume mixtures, spacing and nitrogen on the growth of fodder grasses, and selection of various species and strains of grasses and legumes were planted during November-December 1964. Due to the failure of the N-E monsoon and subsequent drought, establishment was poor. They will be attempted again with the S-W monsoon in 1965.

(*r*) *Growth of Brachiaria miliiformis with time in pots*

Single rooted tillers of the grass were planted in 10″ earthenware pots. The plants after establishment were defoliated at ground level till uniformity was attained. With the next defoliation the experiment was commenced where five pots were harvested at weekly intervals over a period of 18 weeks, to determine the total dry matter yield above ground and the components of yield. These are shown in Table XV as corrected mean yield per plant.

**TABLE XV**

**Total dry matter and components of yield of *Brachiaria miliiformis* (gms./plant) with time**

| *Time in Weeks* | *Total Dry matter* | *Stems* | *Leaves* | *Inflores-cences* | *Dead matter* |
|---|---|---|---|---|---|
| 1 | 0.47 | 0.11 | 0.35 | 0.00 | 0.00 |
| 2 | 5.17 | 3.18 | 1.99 | 0.00 | 0.02 |
| 3 | 12.77 | 7.70 | 5.05 | 0.00 | 0.02 |
| 4 | 21.70 | 14.50 | 7.02 | 0.13 | 0.05 |
| 5 | 33.40 | 21.20 | 7.65 | 0.73 | 3.82 |
| 6 | 46.34 | 32.00 | 8.05 | 1.46 | 4.83 |
| 7 | 55.62 | 40.00 | 8.73 | 1.64 | 5.25 |
| 8 | 69.70 | 49.96 | 9.84 | 2.50 | 7.40 |
| 9 | 86.26 | 63.62 | 11.48 | 3.30 | 7.86 |
| 10 | 98.44 | 72.73 | 13.09 | 4.23 | 8.39 |
| 11 | 118.63 | 83.80 | 14.92 | 6.14 | 13.77 |
| 12 | 134.50 | 97.79 | 15.33 | 5.02 | 16.36 |
| 13 | 147.31 | 108.89 | 15.81 | 4.83 | 17.78 |
| 14 | 162.59 | 119.40 | 16.04 | 4.99 | 22.16 |
| 15 | 174.20 | 126.10 | 16.97 | 4.23 | 26.90 |
| 16 | 182.45 | 129.20 | 17.91 | 4.53 | 30.81 |
| 17 | 187.89 | 133.98 | 18.62 | 4.77 | 30.52 |
| 18 | 189.98 | 134.40 | 19.03 | 4.74 | 31.81 |

The total dry matter yield and stems follows sigmoid curves. The weight of functional leaves increased up to about the 4th week at a very high rate. Thereafter the rate was very much less but almost constant. About the 4th week dead matter began to accumulate indicating that as new leaves were being formed there was death of older ones, controlling the amount of functional leaves at any given time. After the 10th week there was a big increase in the yield of dead material. This was caused by the death of older inflorescences. Inflorescences began to appear after the 4th week and their yield followed a pattern similar to that of leaves.

The number of tillers and heads per plant with time are shown in Fig 2. There was a big increase in the number of tillers during the first two weeks and then there was very little tiller production up to the 8th week. From the 4th to the 10th week head emergence was high. From the 9th to the 11th week there was another crop of tillers produced the rate of which decreased and maintained itself up to the end of the experiment. On the other hand the rate of head emergence maintained itself at a low rate from the 10th week to the end of the experiment. These would indicate that after defoliation there was an initial vegetative phase followed by a reproductive phase. Thereafter, however, both vegetative and reproductive growth continued simultaneously.

## 4. CATTLE

### (*a*) *General*

Herd strength on 31.12.64 was as follows:

**TABLE XVI**

**Distribution of cattle at the two estates**

| | *B/E* | *R/E* | *Total* |
|---|---|---|---|
| Bulls .. .. .. .. | 4 | 2 | 6 |
| Cows .. .. .. .. | 81 | 21 | 102 |
| Heifers .. .. .. | 57 | 43 | 100 |
| B'calves .. .. .. | 87 | 15 | 102 |
| Total .. .. .. .. | 229 | 81 | 310 |

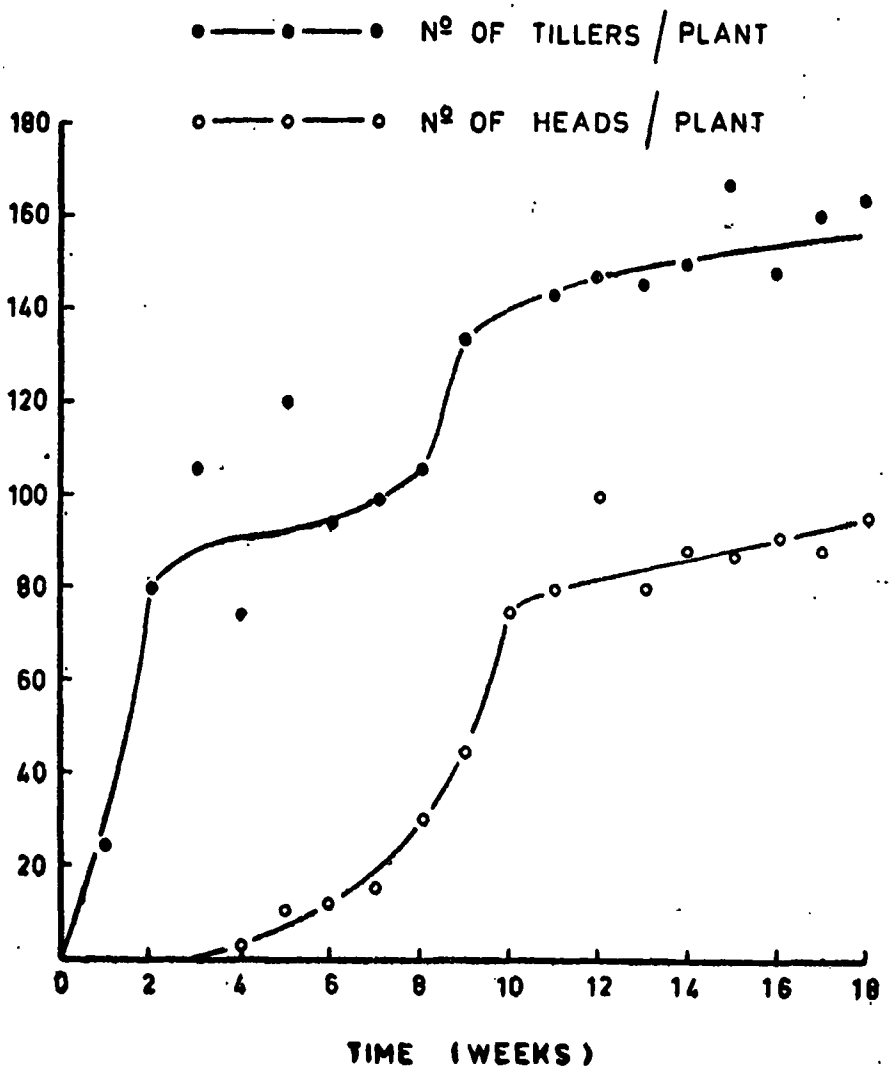
This is an increase of 52 head over 1963. There were 42 and 28 births at B/E and R/E respectively with 14 and 4 deaths of calves at the two estates. This high mortality of calves at B/E was due to unsatisfactory housing, following the total damage to the calfpen early in the year.

A total of 70,600 and 14,791 pints of milk was produced at B/E and R/E respectively and was disposed of. The sale of ghee at the reduced price has helped to bring down the stock.

### (*b*) *Sinhala Cattle*

The data collected over the past 12 years with these animals were studied and a series of papers are under preparation. The first in the series entitled "Lactation characteristics" was presented at the

Figure 2




Number of tillers and inflorescences (per plant) of B. miliiformis with time.

20th Annual Sessions of the Ceylon Association for the Advancement of Science; the relevant portions of the abstract is reproduced below—

"The average yield per lactation (1014.8 pts.) and per day (4.03 pts.) are low compared to other established breeds, though much higher than the Sinhala herd reported by *Mahadevan* (1952). The total yield per lactation is controlled by the yield per day ($r = + 0.7077$) rather than the length of lactation ($r = + 0.3063$).

There is no justification to accept that the total yield per lactation reaches a peak with age or has any trend in this breed as the repeatability values of the mean trend was (0.0187) low and non-significant. The length of lactation however showed a tendency to decrease with age to an asymptote, while the yield per day increased regularly with the age tested.

The lactation curve reached a peak value 3-4 weeks from calving and then declined rectilinearly up to about the 28th week. Thereafter a variable drop was experienced.

Of the three generations tested there was a steady improvement in all characters.

The mean length of lactation (250 days) and dry period (133 days) are longer compared to other herds of this breed.

The yield at first lactation was positively correlated ($r = + 0.3146$) to age at first service—the linear regression showing an increase of 12.8 pts. in the first lactation total yield for every month delay in service".

Another paper on the effect of climatic factors, such as maximum and minimum temperature, diurnal range of temperature, rainfall, day length, etc. on conception, calving and daily milk yield is under study.

(*c*) *Sinhala* × *Scindhi*

At Ratmalagara of the 40 Sinhala × Scindhi $F_1$ crosses 8 reached maturity and were crossed to a Sinhala × Scindhi $F_1$ bull. The progeny will be studied from birth to assess their performance and variation with a view to selecting and stabilizing the cross.

(*d*) *Sinhala* × *European*

At Bandirippuwa 31 and 18 Sinhala cows were artificially inseminated to Jersey and Fresian semen respectively supplied by the Department of Agriculture. These crosses would also be studied along the same lines as the Sinhala × Scindhi crosses. These are no doubt long-term projects which will supplement the work of the Department of Agriculture.

(*e*) *Effect of concentrate feeding on Sinhala cattle*

Two experiments on the level of feeding coconut meal (morlac), one on milk yield and the other on weaner calf growth, were commenced during the year. There do appear to be some beneficial effect. The experiments are in progress.

## 5. GENERAL

During the year the officers of the Division presented the following papers:—

(*a*) 20*th Annual Sessions, Ceylon Association for the Advancement of Science* (1964)

1. The effect of Pasture on the Yield of Coconuts by *K. Santhirasegaram.*
2. The Effect of Nitrogen and Frequency of Cutting on the Dry Matter yield and persistency of *Brachiaria miliiformis* (Presl.) A. Chase. by *K. Santhirasegaram, G.C.M. Goonesekera* and *D.E.F. Ferdinandez.*
3. The Effect of three Sources of Nitrogen on the Dry Matter Yield of *Paspalum commersonii* (Lam.) Grown in Pots by *K. Santhirasegaram* and *D.T. Rajaratnam* (Mrs.).
4. The Sinhala Cattle. 1. Lactation Characteristics, by *K. Santhirasegaram, V. Abeywardena* and *G.C.M. Goonesekera.*
5. *Hemicycliophora longicaudata* (Loos.), a Possible cause of Symptoms observed with *Medicago sativa* (L) on Gonapinuwela Gravel in Pots by *K. Santhirasegaram* and *U.B.M. Ekanayake.*

(*b*) *F.A.O. Second Technical Working Party on Coconut Production, Protection and Processing, Colombo,* 1964.

Some problems of pasture production under coconut by *K. Santhirasegaram,* (Ct. 16/64).

The following papers have been submitted for publication:

(*a*) *The Ceylon Coconut Quarterly.*

1-6. The six papers referred to above.

7. Studies on the Nutrient Status of some Coconut Soils in Ceylon. 2. The "Cinnamon" Sand on Horakelly Estate.

*B.* The "Hard Pan" by *K. Santhirasegaram* and *D.E.F. Ferdinandez.*

(*b*) *Coconut Research Institute Bulletins*

1. "Dry Dust" from Coconut Fibre Mills. A Useful Soil Ameliorant by *K. Santhirasegaram.*
2. Studies on the Nutrient Status of some Coconut Soils in Ceylon. 4. The "Lateritic Soils" on Ratmalagara Estate by *K. Santhirasegaram.*

(*c*) *Jour. Nat. Agric. Soc., Cey.*

Intercropping with Coconuts. (Review of biological principles involved) by *K. Santhirasegaram.*

The Agrostologist was elected Honorary Secretary of the Agriculture and Forestry Section of the Ceylon Association for the Advancement of Science for the year 1965. Mr. D.E.F. Ferdinandez, Technical Assistant successfully completed the B.Sc. (external) examination of the University of London, and was appointed Senior Technical Assistant. Mr. K.C. Muthuchchamy, Field Assistant and Mr. A. Dassanayake Lab and Field Attendant changed their civil status.

There was no change in personnel during the year, and on 31.12.64 the staff was:—

| | |
|---|---|
| *Agrostologist:—* | K. Santhirasegaram, B.Sc. (Hons.) Cey., Ph.D. (Adl.) |
| *Research Assistant:—* | D.T. Rajaratnam, (Mrs.) B.Sc. (Hons.) Cey. |
| *Senior Technical Assistant:—* | D.E.F. Ferdinandez, B.Sc. (Lond.) |
| *Technical Assistants:—* | G.C.M. Goonesekera, Dip.Agric. (Pera.)<br>Vacant |
| *Senior Field Assistant:—* | D.C. Ellewela |
| *Field Assistant:—* | K.C. Muthuchchamy |
| *Lab./Field Assistants:—* | Y.G. Fernando, (Miss)<br>W.S.C. Perera<br>W.H.J. Fernando<br>A.G.K. Silva |
| *Lab./Field Attendants:—* | K.A.D.W. Jinadasa<br>K.P.C. Fernando<br>R.M. Dayaratne<br>A.A. Fernando<br>A. Dassanayake<br>J.M.J. Jayamanne<br>W.P.T. Perera<br>S.A. Ratnayake<br>P.J.E. Fernando<br>D. Amarasinghe |
| *Tractor Driver:—* | M.I. Marikkar |

There were 8 cattle keepers and 12 permanent labourers attached to the Division.

K. SANTHIRASEGARAM,
*Agrostologist, Coconut Research Institute.*

# REPORT OF THE WELFARE OFFICER

| *Staff* | *Senior* | *Intermediate* | *Assistant* | *Minor* | *Total* |
|---|---|---|---|---|---|
| At the end of 1963 | 8 | 7 | 119 | 107 | 241 |
| New appointments in 1964 | — | — | 7 | 1 | 8 |
| | 8 | 7 | 126 | 108 | 249 |
| Less resignations/dismissals and promotions | — | — | — | 3 | 3 |
| | 8 | 7 | 126 | 105 | 246 |

The cadre at the end of 1964 was 246 as against 241 last year. There were seven new Assistants Staff Grade appointments and one Minor Staff Grade appointment of which five were Permanent and 3 Temporary posts. The Minor Staff appointment was filled from the Institute's labour force. Three Officers of the Minor Staff Grade were appointed to the Assistant Staff Grade II during the year. The Minor Staff yet continue to benefit from the Service qualification in lieu of academic qualifications while such concessions have not been extended to some of the other grades in the Staff and the labour force. Due consideration has however been given to the labour force although they do not have the Service qualification and other concessions given to internal candidates when applying for posts in the Minor Staff Grade. The concession allowed to Estate Watchers who are eligible for appointment to the Minor Staff has still not been extended to the other monthly paid workers.

According to the Employees Provident Fund Register the permanent labour force as at 31.12.64 was:

| | |
|---|---|
| On Monthly pay | — 33 |
| On Daily Pay | — 305 |

This excludes the temporary gangs recruited for casual work. The Monthly paid workers referred to above are not attached to the Staff but are entitled to Dearness and Special Living Allowances at Government rates. Daily paid workers are continued to be paid according to the respective trades of the Wages Board Ordinance they are classified. A General Allowance is paid in addition to the W.B.O. rates. A number of old entrants have qualified for the service allowance of -/25 cts. and -/15 cts. on completion of the respective periods of service. There were 10 accidents during the year as against 14 accidents last year. Nine of these were temporary disablement cases and the other a partial disablement case. There were no fatal accidents.

*Housing:*—A sum of Rs. 66,628.48 has been spent in the construction of buildings and a sum of Rs. 14,747.18 on furniture during the year. Two meetings of the Housing Committee were held and three married officers were recommended for allocation of bungalows and a few unmarried officers were recommended for Hostel accommodation. Canteen, Bathroom and Rest-room facilities were made common to all employees of the Institute without any discrimination on the class or category of work and their status.

*Financial Aid:—*

(*a*) A sum of Rs. 34,100/- was paid as Festival Advances to employees drawing a basic salary of less than Rs. 300/- at the rate of Rs. 100/- to the Monthly paid and Rs. 50/- to the Daily paid.

(*b*) A sum of Rs. 43,358.50 has been paid as loans for purchase of building sites and/or construction of houses from the Provident Fund.

(*c*) The total amount contributed to the Provident Fund by the Board was Rs. 87,956.23 while the employees contributed an equal amount. The interest at 4½% on both contributions accrued to the credit of the employees was Rs. 29,159.23 to which the Board has contributed an equal amount.

(*d*) The Officers and Boards contribution to the Medical Aid during the year were Rs. 13,098.96 and Rs. 13,098.79 respectively. 8 Meetings were held and a sum of Rs. 26,086.91 were approved for payment at these meetings. 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. With the amendment of the Medical Aid Fund rules nominations for representing the Senior, Intermediate/Assistant and Minor Staff were called and three members were duly elected.

*General:*—The necessary assistance was given to the Administration in the dealing of applications and complaints regarding Provident Fund, Gratuity, Medical Aid, Festival Advances, Distress Loans, Housing, Transport, training and generally the establishment work of the Institute.

*Thrift, Savings and Supplies:*—The C.R.I. Co-operative Welfare Society have still more expanded its business in the supply of articles including raw materials which were in short supply in the market and were sold below retail rates to members. It caters to the economic needs of the members and thrift and savings were also a part of the Society's business during the year. The Board's Annual Grant to the Society was Rs. 1,500/-.

A fully furnished Rest-room with canteen facilities and Radio Music have been maintained at the Institute's expense during the year. The Institute 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 Second round. The Cricket team also participated in a few friendly matches. A number of socials were arranged including the Annual Christmas Party. A Sports Meet, a variety entertainment, and the distribution of gifts to children were among the main features of the function. The Boards annual grant was Rs. 500/- and a further grant of Rs. 65/- per Cricket match was allowed for the Government Service Tournament. The C.R.I. Art Circle organised the following excursions during the year: 3 days at Southern Province visiting Yala Game Sanctuary, Kataragama Devale etc., to see "Sinhabahu Play", Havelock Town, "Thattu Geval", play at Negombo; North Indian Dancing at the Industrial Exhibition, Colombo. The Art Circle also organised the Sinhalese New Year celebrations which included a variety entertainment and a Sports Meet. A Magazine entitled "Kekulu" was published and distributed to members and a lecture by Mr. G.B. Gunawardena, Lecturer, Hingurakgoda Training School on the subject of "Realism" was arranged for the members.

*Industrial Relations:*—In the field of industrial relationships the Institute continues to remain free from the level of trade disputes. There was however a demonstration which was called off on that date itself. The Institute allowed labour Conferences with representatives of the respective Unions in order to avoid trade disputes as far as possible and a number of problems relating to alleged victimisation and terms and conditions of service were amicably settled during the year.

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

# REPORT OF THE PUBLICATIONS OFFICER

Following publications were issued during 1964.

1. Ceylon Coconut Quarterly, Vol. XIV, No. 1/2.
2. Ceylon Coconut Planters' Review, Vol. III, Nos. 3 and 4.
3. Pol-pawath, Vol. III, No. 1.
4. C.R.I. Bulletin No. 21.
   Biological Control of Coconut Leaf Caterpillar in Ceylon, by Edwin Dharmaraju, Colombo Plan Entomologist.
5. Cumulative Index to "Ceylon Coconut Quarterly". Author and Subject, Vol. I-X, compiled by Mr. M. J. C. Perera.

The Annual Report of the Coconut Research Institute for 1962 was translated into Sinhala by the Publications Officer. The translation of this document was a heavy task, and much time had to be devoted to it. Pol-pawath Volume III, No. 1 was a translation of "Ceylon Coconut Planters' Review" Volume III, No. 3. The translation of C.C.P.R. Vol. III, No. 4 was completed, but could not be sent to the Press before the end of the year.

**Library**

A programme for the reorganisation of the Library according to Dewey Decimal system is being implemented by Mr. Christie Perera. He is also making arrangements to facilitate the process of lending books from the Library.

**Photography Work**

The Photographer assisted the Heads of Divisions in getting photographs for scientific papers. He has taken a valuable series of Micro-Photographs for the use of Colombo Plan Entomologist, Mr. E. Dharmaraju.

A. K. GUNAPALA,

*Publications Officer, Coconut Research Institute.*

# REPORT ON THE ESTATES

## I. BANDIRIPPUWA

### Acreage

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

The above acreage comprises as follows:—

| | A. | R. | P. |
|---|---|---|---|
| Research Section (Working Account) | 175 | 0 | 04 |
| Estate Section (Working Account) | 168 | 0 | 13 |
| Buildings, streams and roads | 17 | 0 | 00 |
| Waste land and paddy | 0 | 3 | 14 |
| Playing field | 5 | 0 | 00 |
| Total .. | 365 | 3 | 31 |

### Census

Census of palms as at February, 1964 is as follows:—

| *Fields* | 1 | 2 | 3 | 4 | 5 | 6 | *BB* | *A* | *GB* | *GA* | *B* | *C* | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Full bearing | 1384 | 466 | 1106 | 2007 | 700 | 96 | 47 | 194 | 262 | 3796 | 2894 | 1599 | 14551 |
| Partial bearing | 311 | 159 | 233 | 317 | 121 | 38 | 21 | 57 | 26 | 1592 | 737 | 386 | 3998 |
| Duds | 112 | 91 | 133 | 103 | 17 | 33 | 15 | 9 | 6 | 827 | 94 | 116 | 1556 |
| In Flower | 5 | 9 | 4 | 136 | 8 | 1 | — | 122 | — | 11 | — | 3 | 299 |
| With Stem | 1 | 117 | 2 | 95 | 50 | — | — | 179 | — | 88 | — | 2 | 434 |
| Established Plants | — | 16 | — | 29 | 57 | — | — | 105 | — | 1848 | 1 | 6 | 2062 |
| Supplies | — | 1 | — | 59 | 4 | — | — | 4 | — | 22 | 2 | — | 92 |
| Vacancies | 6 | 1 | 49 | 93 | 65 | 6 | — | 5 | 6 | 703 | 214 | 245 | 1393 |
| Total .. .. | 1819 | 860 | 1527 | 2839 | 1022 | 174 | 83 | 575 | 300 | 8887 | 3942 | 2357 | 24385 |

**Field Notes**

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

*Drains:*—3,596 fathoms of old drains have been cleaned and deepened.

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

*Streams:*—1,316 fathoms streams have been deepened and silt removed once for the year.

*Pest and Diseases:*—Frequent examination for beetle and other pests have been carried out.

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

**Rainfall**

This compares with the previous year as follows:—

| *Average* 1934/50 | *Months* | 1963 *inches* | *Wet days* | 1964 *inches* | *Wet days* |
|---|---|---|---|---|---|
| 2.20 | January | 5.48 | 10 | 2.75 | 5 |
| 2.17 | February | 3.28 | 9 | 3.00 | 6 |
| 5.38 | March | 9.43 | 12 | 9.55 | 11 |
| 8.40 | April | 7.12 | 14 | 1.99 | 8 |
| 10.31 | May | 16.96 | 16 | 16.74 | 14 |
| 7.42 | June | 7.83 | 17 | 7.04 | 15 |
| 2.82 | July | 6.22 | 18 | 4.87 | 17 |
| 3.45 | August | 2.92 | 11 | 4.45 | 13 |
| 4.28 | September | 12.64 | 16 | 5.71 | 15 |
| 12.56 | October | 14.69 | 19 | 11.93 | 18 |
| 12.92 | November | 14.60 | 25 | 6.76 | 13 |
| 4.81 | December | 4.39 | 13 | 1.79 | 6 |
| 76.72 | Total | 105.56 | 180 | 76.58 | 141 |

**Crops**

This compares as follows:—

| *Pick* | 1960 | 1961 | 1962 | 1963 | 1964 | *5 year average* |
|---|---|---|---|---|---|---|
| 1 | 72224 | 132987 | 177091 | 136099 | 155216 | 134245 |
| 2 | 165615 | 234073 | 208157 | 245978 | 210927 | 214137 |
| 3 | 202811 | 338525 | 290938 | 302346 | 274377 | 266082 |
| 4 | 206694 | 288305 | 247566 | 258931 | 239159 | 235938 |
| 5 | 137012 | 185311 | 144433 | 152098 | 167098 | 149839 |
| 6 | 119750 | 120618 | 111280 | 129715 | 130820 | 111544 |
| Total | 904106 | 1299819 | 1179465 | 1225167 | 1177597 | 1111775 |

The total crop received for 1964 was 1,177,597 nuts from 18,549 palms equivalent to 294.4 acres. Thus nuts per palm were 63.5 nuts and 4,000.0 nuts per acre.

The disposal of crops is as follows:—

| | *Nuts* | |
|---|---|---|
| Sold on Contract | 83230 | |
| Sold to Research | 3177 | |
| Sold to Staff | 1194 | |
| Nursery | 1923 | |
| Cured into Copra | 1052226 | |
| Allowances to Staff | 24231 | |
| Empties | 11616 | 1.0% |
| Total .. | 1177597 | |

The 1,052,226 nuts cured into copra obtained 881 candies and 342 lbs. on an out-turn of 1,193 nuts to a candy. The percentage of No. 1 quality copra was 92.5%. This percentage would have risened to 95.0% if not for some of the copra which underwent experimental treatment, was low in grade and thus 2·5% was lost to No. 1 quality copra.

**Manuring**

The following palms have been manured for the year:—

| | | *Palms* | |
|---|---|---|---|
| *Estate* | No. 1 | 1307 | *Dosage*—3 lbs. Sulphate of Ammonia |
| | 2 | 121 | 3 lbs. Saphos Phosphate |
| | 3 | 1130 | 3 lbs. Muriate of Potash 60% |
| | 4 | 1016 | 9 lbs. @ 7 lbs. per palm half-circle |
| | 5 | 235 | |
| | 6 | 193 | |
| | BB | 70 | |
| | GA | 119 | |
| | A | 3735 | |
| | Total .. | 7926 | |
| *Research* | N.P.K. Experiment | 972 | As per experimental requirements |
| | Botanist | 980 | |
| | Botanist young plantation | 1824 | |
| | Pasture Experiment | 2743 | |
| | Response Curve Expt. | 1346 | |
| | Total .. | 7865 | |
| | Gr. Total .. | 15791 | |

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

**Expenditure**

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

| | *Expenditure* | | | *Estimates* | | |
|---|---|---|---|---|---|---|
| General Charges | Rs. 35397.15 | @ | 30.06 | Rs. 39631.00 | @ | 33.02 |
| Upkeep | Rs. 10236.57 | @ | 8.69 | Rs. 27729.00 | @ | 23.11 |
| Cultivation | Rs. 15378.19 | @ | 13.06 | Rs. 18126.00 | @ | 15.11 |
| Collection | Rs. 21012.00 | @ | 17.84 | Rs. 20107.00 | @ | 16.76 |
| Total .. | Rs. 82023.91 | @ | 69.65 | Rs. 105593.00 | @ | 88.00 |

D. F. WITHANA,
*Superintendent, Bandirippuwa Estate.*

## II. RATMALAGARA

*Director:*—Dr. M. L. M. Salgado.

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

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

Tractor Driver and Four Watchers.

This Research Station is approximately 272 acres in extent and comprises of the following Divisions—which have their own Officers-in-Charge of the experiments. Division of Botany, Division of Soil Chemistry, Division of Agrostology, Planting Division, Advisory Division and the Estate Division.

| *Months* | *Rainfall for the five preceding years at Ratmalagara Estate* | | | | | |
|---|---|---|---|---|---|---|
| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 |
| January | 1.86 | .29 | 3.12 | .94 | 3.15 | 2.50 |
| February | 1.11 | 4.13 | 4.78 | 1.20 | .15 | 1.44 |
| March | 2.47 | 1.65 | 2.48 | 1.85 | 5.05 | 8.00 |
| April | 8.86 | 10.60 | 3.09 | 1.52 | 3.06 | 1.93 |
| May | 12.09 | 14.68 | 10.81 | 15.91 | 7.21 | 9.18 |
| June | 4.39 | 2.37 | 9.09 | 4.26 | 3.14 | 3.18 |
| July | 4.35 | 13.91 | 5.68 | .79 | 7.80 | 2.97 |
| August | 2.74 | .50 | 2.20 | 1.69 | .99 | 1.22 |
| September | 4.31 | .25 | 8.20 | 2.95 | 4.65 | 9.47 |
| October | 10.53 | 9.81 | 5.59 | 14.30 | 10.11 | 7.27 |
| November | 9.74 | 14.21 | 5.98 | 3.64 | 11.90 | 16.79 |
| December | 1.92 | .72 | 3.13 | 1.18 | 4.67 | — |
| Total .. | 60.06 | 73.12 | 64.15 | 50.28 | 60.86 | 63.93 |

Crops picked for the five preceding years

| *Pick* | 1960 | 1961 | 1962 | 1963 | 1964 |
|---|---|---|---|---|---|
| 1 | 65166 | 63476 | 103957 | 88806 | 93857 |
| 2 | 121471 | 123186 | 169045 | 154890 | 128764 |
| 3 | 122657 | 119706 | 177648 | 208134 | 181855 |
| 4 | 105728 | 107782 | 179191 | 175252 | 137397 |
| 5 | 70850 | 56500 | 109552 | 93738 | 116424 |
| 6 | 42309 | 63974 | 87732 | 72627 | 77865 |
| Total .. | 528181 | 534623 | 827325 | 793447 | 736162 |

**Disposal of Nuts**

Estate Section

| *Pick* | *Cured* | *Sold* | *Allowances* | *Rejections* |
|---|---|---|---|---|
| 1 | 48515 | — | 1998 | 1179 |
| 2 | 70921 | — | 2886 | 1509 |
| 3 | 21062 | 92100 | 1998 | 2393 |
| 4 | 40181 | 38648 | 1776 | 1506 |
| 5 | 72973 | — | 1998 | 1687 |
| 6 | 11465 | 31025 | 1060 | 885 |
| Total .. | 265117 | 161773 | 11716 | 9159 |

The 265,117 nuts cured produced 207 cdys. 423 lbs. of copra of all grades giving an average out-turn of 1,274 nuts per candy. Nuts cured from the 3rd, 4th and 6th crops are nuts that were rejected by the buyers due to them being germinated nuts.

**Field Work**

The following field work have been carried out during the year 1964.

| *Item* | *Quantity* | *Fields* |
|---|---|---|
| Weeding | 9859 squares | All Fields |
| Clearing | 298 squares | Field Nos. 4 and 7 |
| Opening Drains | 737 fathoms | All Fields |
| Cleaning Drains | 2274 fathoms | All Fields |
| Ant Hills | 33 | Field Nos. 2, 3, 4 and 6 |
| Husks Pits Closed | 595 | All Fields |
| Road Repairs | 342 fathoms | All Fields |
| New Roads | 51 fathoms | |
| Boundary Fence | 595 fathoms | Field Nos. 4 and 5 |
| Manuring Young Plants | 228 | |
| Manuring Adult Palms | 2974 | |
| Collecting Fronds | 5271 squares | |
| Mulching | 80 acres | |
| Uprooting Illuk | 393 squares | Field Nos. 7 and 8 |
| Opening Husk Pits | 725 | |

## CENSUS OF PALM—RATMALAGARA ESTATE 1964

| | *Block No.* 1 | | | *Block No.* 2 | | | *Block No.* 3 | | | *Block No.* 4 | | | *Block No.* 5 | | | *Block No.* 6 | | | *Block No.* 7 | | | *Block No.* 8 | | | *TOTAL* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Res.* | *Est.* | *Agro.* | *Bot.* | *S.C.* |
| **Bearing Palms** | 239 | 540 | 776 | 184 | 48 | — | 503 | — | 253 | 218 | 625 | 518 | — | 1171 | — | 1026 | 351 | — | 402 | — | 2130 | 333 | — | — | 2905 | 2935 | 2721 | 3677 |
| **Flowering** | 1 | — | — | — | — | — | — | — | — | 26 | — | — | — | — | — | 4 | — | — | 31 | — | — | 8 | — | — | 70 | — | 6 | — |
| **Young Palms** | 3 | 44 | — | — | — | — | — | — | 15 | 30 | — | 55 | — | — | — | 2 | — | — | 200 | — | 9 | 2 | — | — | 237 | 44 | 262 | 79 |
| **Vacancies** | 8 | — | — | 2 | — | — | 34 | — | — | 38 | — | 2 | — | — | — | 56 | — | — | 20 | — | — | 6 | — | — | 162 | — | 146 | 2 |
| **Duds** | 15 | 5 | — | 6 | — | — | 19 | — | — | 6 | — | 5 | — | — | — | 40 | — | — | 11 | — | — | 4 | — | — | 95 | 5 | — | 5 |

*Buildings:*—Bungalows I.S.A. Nos. 1, 2 and 4 were repaired and colour-washed during the year. A new latrine was built for the Power House labourers. Watchers cottages and labourers cottages were repaired and white washed. The old White Copra kiln was converted into a line room for the curers.

*Vehicles:*—A new Ferguson T35 Tractor with trailer and reversible Disc harrow was bought and is in use now.

D. P. L. EBERT SILVA,
*Superintendent, Ratmalagara Estate.*