CEYLON COCONUT QUARTERLY

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ANNUAL REPORT FOR 1973

CONTENTS

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ANNUAL REPORT OF THE COCONUT RESEARCH BOARD 1973

The present report is the second annual report of the Coconut Research Board established under section 58 (1) of the Coconut Development Act No. 46 of 1971 by an Order published by the Minister of Plantation Industries in the Government Gazette of 30th March 1972.

The powers and functions of this Research Board have been specified in the said Order establishing the Board.

I. BOARD OF DIRECTORS

The following served on the Board of Directors during the year under review:

Dr. J. Sivapragasam (Chairman)
Mr. A. J. W. Balthazaar
Dr. J. W. L. Peiris
Mr. A. Edmund Perera
Dr. O. S. Peries
Dr. U. Pethiyagoda and
Mr. P. W. R. de Silva

Eleven meetings of the Board of Directors were held during the year as follows:

No.	*Date*	*Venue*
10	73-01-12 (2.00 p.m.)	C.R.I., Bandirippuwa, Lunuwila.
11	73-02-02 (9.00 a.m.)	C.R.I., Bandirippuwa, Lunuwila.
12	73-03-02 (2.00 p.m.)	C.D.A., Y.M.B.A. Building, Colombo.
13	73-03-30 (9.30 a.m.)	C.R.I., Bandirippuwa, Lunuwila.
14	73-04-27 (2.00 p.m.)	C.D.A., Y.M.B.A Building, Colombo
15	73-05-19 (9.00 a.m.)	I.S.G., Ambakelle & Chilaw.
16	73-06-29 (8.30 a.m.)	C.R.I., Bandirippuwa, Lunuwila.
17	73-09-03 (8.30 a.m.)	C.R.I., Bandirippuwa, Lunuwila.
18	73-10-04 (8.30 a.m.)	C.R.I., Bandirippuwa, Lunuwila.
19	73-10-26 (2.00 p.m.)	C.R.I., Bandirippuwa, Lunuwila.
20	73-11-30 (9.00 a.m.)	C.R.I., Bandirippuwa, Lunuwila.

II. STAFF

The Staff of the Coconut Research Institute as at 30th June 1973 was as follows:

Chairman

J. Sivapragasam, M.B.B.S. (Cey.)

Director

W. R. N. Nathanael, M.Sc., Ph.D. (Lond.), F.R.I.C., F.I. Chem. (Cey.)

Deputy Director (Administration & Finance)

K. D. J. Wilmot

Soil Chemistry Division

Soil Chemist—Vacant.

Acting Soil Chemist & Research Assistant—T. S. Balakrishnamurti, B.Sc. (Lond.), M.Sc. (Aberdeen).

Research Assistants—M. A. T. de Silva, B.Sc. (Lond.), M.Sc. (Lond.), M.I. Biol.

A. S. Amerasinghe, B.Sc. Agric. (Cey.)

Division of Botany & Plant Breeding

Botanist—M. A. P. P. Manthriratne, B.Sc. (Lond.), Ph.D. (Wales)

Research Assistant—H. I. M. V. Vithanage, B.Sc. (Cey.)

Chemistry Division

Chemist—Vacant.

Officer-in-Charge & Research Assistant—M. Jegenathan, B.Sc. (Lond.), M.Phil. (Lond.)

Research Assistant—S. Mohanadas. B.Sc. Hons. (Cey.)

Agrostology Division

Acting Agrostologist—M. A. P. P. Manthriratne, B.Sc. (Lond.), Ph.D. (Wales)

Research Assistants—N. T. M. H. de Silva, B.Sc. Agric. (Cey.)

M. P. L. D. Martin, B.Sc. Agric. (Cey.)

Crop Protection Division

Crop Protection Officer—Vacant

Officer-in-Charge & Research Assistant—R. Mahindapala, B.Sc. (Cey.)

Research Assistants—B. H. Rohita, B.Sc. (Cey.).

P. Kanagaratnam, B.Sc. Agric. (Cey.)

Biometrics Unit

Biometrician—V. Abeywardena, F.I.S.

Planting Division

Planting-Officer—P. D. L. Fernando

Assistant Planting Officer (Advisory)—H. D. M. S. C. Samaranayake, B.Sc. Agric. (Poona).

Publications-Publicity Unit & Library

Publications/Publicity Officer—M. S. S. Fernandopulle, B.A. Hons. (Lond.), B.Th. (Rome)

Administration Division

Assistant Administrative Officer—C. S. E. Fernando, LL.B. (Cey.)

Accountant—G. W. M. Wijetunga.

Engineering Unit

Engineering Assistant—A. Senaratne.

III. GENERAL

(1) Mr. V. M. F. Alles was appointed Officer-in-Charge of the Agrostology Division with effect from 20th July, 1973.

(2) Dr. P. Loganathan was appointed Soil Chemist with effect from 8th August, 1973.

(3) Mr. T. S. Balakrishnamurti, Research Assistant, was promoted Research Officer during the year and the appointment was made retrospective to 72-05-01.

(4) Mr. V. Abeywardena, Biometrician, was promoted to Class II of the Executive Grade during the year and the appointment was made retrospective to 72-05-01.

(5) Mr. R. Mahindapala, Research Assistant, left for U.K. on 73-09-25 to follow a course of post-graduate studies in Plant Pathology at the Universtiy of Exeter.

(6) Mr. P. H. Rohita was appointed Research Assistant in Charge of the Crop Protection Division with effect from 73-09-25 on Mr. Mahindapala's departure to Britain on overseas training.

(7) Mr. H. I. M. V. Vithanage, Research Assistant, resigned from the service of the Institute with effect from 73-0-23 to take up an appointment in Australia.

(8) Throughout the year under review Dr. P. R. Dharmadhikari, F.A.O. Entomologist, continued to be in charge of the 2 year FAO/UNDP Biological Control Project (No.Cey./73/038) which commenced on 72-10-29.

(9) *Coconut Crops:* Consequent on the severe drought conditions that prevailed during the preceding year, 1973 has been an extremely poor year for the coconut industry from the point of view of production.

An estimate prepared by the Institute revealed that the production of coconut for 1973 was 2,272 million nuts representing an unprecedented decline over the previous years. In relation to 1972 (3,073 million nuts) the decrease is 26.1%. In terms of the average production for the past 5 years (2,771 million nuts) the drop is 18.0%. Sri Lanka's peak production estimated at 3,148 million nuts was recorded in 1964. The 1973 figure is lower than this by 27.8%.

The reflection of the decrease in production in 1973 (over the preceding year) on the volume of exports amounts to 66.5%. In terms of the average for the past 5 years, the exports are lower by 59.0%, and in terms of the 1964 record there has been a sharp decline of 74.1%.

Despite the low volume and total value of coconut products exported, an all-time record in prices was recorded during 1973. The previous record for prices amounting to Rs. 302.62 per 1,000 nuts was registered in 1968. In relation to this the figure for 1973 (Rs 343.79) is higher by 13.6%, and also higher by 61.6% in comparison with the previous year. The average price of coconut products exported for the past five years has been 263.67 per 1,000 nuts. The 1973 figure is higher than this by 30.4%.

IV. VISITORS

The visitors to the Institute during the year included the following.

Prof. C. J. Alexopoulos, University of Texas, U.S.A.
Dr. Kirsti Behrens, University of Oslo, Norway.
Mr. E. Ogor, Director, Nigerian Institute for Oil Palm Research.
Prof. J. Krans, University of Ciessen, West Germany.
Mr. R. A. Bailey, World Bank, Washington, D.C.
Dr. H. H. Groennewold, FAO/IBRD, Rome.
Mr. M. Priestley, UNDP, Colombo.
Mr. Pablo C. Hofer, Philippine Coconut Planters' Federation.
Dr. R. Child, (former Director/CRI) Wokingham, U.K.
Mr. David Meadows, FAO/Manila.
Dr. F. J. Simmonds, Commonwealth Institute of Biological Control, Trinidad.
Mr. Jose R. Bastida Perez, Venezuela.

V. PUBLICATIONS

Articles entitled "Coconut Industry (1972)" and "Activitites of the Coconut Research Institute in 1972" were contributed to the Annual Report of the Planters' Association of Ceylon.

Two issues of the Ceylon Coconut Quarterly (Volume XXIII Nos. 1/2 and Volume XXIII Nos. 3/4) were published during the year.

One issue of the Ceylon Coconut Planters' Review (Volume VII No. 1) was published during the year.

One issue of the Sinhala Journal—"Pol Pawath" (Volume V No. 3) was published during the year.

VI. STAFF RESEARCH CONFERENCE

Following the series of staff research conferences started in 1966 one conference was held during the year as follows:

Date	*Leader of Discussion*	*Subject*
73-10 03	Dr. P. R. Dharmadhikari	"The Role of natural enemies in the control of insect pests of palms".

VII. NOTES ON REPORT OF DIVISIONS

The following notes draw attention to points of interest relating mainly to the work of the Research Divisions of the Institute during the year.

SOIL CHEMISTRY DIVISION

A. Field Experiments

(1) Ten long term field experiments were maintained at Bandirippuwa, Ratmalagara, Pothukulama, Bingiriya, Veyangoda, Dankotuwa and Rathgama.

Results of interest are:

(*a*) The B, Zn, S experiment at Monrovia Estate showed that while sulphur has had a negative effect on the weight of husked nut and fresh kernel, the total yield of nuts and copra responded positively. These results suggest that sulphur had in effect reduced the size of the fruit but increased the overall yield.

(*b*) An examination of copra samples from Mawatte experiment for rubberiness showed that there was no deficiency of sulphur in the samples from the $(NH_4)_2\ SO_4$, $NH_4\ NO_3$, $NaNO_3$ and control treatments. One out of the two samples from the urea treatment however gave some indication of sulphur deficiency.

(*c*) An outbreak of red weevil was detected at the PRS young palm experiment in January 1973, affecting about 140 palms. Preventive measures were taken and the outbreak was brought under control.

(2) *Fertilizer requirements of* ($T \times D$) *coconut hybrids.*—A new experiment was laid down to determine the growth and yield response curves of young hybrid palms to the application of an inorganic fertilizer mixture and assess the optimum level of fertilizer needed on a sandy loam soil at Bandirippuwa Estate. The seedlings were planted in December 1973.

(3) Pot experiment to study the relative efficiencies of Eppawala phosphate fertilizer and Saphos phosphate using *Paspalum commersonii* as a biological indicator.

The first harvest was taken on October 22nd and the second harvest on November 29th. With the second harvest the experiment was terminated. While the data of the first harvest indicate no difference in response between the two sources, the data of the second harvest show that saphos phosphate is superior to Eppawala phosphate. Analysis of plant and soil samples drawn from this experiment is in progress.

(4) Experiments on micronutrient requirements of coconut seedlings.

(*a*) The effect of micronutrients on the rate of sprouting and growth of seedlings was studied by injecting solutions of micronutrients into the husks of seednuts. The data show that while zinc and copper increased the rate of germination, excess of boron decreased the rate of germination.

(*b*) A sand culture experiment to study the effects of the deficiencies of micronutrients (boron, zinc, iron, manganese, copper) was concluded. Deficiency symptoms were observed for boron, iron and copper. The Chemical analyses of plant parts drawn from this experiment are now in progress.

B. Laboratory Investigations

(1) Chemical analyses of soil samples from model profiles of coconut growing areas were carried out to determine cation exchange capacity, base saturation, total nitrogen, total carbon, available phosphorus and pH.

(2) Estimation of sulphur in leaf samples from Marandawila, Walahapitiya, Horrekelly and Monrovia Estates.

(3) Estimations of sulphur in kernel and nut water samples from Monrovia Estate.

(4) Estimations of Ca, Mg, Zn, Mn, Cu and Fe in kernel and cotyledon samples of amputated seednuts from the pot culture experiment.

(5) Studies and analytical methodology for the estimation of available sulphur in soils.

C. Soil Surveys

(1) Soil surveys of coconut growing areas:

(*a*) Detailed reconnaissance survey of Dandegamuwa 1" sheet (50% of the 1" sheet completed).

(*b*) Detailed reconnaissance survey of Wariyapola 1" sheet (completed).

(*c*) Detailed reconnaissance survey of Negombo 1" sheet (completed. 16 soil series were found).

(2) Detailed reconnaissance soil survey of the Soil Chemistry Division Experimental plots.

Ratmalagara Estate (two plots)
Mawatte Estate (one plot)

(3) Isolated seed garden, Ambakelle—Detailed reconnaissance soil survey of the barrier on the northern and eastern sides.

(4) *Miscellaneous.*—Soil survey of areas to determine the suitability of land for hybrids and the *typica* form of coconut.

Division of Botany and Plant Breeding

1. Controlled Pollination Work

The pollination programme at Bandirippuwa, Ratmalagara, Walpita, Ambakelle, Kiniyama, Andigedera and Achchitotam Estates was run to schedule. Work at Marandawila Estate was suspended to enable the palms to recover, and only pollen collection from prepotent palm was carried out at this station. A new pollination unit on 350 palms was commenced at Horrekelly Estate, Kudawewa. For the first time, extensive use has been made of foreign germ plasm in the form of pollen from Ivory Coast, kindly supplied *gratis* by the IRHO. Emasculation work in the dwarf palm block (field number 5, ISG, Ambakelle) was suspended to obtain dwarf green (selfed) seednuts in order to expedite the Seed Garden Expansion Programmes. A summary of the pollination work is given below:

Total number of female parents	..	1,330
Total number of female flowers pollinated		
Typica × *typica*	.. ..	13,453
Typica × *pumila*	.. ..	183,062
Typica × Ivory coast dwarfs	..	35,836

5,806 *typica* × *typica* and 25,000 *typica* × *pumila* seednuts from crosses done in 1972 were harvested this year.

398 ampoules of typica (prepotent) pollen and 271 ampoules of *pumila* pollen were issued to the private sector.

2. Research Nurseries

The undermentioned quantities of seednuts were planted in the Research Nurseries at Bandirippuwa and the Seed Garden, Ambakelle:

Typica × *typica*	*Typica* × *pumila* × *Pumila* × *typica*	*tall OP*
6,491	26,751	16,023	2,600

12,686 dwarf yellow (eburnea) and dwarf green (pumila) seednuts have been planted to provide the material for the Ambakelle Seed Garden Expansion Project. An additional 2,371 seednuts were planted at Ratmalagara for the same purpose.

This year 41,462 hand pollinated seedlings have been issued consisting of 13,005 *typica* × *typica*, 18,308 *typica* × *pumila* and 10,149 *pumila* × *typica*.

3. Mother Palm Seed Supply

1,508,650 selected seednuts were supplied to the Planting Division Nurseries. Re-selection work was completed on St. Annes, Mampuri and North Western Fruit Garden and 3,105 mother palms were re-selected.

4. Isolated Seed Garden, Ambakelle

Besides maintaining the 135 acres planted prior to 1966 and 50 acres of land cleared and planted in 1972, 30 acres were cleared and planted in May/June 1973, and an additional 30 acres were cleared for planting with favourable weather conditions. Two reservoirs have been constructed and prospecting for ground water is now being done by the Division of Land Use. It is hoped to have a co-ordinated irrigation scheme for Ambakelle if the preliminary investigations are successful.

5. Second Seed Garden

A part of Horrekelly Estate, Kudawewa has been identified as suitable for a Second Seed Garden for the mass production of *dwarf* × *tall* hybrids and a recommendation has been made to this effect.

6. Field Experiments

The field experiments and observation trials at Bandirippuwa (14) Ratmalagara (8) Pothukulama (10) and Walpita Progeny trial were maintained during the year.

7. Issues of variety seednuts

2,631 seednuts have been issued consisting mainly of dwarf king coconuts and king coconuts.

8. Laboratory & Field investigations

(*a*) Study of pollen characteristics from the progeny of the Diallel Cross Experiment (Pothukulama) is being continued.

(*b*) The observation trial on size (volume) of hybrid seednuts and quality and performance of resulting seedlings is being continued.

(*c*) A trial to study the root system of *tall* × *dwarf*, *dwarf* × *tall* and *tall* × *tall* seedlings in relation to observed differences in susceptibility to drought has been initiated.

(*d*) The study on the relationship between stomatal density and yield has been temporarily stopped due to difficulties encountered in field work.

(*e*) The investigations on the extent of parthenocarpy in the dwarf variety of coconut and the genetics of the pasture grass *Br. miliiformis* have been suspended following the resignation of the Research Assistant who was handling these investigations.

Chemistry Division

1. Study on Diurnal and Seasonal Fluctuations of nutrients in Foliar Tissue

Studies on the diurnal and seasonal fluctuations of nutrient concentrations in the leaves of adult *typica* palms which commenced in 1972 were concluded during the year, with two more sampling in January and February.

Out of the 1,800 samples collected from this experiment, 650 have been analysed for nitrogen and 320 samples for P, K, Na, Ca and Mg. The Analytical work is being continued.

2. Study on Annual Exhaust of Soil Nutrients

Studies on the estimation of the annual exhaust of the macro-nutrients (N, P, K, Ca & Mg) from the soil by adult *typica* palms, which commenced in June 1972 were concluded in April after consolidating data for six harvests. An assessment was also made of nutrient losses associated with the abscission of fronds. The results of this work will be reported elsewhere. A similar study on adult (T × D) hybrid palms was started from the 3rd (May/June 1973) harvest and is being continued.

3. Toddy yield from (T × D) Hybrid Palms

Records of toddy yields from 12 healthy hybrid palms from the Botanist's hybrid block at Bandirippuwa Estate were maintained for the eight-month period May to December.

4. Analytical Techniques

Available rapid methods of chemical plant tissue analyses were tested out, and a dry digestion procedure has been found satisfactory for plant tissue sampled from the coconut palm.

5. Comparative Studies on Tall and Hybrid Palm toddy

Samples of toddy collected from tall and hybrid palms using lime and *Vateria acuminata* bark (separately as anti-ferments) revealed no significant difference in respect of their sugar contents.

6. Experiments on Toddy Distillation and the Manufacture of Arrack

A series of laboratory scale experiments were carried out during the year on various aspects of toddy distillation and the manufacture of "special arrack" employing rectified spirits.

The results which show promise of practical application will be reported in full elsewhere.

7. Technical Advice on Bottling Palmyrah Toddy

On a request made by the Ministry of Finance, the Research Assistant, Chemistry Division working on toddy, visited the Chankanai M. P. C. S., Ltd., and gave technical advice on the bottling of palmyrah toddy.

Agrostology Division

1. Pasture Studies

During the year five new experiments were set up (all during the yala season) as follows:

P_{88} at Bandirippuwa Estate

To compare the productivity of three fodder species at high levels of N fertilization under coconut.

P_{89} at Bandirippuwa Estate

To investigate the effect of levels of N Fertilization, intensity and frequency of defoliation on the productivity of Pusa Giant Napier under coconut.

P_{90} at Bandirippuwa Estate

To compare the productivity of three pasture species at high levels of Nitrogen fertilization under coconut (Repeated attempts at establishing *Brachiaria ri ziziensis* under this experiment have proved unsuccessful. However, attempts are being made to introduce this pasture once again).

P_{91} at Ratmalagara Estate

To investigate the effect of intensity and frequency of defoliation on the productivity of three fodder species under coconut.

P_{92} at Kirimetiyana Estate

(i) To determine the optimum levels of Nitrogen, Phosphorus, and Potassium required for growth and productivity of Pusa Giant Napier under coconut.

(ii) To investigate the effect of Pusa Giant Napier fertilized with different levels of N, P, K on the yield of coconut when grown in association.

All long term experiments (P_5, P_{21}, P_{22}, P_{70}) started by earlier workers were managed to schedule during the year.

Experiments P_{85}, P_{86} and P_{87} at Kuliyapitiya, Kobbeigane and Baddegama respectively to study the effect of five levels of Nitrogen applied as Ammonium Sulphate) on the productivity of *Brachiaria miliiformis* under coconut at three different rainfall regimes continued up to July. Due to lack of cooperation from the estate owners at Kobbeigane and Baddegama, action is being considered to abandon these experiments.

2. Subsidiary Food Crop Studies

During the year six new experiments were set up on the above (two during Yala Season and four during the Maha Season) as follows:

Experiments set up during Yala Season

Experiment S_1 at Ratmalagara Estate

Studies on the growth patterns of Soyabean, Green Gram and Black Gram under coconut as influenced by differences in the availability of light, moisture and nutrients within the coconut square.

Experiment S_2 Bandirippuwa Estate

An investigation on the effect of nitrogen fertilization and plant density on the yield of Manioc.

The experiment is being carried out in collaboration with Dr. H. P. M. Gunasena of the Faculty of Agriculture, University of Sri Lanka, Peradeniya.

Experiments set up during Maha Season

Experiment S_3 at Ratmalagara Estate

To investigate the effects of nitrogen fertilization and planting density on the growth pattern and yield of Soyabean (*Variety–Bragg*) under coconut.

Experiment S_4 Ratmalagara Estate

International Soyabean varietal Trial
'INTSOY'—Ratmalagara Code No. AAA 73.

Experiment S_5 at Bandirippuwa Estate

To determine the optimum spacing for Soyabean under coconut.

Experiment S_6 at Ratmalagara Estate

This is similar to experiment S_5 and has been set up at Ratmalagara Research Station.

Ramie (Boechmeria Nivea)

Preliminary studies on this crop were undertaken during the latter part of the year. It is proposed to lay down experiments in the Wet Zone during 1974.

Food Production

With the accent on food production, action was taken to bring as much land as possible under food crops in the 21 acre block at Bandirippuwa Estate, planted with hybrids. With the maha rains approximately 3 acres which could be cleared were established with chilli, green gram, beans and soya.

Intercropping on Estate

Plans were drawn up to carry out intercropping trials on 10 acre block with 6 locations each in the Wet, Dry and Intermediate Zones. A sum of Rs. 350,000/- was released by the Ministry of Planning for these trials. These experiments will be carried out in 1974 after the appointment of the required staff of Experimental Officers and Field Assistants. During December over 20 Estates expressing willingness to participate in this Scheme were inspected to ascertain suitability.

Animal Husbandry Unit

The animal husbandry report of the Division as at 73-12-31 is as follows:—

	Bandirippuwa Estate	*Ratmalagara Estate*	*Total*
Milk produced (pints) ..	103,745	4,320	108,065
Herd Strength	278	76	354
Births	101	35	136
Deaths	36	15	51
No of A.I.	80	—	80
Animals sold: Bulls ..	2	—	2
Cows ..	64	—	64
Heifer Calves	3	—	3
Bull Calves	72	—	72

The rotational cross-breeding programme recommended by Professor Mahadevan (Dean of the Faculty of Agriculture, University of West Indies) is being followed. The F_1 progeny of (Sinhala × Jersey) has been crossed to the Sindhi.

General Activities

During the year the Officer-in-Charge of the Division and the Research Assistant attended the In-Service Training Course on Intercropping held at Gannoruwa and conferences on Rubber, Ramie and Soyabean.

Crop Protection Division

A. Insect Pests

1. Promecotheca cumingi

Biological Control Laboratory in Colombo continued to function during 1973. The following parasites were bred and released:

1. *Pediobius parvulus*
2. *Dimmokia Javanica*

During the course of the year it was apparent that the pest was under control and recoveries of the parasites were made in the field. Continuous observations were kept in the *P. cuminigi*—infested areas, and leaf samples with larval instars were brought to the laboratory from such areas for the breeding of the parasites. Availability of material for parasites breeding become progressively meagre. A survey to assess the incidence of the pest was carried out during the year. Dr. P. R. Dharmadhikari, F.A.O. Expert from the Commonwealth Institute of Biological Control was in charge of the biological control programme throughout the year.

2. Coconut Caterpillar (*Nephantis serinopa*)

Parasite breeding programme was continued at the two insectaries at Head Quarters and at the Parasite Breeding Station at Mylambavelly. A new egg parasite, *Trichogramma braziliensis*, was introduced into the field. Breeding of *Perisiorola nephantidis*, *Nythobia* sp, *Spoggosia bezziana Brachymaria*, *Trichogramma braziliensis* was carried out at Head Quarters.

No field recoveries of *Trichospilus* and *Tetrastichus* were observed and their multiplication was reduced to a minimum, though nucleus cultures were maintained in the laboratory. *Perisierola* and *Nythobia* have shown good signs of field recoveries, *Trichogramma braziliensis*, *Nythobia* and *Spoggosia bezziana* were bred at the Parasite Breeding Station. Towards the end of the year infestation in the North Western Province showed signs of declining. Population studies of the pest intensity were carried out in the Eastern Province under the guidance of the F.A.O. Expert.

3. Red Weevil (*Rhynophorus ferrugineus*)

The incidence of the pest showed signs of increase towards the end of the year and this could be attributed to the fairly long drought that prevailed. New infestations were reported from the Vanathavillu Colonisation Scheme. "Azodrin 60" had to be recommended for its control in place of "Metasystox" as the latter ceased to be available at many places. The trap to collect the weevils was continued to be tested. The estates where *Platymeris levicollis* was released against Red Weevil were kept under constant observation.

4. Coconut Scale (*Aspidiotus destructor*)

A fresh report of the pest was received from Ravita Estate and spraying was carried out for its control. The experimental programme on the mass breeding of aessinolid beetles was continued at head quarters.

5. Black Beetle (*Oryctus rhinoceros*)

No fresh infestations of this pest were reported.

6. Other Pests

No outbreaks of *Parasa lepida* and *Xyleborus similis* were reported during the year under review.

B. Diseases

1. Bud Rot disease

Several reports of this disease were received during the year. Incidence was observed mostly in the Southern Province. Axil placement of fungicidal bags and axil placement of fungicidal soap were continued, and they were found to be effective.

2. Stem Bleeding

The disease was observed at Pothukulama Research Station and at Halmellagara Estate, Hunnalembawa. The affected palms were treated with copper fungicide.

3. Ganoderma

This was detected newly in the Southern Province. It is proposed to carry out some research on this problem.

4. Leaf Scorch Decline

No new reports of the disorder were received during the year. Experiments to determine the association of soil drainage with the leaf scorch condition were continued at Kirimetiyana and Ratmalagara Estates.

C. Assessment of Pest & Disease Position in the Island

Two questionnaires pertaining to pests and diseases on coconut estates were printed and sent to coconut growers in the island. A fair number had replied and it is expected to analyse the particulars during 1974.

Miscellaneous

1. Dr. F. J. Simmonds, Director, Commonwealth Institute of Biological Control, in one of his visits to Sri Lanka, (at the end of 1973) brought a consignment of 2 leaf eating caterpillars which feed on two economically important weeds, namely, *Eupatorium* and *Salvinia*. These insects are being bred in the Laboratories at head quarters and the Biological Control Laboratory, Colombo under the supervision of Dr. P. R. Dharmadhikari.
2. Four, 3 month fellowships were arranged at the Commonwealth Institute of Biological Control in Bangalore, under the provisions of the U.N.D.P. Biological Control Project. Whilst Mr. T. M. F. Hassan, Technical Assistant and Mr. P. A. C. R. Perera, Senior Technical Assistant have already completed their training at the C.I.B.C., Mr. M. S. Velu, Technical Assistant (who was awarded the third fellowship) left for India at the end of the year.

Biometry

Statistical Work

Routine statistical work of the Research Divisions were attended to. Designs were provided for a number of new experiments.

Research

(i) *Calibration Trial*—The Calibration trial was maintained uninterrupted.

(ii) *High & Low Yielding Palms*—The study of the distinguishing characteres of high and low yielding palms was completed.

The same data were subjected to a "Principal Component Analysis" in order to determine whether the numerous quantitative characters expressing "yield" can be expressed in a fewer number of functions or vectors.

(iii) The yield components of different cultivars of coconut were examined for the Botanist.

(iv) *Watering Experiment*—The watering experiment wherein water was supplied at various intensities and frequencies to palms during periods of drought continued without interruption.

(v) *Drought Index*—The analytical work towards improving the "drought Index" (put out recently by us as an interim measure) received considerable attention during the year. The "sweep out" statistical approach adopted through the Computer is showing good results.

Agri-Meteorology

The three agri-meteorological stations at B/E, R/E and I.S.G. were maintained satisfactorily.

General

The Biometrician continued to function as Consultant Biometrician to the Rubber Research Institute of Ceylon.

As visiting lecturer at the Vidyodaya campus, the Biometrician delivered lectures both to the undergraduates as well as to the students for Post-graduate diploma course.

Planting Division

1. Seed-nuts

The Planting Division maintained 14 nurseries during the year. Land at Pallekelle, Kandy was obtained to open a new nursery, making a total of 15 nurseries at the end of 1973.

A total of 1,298,505 seednuts were laid down in the nurseries for seedling issues during the May/June and October/November 1973 season as follows:

Season	*Seed-nuts*
May/June 1973	367,710
October/November 1973	930,795
	1,298,505

2. Seedlings

Orders were booked and payments were received in 1973 for 854,204 seedlings for undermentioned issue seasons:

Season	*Seedlings*
October/November 1971	370
May/June 1972	150
October/November 1972	45,477
May/June 1973	197,519
October/November 1973	610,688
Total	854,204

The actual issues of seedlings during 1973 from the 14 nurseries amounted to 904,927 and their distribution in respect of the various seasons is as follows:

Season	*Seedlings*
October/November 1971	170
May/June 1972	50
October/November 1972	204,359
May/June 1973	221,460
October/November 1973	476,560
May/June 1974	2,328
Total	904,927

Publications/Publicity Unit & Library

1. Journals

The following issues of the C.R.I. journals were published during the year:

(a) Ceylon Coconut Quarterly

Volume XXIII, Nos. 1/2
Volume XXIII, Nos. 3/4

(b) Ceylon Coconut Planters' Review

Volume VII, No. 1

(c) Pol Pawath

Volume V, No. 3

2. Advisory Leaflets

Wherever necessary C.R.I. Advisory Leaflets were revised and/or reprinted in order to up-date the subject material and to maintain the stock position.

A new leaflet (No. 52) on *Promecotheca cumingi* was printed in Sinhala, Tamil and English.

3. Library

152 new books have been added to the library making a total of 3,252. No new subscriptions for journals have been entered, but eight new journals have been included in the stock under exchange agreements. The total number of journals acquired on subscriptions and on exchange stand at 350.

Under the ODA Book Presentation Programme the British Council kindly agreed to donate to the Institute books and journals (of our choice) to the value of £ 1750. A request has already been made for 160 books and subscriptions for 32 journals under this programme.

Library Bulletin

Four issues, at quarterly intervals, of the Library Bulletin, compiled (in mimeo form) by the Librarian were produced during the year.

W. R. N. NATHANAEL
Director.

Ceylon Cocon. Q. (1973) 25, 16-42.
Printed in Sri Lanka.

REPORT OF THE CHEMISTRY DIVISION (1973)

1. STUDY ON DIURNAL AND SEASONAL FLUCTUATIONS OF NUTRIENTS IN FOLIAR TISSUE

Studies on the diurnal and seasonal fluctuations of nutrient concentrations in the leaves of *typica* coconut palms that have reached the productive phase, commenced in March 1972 were concluded in February 1973.

The study was conducted on 30 healthy palms from the Botanist's Progeny Trial at Walpita. Samples were taken from the leaflets confined to the mid-region of the 14th leaf, as recommended by the IRHO in Paris.

For the study of diurnal fluctuations of nutrients, sampling commenced at 0600 hours and was repeated at 3 hourly intervals upto 1800 hours. (i.e. 5 sampling times per day totalling 150 samples from the 30 palms on each sampling date).

The seasonal fluctuations were studied by sampling at monthly intervals, covering both the rain and dry months. Altogether 12 samplings were done at monthly intervals covering a full one year period.

Based on the findings of this experiment the ideal time for leaf sampling (diurnal and seasonal) will be determined by indications of the time when fluctuations in nutrient concentrations is least.

Analyses for macro-nutrient contents (N, P, K, Ca, Mg and also Na) are in progress Table I gives the results obtained for the months of March and April, 1972.

TABLE I

Analytical data on Diurnal and Seasonal Fluctuations in Nutrient Concentrations

Date of Sampling (3rd March, 1972)

(*Per Cent*)

Element / (*Time Hours*)	*Nitrogen* (*as N*)	*Phosphorus* (*as P*)	*Potassium* (*as K*)	*Calcium* (*as Ca*)	*Magnesium* (*as Mg*)	*Sodium* (*as Na*)
0600	2.086	0.149	1.183	0.327	0.201	0.305
0900	2.028	0.143	1.186	0.397	0.201	0.220
1200	2.014	0.149	1.158	0.274	0.167	0.128
1500	2.115	0.161	1.283	0.324	0.195	0.146
1800	2.068	0.152	1.223	0.346	0.193	0.130

Date of Sampling (19th April 1972)

(Per Cent)

Element / *(Time Hours)*	*Nitrogen (as N)*	*Phosphorus (as P)*	*Potassium (as K)*	*Calcium (as Ca)*	*Magnesium (as Mg)*	*Sodium (as Na)*
0600	2.075	0.156	1.322	0.313	0.193	0.136
0900	2.078	0.160	1.381	0.330	0.199	0.161
1200	2.052	0.155	1.323	0.267	0.261	0.114
1500	2.103	0.157	1.399	0.347	0.192	0.151
1800	2.193	0.162	1.080	0.301	0.184	0.096

2. STUDY ON THE ANNUAL EXHAUST OF SOIL NUTRIENTS

The Botanist's 300 palm block at Bandirippuwa Estate, was chosen for the study of the annual exhaust of nutrients from the soil by adult *typica* coconut palms.

Commencing with the estate pick for May–June 1972, at bimonthly intervals a study was made to estimate the annual removal of the macro-nutrients (N, P, K, Ca & Mg) by the selected palms. The study was concluded with the final pick in March–April 1973. Plant analyses in connection with this study covered the sampling of fallen fronds, fallen nuts, and the nuts in the first and second clusters.

The estimated total amounts of nutrients removed by the picks in November–December 1972, January–February 1973 and March–April 1973 together with the estimated amounts of nutrients for the 12 month period May 1972 to April 1973 are tabulated in Tables II, III, IV and V.

TABLE II

Estimates of amounts of mineral elements in the fruit components of the fallen, first bunch and second bunch nuts at time of Harvest and in the components of the fallen fronds collected at end of harvest.

Harvest: November–December, 1972

(*Grammes*)

Elements / *Components*	*Nitrogen (as N)*	*Phosphorus (as P)*	*Potassium (as K)*	*Calcium (as Ca)*	*Magnesium (as Mg)*
Dead ripe fallen nuts					
Husk	76	15	696	54	36
Shell	21	2	20	16	4
Kernel	230	30	180	5	5
Nut Water	3	1	20	2	0.4
Total	330	48	916	77	45
First bunch nuts					
Husk	243	86	3,760	249	172
Shell	117	8	79	65	10
Kernel	1,400	129	716	21	23
Nut Water	16	17	155	11	1
Total	1,776	240	4,710	346	206
Second bunch nuts					
Husk	696	104	5,121	388	273
Shell	122	7	74	57	22
Kernel	1,524	141	847	21	22
Nut Water	18	7	175	13	4
Total	2,360	259	6,217	479	319
Fallen Fronds					
Rachis	484	58	223	1,211	265
Mid-rib	148	12	50	112	52
Lamina	1,187	86	226	701	230
Total	1,819	156	499	2,024	547

TABLE III

Estimates of amounts of mineral elements in the fruit components of the fallen, first bunch and second bunch nuts at time of harvest and in the components of the fallen fronds collected at end of harvest.

Harvest: January–February 1973

(*Grammes*)

Element / *Components*	*Nitrogen* (*as N*)	*Phosphorus* (*as P*)	*Potassium* (*as K*)	*Calcium* (*as Ca*)	*Magnesium* (*as Mg*)
			Dead ripe fallen nuts		
Husk	187	16	558	39	42
Shell	58	1	42	17	1
Kernel	309	36	159	7	3
Nut Water	4	2	26	2	0.4
Total	558	55	785	65	46
			First bunch nuts		
Husk	990	87	3,580	224	175
Shell	340	6	173	58	7
Kernel	1,473	150	652	24	12
Nut Water	18	11	159	10	3
Total	2,821	254	4,564	316	197
			Second bunch nuts		
Husk	953	83	3,638	286	149
Shell	349	5	151	71	—
Kernel	1,131	108	503	22	11
Nut Water	15	11	155	7	2
Total	2,448	207	4,447	386	162
			Fallen fronds		
Rachis	450	43	192	1,484	416
Mid-rib	212	15	88	146	69
Lamina	1,049	92	172	749	281
Total	1,711	150	452	2,379	766

TABLE IV

Estimates of amounts of mineral elements in the fruit components of the fallen, first bunch and second bunch nuts at time of harvest and in the components of the fallen fronds collected at end of harvest.

Harvest: March–April, 1973

(*Grammes*)

Elements / *Components*	*Nitrogen* (*as N*)	*Phosphorus* (*as P*)	*Potassium* (*as K*)	*Calcium* (*as Ca*)	*Magnesium* (*as Mg*)
			Dead ripe fallen nuts		
Husk	218	32	1,889	95	109
Shell	22	12	163	30	9
Kernel	716	73	433	13	4
Nut Water	10	5	79	6	5
Total	966	122	2,564	144	127
			First bunch nuts		
Husk	513	83	5,482	224	231
Shell	61	13	383	64	7
Kernel	2,062	206	1,168	34	18
Nut Water	34	21	227	19	14
Total	2,670	323	7,260	341	270
			Second bunch nuts		
Husk	436	54	3,878	171	129
Shell	39	13	283	42	15
Kernel	1,425	140	813	21	11
Nut Water	21	8	169	11	9
Total	1,921	215	5,143	245	164
			Fallen fronds		
Rachis	619	64	435	2,532	547
Mid-rib	269	14	143	238	97
Lamina	1,525	104	375	1,193	466
Total	2,413	182	953	3,963	1,110

TABLE V

Estimated amounts of nutrients removed by the nuts and fronds during the period May 1972–April 1973

(*Grammes*)

Elements / *Harvest*	*Nitrogen (as N)*		*Phosphorus (as P)*		*Potassium (as K)*		*Calcium (as Ca)*		*Magnesium (as Mg)*	
	Nuts	*Fronds*	*Nuts*	*Fronds*	*Nuts*	*Fronds*	*Nuts*	*Fronds*	*Nuts*	*Fronds*
May–June 1972	14,589	2,147	1,648	155	26,740	668	1,365	2,340	1,207	794
July–August 1972	10,353	1,263	1,059	79	18,075	347	1,513	1,653	858	374
September–October 1972	6,774	2,901	623	173	13,246	465	709	3,708	874	831
November–December 1972	4,467	1,819	549	155	11,843	498	903	2,024	570	547
January–February 1973	5,829	1,711	518	150	9,796	452	767	2,379	405	766
March–April 1973	5,555	2,413	660	182	14,966	953	729	3,963	560	1,109
Total	47,567	12,254	5,057	894	94,666	3,383	5,986	16,067	4,474	4,421

A similar quantitative study on the macro-nutrient removal by hybrid palms (T×D) i.e. *typica*×*pumila* during each of the bimonthly picks of 1973 was commenced in June 1973. Chemical analyses of the samples collected are now in progress.

3. TODDY YIELDS FROM (T × D) HYBRID PALMS

The yield records of toddy on the 12 (*typica* × *pumila*) selected hybrid palms kept during the year 1972 were recommenced in May 1973, after a rest period of 4 months.

Yield records were maintained for the period 20th May to 26th December i.e. covering a tapping period of 220 days.

The results are tabulated in Table VI, giving the yield records of each of the 12 palms separately. It would be observed that the average daily yield per palm during the tapping period ranges between 1905 ml and 2,621 ml, the overall average daily yield per palm being 2174 ml (approximately 0.47 gallon or 2.8 bottles).

Yield records were also maintained for each spadix of every palm tapped and the results are tabulated in Table VII. The average yield per spadix per palm ranges from 37.5 litres to 59.4 litres. The overall average yield per spathe during the tapping period was 47.9 litres (10.5 gallons).

The yield records are being continued to cover a 12 month period i.e. upto May 1974.

4. ANALYTICAL METHODS

Work on Rapid Chemical Methods for plant tissue analyses were continued during the year and the following dry digestion procedure for plant material was finally adopted:—

Digest

The method consists of ashing 2.0 gm of the powdered plant material overnight in a muffle furnance at 450° C. The ash is then allowed to cool and 10 ml of 6 M HCl is added taking care that no losses due to effervescence occur. The solution is then evaporated to dryness over a water bath and dried in an oven at 105°C for 1 hour to dehydrate the silica. It is then moistened with 2 ml of 36% w/w Hcl and boiled for two minutes, followed by adding 10 ml of deionised water and boiled again, both operations being done on the water bath. Finally, the contents are transferred quantitatively into a 50 ml graduated flask and made up to the mark with deionised water. The solution is then filtered into polythene containers, after rejection of the first few millilitres of the filtrate. Ref. (NAAS/ANAL/242).

Estimation of Potassium and Sodium

1 ml of the filtrate is diluted to 100 ml with deionised water. Potassium is estimated on the EEL flame photometer and sodium on the Atomic Absorption Spectrophotometer.

Estimation of Calcium

To 2 ml of the filtrate, added 1ml of 10,000 ppm. Sr Cl_2 6 H_2O and the solution made upto 50 ml in a standard flask. The calcium content was determined on the A.A.S.

Estimation of Magnesium

To 1 ml. of the filtrate, added 2 ml. of 10,000 ppm. Sr Cl_2 6 H_2O and the solution made upto 100 ml. in a standard flask. The magnesium content was estimated on the A.A.S.

TABLE VI

Yields of Toddy (in millilitres)
(Records kept during the 8 month period May to December 1973 in 12 Hybrid Palms (A–L) at Bandirippuwa Estate, Lunuwila

Monthly averages	*Palm A*	*Palm B*	*Palm C*	*Palm D*	*Palm E*	*Palm F*	*Palm G*	*Palm H*	*Palm I*	*Palm J*	*Palm K*	*Palm L*	*Average daily yield per palm*
May ..	26,255	17,745	22,960	23,800	16,405	15,890	20,740	20,990	22,170	15,535	28,075	22,915	2,112
June ..	14,858	19,825	21,363	20,920	18,030	16,198	28,047	25,720	18,463	21,667	21,323	21,143	2,063
July ..	24,453	18,167	25,523	18,513	33,780	21,380	24,457	25,063	27,040	22,787	22,610	23,183	2,391
August ..	25,040	25,247	20,853	19,327	13,200	15,753	24,667	19,333	25,163	23,820	22,787	20,820	2,133
September ..	28,447	17,977	16,227	21,233	16,693	19,363	29,423	27,600	24,103	27,357	24,080	21,453	2,282
October ..	29,423	21,560	23,473	20,750	21,687	19,907	28,780	24,577	21,710	25,630	18,183	25,157	2,341
November ..	18,927	16,816	13,883	21,077	21,867	19,550	28,863	18,937	23,100	23,120	18,930	18,350	2,011
December ..	23,310	15,160	22,907	18,427	20,113	17,883	26,797	15,050	21,633	17,580	22,947	24,973	2,056
Average daily yield per palm 8 months May to December	2,333	1,905	2,089	2,050	2,021	1,824	2.621	2,215	2,292	2,218	2,236	2,224	2,174

TABLE VII

Variation in the Production of Toddy per Spadix (Volume in Litres)
(Records kept during the period of 20th May to 26th December on 12 (T × D) Hybrid Palms (A–L) at Bandirippuwa Estate, Lunuwila.

Spathe / *Palms*	1	2	3	4	5	6	7	8	9	10	11	12	*Overall average yield per spathe per palm*
Palm A	66.4	—	46.4	46.1	47.4	63.0	61.4	41.0	59.6	33.0	55.8	59.7	52.7
Palm B	42.4	32.0	51.9	55.9	66.0	31.9	45.8	53.9	—	57.4	37.9	39.8	46.8
Palm C	41.4	50.1	50.1	51.3	54.9	19.6	53.5	38.3	44.2	46.7	52.7	54.8	46.4
Palm D	35.4	37.5	46.0	37.3	40.6	66.9	41.1	34.6	40.8	38.8	35.3	56.8	42.5
Palm E	51.8	28.4	60.7	70.1	—	37.0	40.0	48.5	45.3	57.7	33.8	77.4	50.0
Palm F	—	36.5	29.4	35.4	45.0	35.0	36.0	33.7	38.6	47.8	44.8	30.7	37.5
Palm G	39.2	59.0	74.9	50.6	57.5	60.3	51.2	77.4	60.4	55.6	58.9	68.2	59.4
Palm H	44.3	46.8	70.0	35.6	42.7	54.1	46.2	54.6	41.5	42.3	39.4	57.0	47.8
Palm I	53.7	40.5	53.7	58.7	70.6	45.7	49.3	43.0	65.1	40.0	63.1	36.9	51.6
Palm J	45.2	41.6	46.9	49.5	59.0	47.1	60.3	52.1	38.8	46.0	38.4	56.0	48.4
Palm K	60.9	42.7	52.7	44.5	29.4	69.3	45.8	32.5	31.5	53.5	43.8	36.6	45.2
Palm L	46.1	32.9	55.7	46.6	37.2	66.6	27.6	59.6	52.2	39.6	58.2	45.9	47.3
Average yield of spathes per palm	47.9	40.7	53.2	48.4	50.0	49.7	46.5	47.4	47.0	46.5	46.8	51.6	47.9

Estimation of Phosphorus

To 10 ml of the filtrate, added 10 ml of Vanado–molybdate solution and the whole made upto 50 ml. The flask is shaken up and set aside for ½ an hour for colour development. The absorbance is then measured on an EEL Absorptiometer.

5. PREPARATION OF TEST SAMPLES SIMULATING 'SPECIAL ARRACK' USING AN ESSENCE RECOVERED FROM COCONUT TODDY

Basis:-

Fore-shots obtained from the straight distillation of toddy is diluted with rectified spirits in suitable proportions to yield a liquor of agreeable bouquet and taste simulating that of ordinary coconut arrack. In other words 'Foreshots' obtained during toddy distillation constitute the 'essence' for the preparation of the test samples.

Fore-shots:-

On a request made by the Director, C.R.I., arrangements were made by the Excise Commissioner to collect samples of fore-shots from six distilleries. The first gallon of the distillate from a charge of approximately 1,000 gallons of toddy was collected in six consecutive bottles and labelled 1, 2,..6. Samples representative of the 1st gallon were prepared in the laboratory by bulking 100 ml portions from each of the first six bottles. Details pertaining to the samples collected and supplied from six distilleries by the Excise Commissioner are given in Table 1.

TABLE 1

Date of collection	*Distillery number*	*Number of gallons of toddy distilled*	*Type of still*	*No. of gallons of fore-shots collected*
7th Dec. '72	(1)	972	Pot still number one	One and four
8th Dec. '72	(2)	1,150	Pot still number one	One and four
7th Dec. '72	(3)	580 and 138 gallons of weak spirit	Pot still number three	One and four
7th Dec. '72	(4)	995	Patent still number one	One and four
7th Dec. '72	(5)	about 1,000 (not mentioned)	Patent still number one	One and four
7th Dec. '72	(6)	1,485	Patent still	One and four

The analytical results obtained on the various samples examined in the laboratory are charted in Tables 2 to 7.

TABLE 2—DISTILLERY (1)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters in gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
C_1	16.7 O.P.	66.61	10,032	52.12
C_2	21.2 O.P.	69.17	9,388	29.61
C_3	22.9 O.P.	70.14	8,448	20.43
C_4	24.6 O.P.	71.11	7,050	19.99
C_5	22.9 O.P.	70.14	5,984	19.99
C_6	22.7 O.P.	70.03	4,576	20.14
C_7	24.4 O.P.	71.00	7,518	26.46

Pot still No. 1 was charged with 972 gallons of pure toddy and the first gallon of the distillate was collected in six bottles labelled (C_1 C_2 C_3 C_4 C_5 and C_6).

A bulk sample C_7 was prepared by mixing 100 ml each of the foregoing samples C_1 to C_6 corresponding in composition to the first gallon of the distillate.

TABLE 3—DISTILLERY (2)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
SL_1	38.9 U.P.	34.94	5,034	215.46
SL_2	29.0 U.P.	40.58	3,788	112.27
SL_3	27.2 U.P.	41.60	3,907	162.86
SL_4	26.1 U.P.	42.23	3,232	152.33
SL_5	20.7 U.P.	45.30	2,820	129.98
SL_6	21.4 U.P.	44.91	2,830	104.33
SL_7	27.9 U.P.	41.20	3,420	146.16

Pot still No. 1 was charged with 1,150 gallons of pure toddy and the first gallon of distillate was collected in six bottles labelled (SL_1 SL_2 SL_3 SL_4 SL_5 SL_6).

A bulk sample SL_7 was prepared by mixing 100 ml. each of the foregoing samples SL_1 to SL_6 corresponding in composition to the first gallon of the distillate.

TABLE 4—DISTILLERY (3)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
S_1	21.8 O.P.	69.52	1,837	29.82
S_2	21.8 O.P.	69.52	1,760	33.03
S_3	23.3 O.P.	70.37	1,600	32.57
S_4	25.5 O.P.	71.62	1,600	35.03
S_5	26.0 O.P.	71.91	1,433	32.11
S_6	25.8 O.P.	71.80	1,433	31.65
S_7	23.8 O.P.	70.65	1,624	32.34

Pot still No. 3 charged with 580 gallons of pure toddy and 138 gallons of weak spirit and the first gallon of distillate was collected in six bottles labelled (S_1 S_2 S_3 S_4 S_5 and S_6).

A bulk sample S_7 was prepared by mixing 100 ml each of the foregoing samples S_1 to S_6 corresponding in composition to the first gallon of the distillate.

TABLE 5—DISTILLERY (4)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
W_1	45.8 U.P.	31.00	283	26.71
W_2	46.0 U.P.	30.89	290	33.39
W_3	45.0 U.P.	31.46	280	32.34
W_4	46.0 U.P.	30.89	570	32.66
W_5	42.7 U.P.	32.77	550	32.97
W_6	44.5 U.P.	31.75	560	33.39
W_7	44.5 U.P.	31.75	554	32.97

Charged 995 gallons of pure toddy into Patent Still number one and the first gallon distillate was collected in six bottles labelled (W_1 W_2 W_3 W_4 W_5 and W_6).

A bulk sample W_7 was prepared by mixing 100 ml. each of the foregoing samples W_1 to W_6 corresponding in composition to the first gallon of the distillate.

TABLE 6—DISTILLERY (5)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
B_1	13.6 O.P.	65.25	488	14.55
B_2	12.2 O.P.	64.05	206	16.38
B_3	11.0 O.P.	63.36	312	16.59
B_4	9.1 O.P.	62.28	212	16.69
B_5	5.5 O.P.	60.24	264	20.66
B_6	0.1 O.P.	57.16	154	21.42
B_7	8.2 O.P.	61.77	356	16.80

Charged about 1,000 gallons of pure toddy into Patent Still number one and first gallon distillate was collected in six bottles labelled (B_1 B_2 B_3 B_4 B_5 and B_6).

A bulk sample B_7 was prepared by mixing 100 ml each of foregoing samples B_1 to B_6 corresponding in composition to the first gallon of the distillate.

TABLE 7—DISTILLERY (6)

Sample No.	*Proof Strength*	*Alcohol % by vol.*	*Esters gms/100 L abs. alc.*	*Acids gms/100 L abs. alc.*
R_1	87.1 U.P.	6.59	595	131.92
R_2	84.7 U.P.	8.01	2,263	118.34
R_3	77.7 U.P.	11.88	1,548	65.35
R_4	62.0 U.P.	20.51	910	38.47
R_5	30.9 U.P.	38.18	389	15.75
R_6	3.6 U.P.	53.86	240	11.28
R_7	57.4 U.P.	23.08	541	25.89

Charged 1,485 gallons of pure toddy into patent still number two and the first gallon distillate was collected in six bottles labelled (R_1 R_2 R_3 R_4 R_5 and R_6).

A bulk sample R_7 was prepared by mixing 100 ml each of the foregoing samples R_1 to R_6 corresponding in composition to the first gallon of the distillate.

The analytical figures for the distillate obtained from the Co-operative Distillery, Kalutara are in conformity with figures obtained in the laboratory. Details are summarised in Table 8.

TABLE 8—Miscellaneous Distillates

Sample No.	*Proof Strength*	*%Alcohol by vol.*	*Esters gms/100 L abs. alc.*
N_1	42.9 O.P.	81.53	3,757.6
N_2	36.75 O.P.	78.00	1,126.4
N_3	23.71 O.P.	70.60	7,500.0
C_7	24.4 O.P.	71.00	7,518.0
N_4	161.07 O.P.	91.89	107.0

Note: Compare N_3 and C_7

N_1 A sample constituting one-tenth the original volume of toddy distilled (in 1955 at the CRI) was redistilled (during the first quarter, 1973) and 1/100th of the volume collected (N_1). In other words, N_1 represents 1/1000th of the volume of the 1955 sample of toddy.

N_2 Represents a precisely similar sample to that of N_1, but the original toddy (1955) was strained through felt.

N_3 Foreshots (1/1,000 original) obtained from toddy distilled during the 1st quarter 1973 in the laboratory.

N_4 Represents a sample of rectified spirits obtained from the State Distillery Seeduwa and redistilled at the C.R.I.

C_7 The sample already described in Table 2, representing 1/1,000th of the volume of original toddy distilled.

Regarding the other 5 distilleries, three of which used patent stills, the foreshot fractions were found unsuitable for the present purpose. The samples from the remaining two distilleries, where pot stills were used gave weak spirits (contaminated) with a low concentration of esters. In view of these facts, the distillate collected at the Co-operative Distillery alone has been used for our studies.

Preparation of test samples using foreshots

Required quantities of C_7, rectified spirits and water were mixed to obtain test samples having an alcohol strength and esters of the same order as that of ordinary coconut arrack. In order to prepare a test sample corresponding in strength and ester content to that of special arrack, 2.0 ml of C_7 and 70 ml of rectified spirits were mixed and made up to a final volume of 100 ml with water.

Samples prepared in this fashion were submitted for a Connoisseur's report from a competent source.

Connoisseur's Report dated 29th March 1973

Bouquet — Satisfactory, but has a slight burnt or smoky smell

Flavour — Satisfactory,

Leaves a faintly bitter after taste. Does not simulate the smell or taste of true coconut arrack, but is superior to most blends of "Special Arrack".

6. FRACTIONAL DISTILLATION OF TODDY TO DETERMINE THE ANALYTICAL CHARACTERISTICS OF THE DISTILLATE AT PROGRESSIVE STAGES: (UTILIZATION OF "FORESHOTS" FOR FLAVOURING)

For the preparation of a flavouring essence for coconut arrack (i.e. from the foreshot fraction as discussed under 5 above) it has been suggested that one part of foreshots could be diluted 35 times with rectified spirits. On further dilution with water to marketable strength, it was found that from every bottle of foreshots, 50 bottles of special arrack could be prepared. This is reasonably satisfactory and could be commercially applied. It is reckoned that a product similar to Special Arrack could be prepared by blending 4 parts of silent spirits with 1 part of coconut arrack. A ratio 1 : 35 would therefore be a decided improvement in the right direction.

Based on the above findings, further laboratory trials were carried out to determine whether a bigger foreshots fraction (i.e. more than one gallon per 1,000 gallons toddy distilled) could flavour a bigger volume of silent spirits. With this object in view laboratory samples corresponding to 5 gallons, 10 gallons and 15 gallons foreshots from every 1,000 gallons of toddy were prepared. Refer Table 9 for ester values.

TABLE 9

	Esters (*gms* 100 *litres absolute alcohol*)			
	1/1,000	5/1,000	10/1,000	15/1,000
	7,788	5,062	2,336	2,336
	7,920	5,148	4,356	2,376
	7,642	5,095	3,397	1,698
	6,435	3,861	3,003	2,145
Average	7,446	4,792	3,273	2,139

Industrially the samples indicated in the above table could be prepared as follows:

1/1,000 Charge 1,000 gallons of toddy in a Pot-Still and collect the first gallon of distillate.

5/1,000 Charge 1,000 gallons of toddy in the Pot-Still and collect the first 5 gallons of distillate.

10/1,000 and 15/1,000 Similarly for the 10/1,000 and 15/1,000 for each charge of 1,000 gallons of toddy collect 10 gallons and 15 gallons respectively of the distillates.

It has already been mentioned that one bottle of foreshots (1/1,000) can give 50 bottles of Special Arrack (i.e. 300 bottles of Special Arrack from 1 gallon of these foreshots). Table 10 shows the number of proof gallons of rectified spirits that can be diluted with one gallon of foreshots (i.e. the dilution factor) instead of the usual 1 : 4 dilution and also the number of bottles (at market strength) that can be prepared from 1,000 gallons of toddy.

TABLE 10

Foreshots	*Esters (gm/100 litres absolute alcohol)*	*Dilution factor in terms of proof gallon spirits*	*Number of bottles (at Market strength) from every 1,000 gallons of toddy*
1/1,000	7,446	35	300
5/1,000	4,792	22	990
10/1,000	3,273	15	1,320
15/1,000	2,139	9	1,170

From the figures charted above we could therefore infer that 5 to 10/1,000 foreshots, would be of the right order under industrial conditions. In other words, when we collect 10 gallons of foreshots (10/1,000) from 1,000 gallons of toddy, the product will serve to produce 4 times the volume of marketable arrack, in comparison with that of one gallon of foreshots (1/1,000).

Since the capacity of most pot-stills in the distilleries is, 1,500 gallons, from each charge (i.e. 1,500 gallons of toddy) 7.5 to 15 gallons of foreshots could be collected for blending purposes.

7. PREPARATION OF TEST SAMPLES SIMULATING ORDINARY COCONUT ARRACK USING TODDY AND RECTIFIED SPIRITS

Three samples of ordinary coconut arrack (M_1, M_2, & M_3) have been prepared in the laboratory and the details are furnished below:

Basis-

Samples have been prepared by distilling rectified spirits (obtained from the State Distillery, Seeduwa) in admixture with toddy.

Samples-

Details pertaining to the above samples are as follows:

M_1 On distilling 1,600 ml of fully fermented pure toddy a yield of 120 ml. of alcohol is recoverable. Assuming that this volume (120 ml) will be present in the charge of 16,000 ml distilled, a calculated volume of rectified spirits containing 60 ml of alcohol is added and the mixture distilled. In effect, the proportion of the alcohol derived from the fermentation of toddy to the alcohol contained in the volumes of rectified spirits added is 2 : 1.

M_2 The adjustments were made as with M_1 so that the proportion of alcohol from toddy to the alcohol from rectified spirits is 1 : 1.

M_3 The corresponding proportions were 1 : 4.

The distilled samples (M_1, M_2 and M_3) were not stored in wooden barrels or coloured. They were submitted to a reliable authority for observations and comments.

Connoisseur's Report dated 29th March 1973

M_1 *Bouquet* — has a taste of stale toddy and also of smoke.
Flavour — Satisfactory.

Leaves a faintly bitter after taste.
Has a slight similarity to coconut arrack in taste and smell.
Superior to most blends of "Special Arrack".

M_2 *Bouquet* — Satisfactory and better than 'M_1'
Flavour — Satisfactory.

Closer to coconut arrack than 'M_1'
Superior to all 'Special Arrack'.

M_3 Is superior in all aspects to 'M_2'

8. STUDIES ON THE OPTIMUM TIME FOR DISTILLING TODDY COLLECTED UNDER CONDITIONS PREVAILING IN TAPPING TOPES

In distilling practice, toddy is generally distilled from 3.00 p.m. onwards. Experiments have been carried out in the laboratory to determine the optimum time for distillation.

Toddy was lowered from the palms once daily in the morning around 9.00 a.m. and brought to the laboratory in earthenware pots. The same pots were continuously used for collection and transport daily without change.

Toddy brought to the laboratory is then bulked in a large earthenware pot. Samples were drawn at intervals of 3 hours for the estimation of sugar and acids, in order to follow their changes as fermentation proceeds. The results are charted in tables 11, 12 and 13.

TABLE 11

Date	*Time of Analyses*	*No. of hours since collection*	*Percentage acidity as Acetic Acid*	*Percentage alcohol (V/V)*	*Sugars*		
					%Reducing sugars as Invert sugar	*% non reducing sugar as sucrose*	*Total sugars (Invert sugar + sucrose)*
73-03-05	9 a.m.	nil	0.47	3.32	3.72	5.83	9.55
	12 noon	3 hrs.	0.59	3.89	5.14	2.71	7.85
	3 p.m.	6 hrs.	0.62	5.34	4.32	1.16	5.48
	6 p.m.	9 hrs.	0.71	6.20	3.00	0.35	3.35
	9 p.m.	12 hrs.	0.71	6.42	2.04	0.26	2.29
	12 mid-night	15 hrs.	0.77	6.71	1.34	0.34	1.68
73-03-06	3 a.m.	18 hrs.	0.80	6.99	1.17	0.20	1.37
	6 a.m.	21 hrs.	0.83	6.99	0.90	0.16	1.06
	9 a.m.	24 hrs.	0.83	6.99	0.71	0.23	0.94
	12 noon	27 hrs.	0.88	6.99	0.53	0.19	0.72
	3 p.m.	30 hrs.	0.88	6.08	0.38	0.20	0.57
	6 p.m.	33 hrs.	0.88	6.08	0.23	0.23	0.45
	9 p.m.	36 hrs.	0.88	5.79	trace	0.26	0.26
	12 mid-night	39 hrs.	0.88	5.51	trace	0.24	0.24
73-03-07	9a.m.	48 hrs.	0.94	3.77	trace	0.28	0.28

TABLE 12

Date	Time of Analyses	No. of hours since collection	Percentage acidity as Acetic Acid	Percentage alcohol (V/V)	Sugars		
					% reducing sugars as Invert sugar	% non reducing sugar as sucrose	Total sugars Invert (sugar + sucrose)
73-03-06	9 a.m.	nil	0.65	5.22	3.00	2.76	5.75
	12 noon	3 hrs.	0.65	5.79	2.96	1.75	4.71
	3 p.m.	6 hrs.	0.68	6.37	2.27	0.79	3.06
	6 p.m.	9 hrs.	0.68	6.94	1.62	0.48	2.10
	9 p.m.	12 hrs.	0.71	7.22	1.05	0.30	1.36
	12 mid-night	15 hrs.	0.71	7.22	0.75	0.19	0.94
73-03-07	3 a.m.	18 hrs.	0.71	7.39	0.57	0.17	0.74
	6 a.m.	21 hrs.	0.74	7.68	0.43	0.17	0.60
	9 a.m.	24 hrs.	0.74	7.51	0.30	0.23	0.54
	12 noon	27 hrs.	0.74	7.51	0.23	0.12	0.34
	3 p.m.	30 hrs.	0.74	7.22	0.17	0.17	0.34
	6 p.m.	33 hrs.	0.80	7.22	trace	0.26	0.26
	9 p.m.	36 hrs.	0.80	7.22	trace	0.25	0.25
	12 mid-night	39 hrs.	0.80	7.22	trace	0.21	0.21
73-03-08	3 a.m.	42 hrs.	0.80	7.22	trace	0.19	0.19
	6 a.m.	45 hrs.	0.80	7.22	trace	0.18	0.18
	9 a.m.	48 hrs.	0.80	7.22	trace	0.18	0.18
73-03-09	9 a.m.	72 hrs.	0.94	4.93	trace	0.24	0.24

TABLE 13

Date	*Time of Analyses*	*No. of hours since collection*	*Percentage acidity as Acetic Acid*	*Percentage alcohol (V/V)*	*Sugars*		
					% reducing sugars as Invert sugar	*% non reducing sugar as sucrose*	*Total sugar (Invert sugar + sucrose)*
73-03-08	9 a.m.	nil	0.68	4.64	2.95	3.65	6.61
	12 noon	3 hrs.	0.68	6.08	2.74	1.52	4.26
	3 p.m.	6 hrs.	0.71	6.65	2.25	0.69	2.94
	6 p.m.	9 hrs.	0.71	7.51	1.37	0.49	1.86
	9 p.m.	12 hrs.	0.77	7.79	0.88	0.29	1.16
	12 mid-night	15 hrs.	0.80	7.79	0.69	0.18	0.87
73-03-09	3 a.m.	18 hrs.	0.83	7.79	0.51	0.16	0.67
	6 a.m.	21 hrs.	0.83	8.07	0.35	0.11	0.49
	9 a.m.	24 hrs.	0.83	7.79	0.27	0.13	0.40
	12 noon	27 hrs.	0.83	7.79	0.22	0.11	0.33
	3 p.m.	30 hrs.	0.86	7.79	0.16	0.11	0.27
	6 p.m.	33 hrs.	0.86	7.51	trace	0.26	0.26
	9 p.m.	36 hrs.	0.86	7.51	trace	0.20	0.20
	12 mid-night	39 hrs.	0.86	7.51	trace	0.19	0.19
73-03-10	3 a.m.	42 hrs.	0.88	7.51	trace	0.18	0.18
	6 a.m.	45 hrs.	0.91	7.51	trace	0.18	0.18
	9 a.m.	48 hrs.	0.94	7.11	trace	0.17	0.17
73-03-11	9 a.m.	72 hrs.	0.94	6.25	trace	0.18	0.18

The results indicate that the optimum time for distillation would be after a period of 18 hours since collection from the palm. In other words, it would be advisable to start distillation only by about 3 a.m. on the following day and not by evening on the same day as currently practised. This experiment however had to be repeated at a distillery for confirmation.

The Co-operative Distillery at Kalutara was selected for this study. The alcoholic strength of toddy was determined by drawing samples from Wash Back No. 1 at hourly intervals. This Wash Back was filled with toddy by 12.00 noon and analyses commenced from 1.00 p.m. until the toddy was pumped into the Pot-Still.

Results (charted on table 14) reveal that the toddy reaches its maximum alcoholic strength by about 5.00 p.m., that is about 8 hours after collection from the palm. In view of this, further work has to be done to ascertain the factors affecting fermentation such as climate, seasonal variations etc.

TABLE 14

Time	*No. of hours since collection*	*Percentage alcohol (V/V) (done on 2-8-73)*	*Percentage alcohol (V/V) (done on 9-8-73)*
1.00 p.m.	4	6.7	7.2
2.00 p.m.	5	6.7	7.4
3.00 p.m.	6	6.7	7.4
4.00 p.m.	7	6.8	7.4
5.00 p.m.	8	6.8	7.5
6.00 p.m.	9	6.8	7.5
7.00 p.m.	10	6.7	7.5
8.00 p.m.	11	6.7	7.5
9.00 p.m.	12	6.7	7.5
10.00 p.m.	13	6.7	7.5
11.00 p.m.	14	6.7	7.5
12.00 p.m.	15	6.7	7.5
1.00 p.m.	16	6.7	7.5
2.00 p.m.	17	6.7	7.5
3.00 p.m.	18	6.6	7.4

9. STUDIES ON THE OPTIMUM TIME FOR DISTILLING SWEET TODDY COLLECTED WITH VATERIA ACUMINATA BARK (STV)

The current method of collecting sweet toddy for the manufacture of coconut treacle is by the use of heat sterilized earthenware pots containing *Vateria acuminata* bark. This method of collection has been employed in this study. The sweet toddy collected in this way when stored ferments very slowly. It has also been noted that when this fermented toddy is distilled, a higher percentage of alcohol is recoverable (9-10%).

The earthenware pot was first sterilized by burning with dried coconut fronds. Next about 5 grammes of finely cut pieces of *Vateria acuminata* bark were added into the pot and raised to the palm around 2.00 p.m. The sweet toddy was lowered from the palm on the following day at 9 a.m. and bulked in a large earthenware pot. Samples were drawn from the bulk at 3 hourly intervals and analysed for alcohol and acid. The results are tabulated (Table 15).

TABLE 15

Time	*No. of hours*	*% Alcohol (V/V)*	*% acidity (as acetic)*
9 a.m.	—	0.06	0.18
12 noon	3	0.57	0.23
3 p.m.	6	0.80	0.26
6 p.m.	9	1.32	0.28
9 p.m.	12	2.41	0.31
12 midnight	15	3.49	0.32
3 a.m.	18	4.64	0.34
6 a.m.	21	5.79	0.35
9 a.m.	24	6.94	0.40
12 noon	27	7.51	0.41
3 p.m.	30	8.07	0.45
6 p.m.	33	8.64	0.45
9 p.m.	36	8.93	0.45
12 midnight	39	8.93	0.45
3 a.m.	42	8.93	0.45
6 a.m.	45	8.93	0.45
9 a.m.	48	8.64	0.45
12 noon	51	8.64	0.45
3 p.m.	54	8.64	0.45
6 p.m.	57	8.36	0.45
9 p.m.	60	8.07	0.45
12 midnight	63	7.79	0.45
3 a.m.	66	7.51	0.45
6 a.m.	69	7.51	0.45
9 a.m.	72	7.51	0.45

The results reveal that the optimum time for distilling sweet toddy (STV) is around 9.00 p.m. on the following day that is about 36 hrs. after collection.

10. COMPARATIVE STUDIES ON THE SUGAR CONTENT OF TODDY FROM HYBRID AND TALL COCONUT PALMS

When a Coconut palm is "tapped" an exudation of sap is obtained from the spathe. This in the fresh state is very sweet and is essentially a watery solution of sugar. This sweet juice is popularly known as "sweet toddy".

As the sweet toddy drips into the pot, wild yeasts and other micro-organisms act on it. The yeasts convert the sugar into alcohol and the products that is lowered from the palm is in a state of fermentation and is called "toddy".

In order to determine the sugar content of sweet toddy, the method STV (i.e. sterilized earthenware pots with *vateria acuminata* bark) was used for the collection of sweet toddy, and also tested out side by side using lime.

Initially the earthenware pots used for collection were sterilized by burning (using dried coconut fronds) and then about 5 grammes of finely cut pieces of dried *Vateria Acuminata* bark put into each of them.

Pots treated in this manner were suspended from the spathe of the palm at 9 a.m. Samples were taken at the end of 5 hours i.e. at 2.00 p.m. and again after 19 hours i.e. at 9.00 a.m. on the following day.

Six palms each, representing the tall (*typica*) and the Tall × Dwarf hybrid (*typica* × *pumila*) were used for this study. The sweet toddy from tall and hybrid palms were bulked seperately in large flasks. Samples from these were tested for sugar content. Even though antiferments (lime or *Vateria* bark) were added, it was found that fermentation of sugar to alcohol was not arrested but only retarded. Analyses revealed that about 0.06 to 0.40% alcohol (V/V) were found in the sweet toddy at the time of analyses.

The original sugar present in the form of sucrose, by the action of the enzyme invertase from yeast, get converted to invert sugar (glucose + fructose in equal proportions). Therefore the total sugar at the time of analyses is a mixture of invert sugar and sucrose. The results obtained are tabulated in Table 16.

TABLE 16

***Sugar Content of Toddy Derived from Hybrid and Tall Coconut Palms**

Palms	*Hybrid palm*				*Tall palm*			
Antiferments	*Lime*		*V. a. Bark*		*Lime*		*V. a. Bark*	
Hours	5	19	5	19	5	19	5	19
Reducing Sugars ..	1.80	5.34	1.65	3.67	2.47	4.70	3.13	5.90
Non-Reducing Sugars ..	14.33	9.67	15.25	12.96	14.22	11.96	13.78	10.03
Total Sugars ..	16.13	15.01	16.90	16.63	16.69	16.66	16.91	15.93

(**The figures represent averages for a seven day period*).

These results indicate that there is no appreciable significant difference in the initial sugar content of hybrid and tall coconut palm toddy. The average sugar content is of the order 16 (± 1) grammes per 100 ml.

The figures confirm that the antiferments do not arrest fermentation but only retard it. There is evidence of higher invert sugar values in all the 19 hour samples, in comparison with the 5 hour samples.

11. COMPARATIVE STUDIES ON COCONUT AND PALMYRAH TODDY AND THEIR DISTILLATES

Toddy:-

Toddy samples from coconut and palmyrah palms were analysed for N, P, K, Ca and Mg. Coconut toddy from 6 (T × D) hybrid palms (*typica* × *pumila*) at Bandirippuwa Estate were collected separately between 3 p.m. and 9 a.m. and analysed individually. In the case

of palmyrah palms, 6 samples of bottled toddy from Chankanai M.P.C.S. Ltd., have been used for analyses. The results charted on Tables 17 & 18 reveal that coconut toddy has higher concentrations of N, P and K compared with palmyrah toddy. Palmyrah toddy on the otherhand has a higher content of Ca and Mg.

Toddy Distillates:-

Fermented toddy samples from coconut and palmyrah palms have been distilled and their distillates were analysed for chemical constituents and the results are charted in Table 19.

TABLE 17

Analyses on Cocenut Toddy for N, P, K, Ca and Mg

Palm No.	*N*	*P*	*K*	*Ca*	*Mg*
C_1	0.030	0.026	0.168	0.0018	0.0048
C_2	0.033	0.028	0.180	0.0019	0.0040
C_3	0.033	0.023	0.128	0.0018	0.0035
C_4	0.033	0.023	0.136	0.0018	0.0037
C_5	0.036	0.030	0.200	0.0021	0.0047
C_6	0.037	0.025	0.168	0.0017	0.0036
Range	0.030 - 0.037	0.023-0.030	0.128 - 0.200	0.0017 - 0.0021	0.0035 - 0.0045
Average	0.033	0.026	0.163	0.002	0.004

TABLE 18

Analyses on Palmyrah Toddy for N, P, K, Ca and Mg

Sample	*N*	*P*	*K*	*Ca*	*Mg*
P_1	0.025	0.0145	0.096	0.0033	0.0064
P_2	0.023	0.0150	0.096	0.0035	0.0064
P_3	0.024	0.0150	0.092	0.0034	0.0061
P_4	0.023	0.0150	0.088	0.0036	0.0062
P_5	0.025	0.0150	0.092	0.0037	0.0057
P_6	0.026	0.0150	0.088	0.0037	0.0054
Range	0.023 - 0.026	0.0145-0.0150	0.088 - 0.096	0.0033 - 0.0037	0.0054 - 0.0064
Average	0.024	0.015	0.092	0.004	0.006

TABLE 19

Chemical analyses of distillates

Analyses	*Coconut Arrack*	*Palmyrah Spirit*
Strength	11.0 under proof (50.8 % V/V)	11.2 under proof (50.7% V/V)
Total Acid g/100 L absolute alcohol	13	81
Esters. g/100 L absolute alcohol	123	97
Aldehydes g/100 L absolute alcohol	25	22
Furfural	nil	nil
Methanol	nil	trace
Bouquet and taste	typical of coconut arrack	distinct from that of coconut arrack

Note: Sections (5) to (11) of this report were written by Mr. S. Mohanadas, Research Assistant who was responsible for the work embodied in these sections.

M. JEGANATHAN,
Officer-in-Charge,
Chemistry Division.

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REPORT OF THE DIVISION OF BOTANY AND PLANT BREEDING (1973)

1. CONTROLLED POLLINATION WORK

As in the previous year, the emphasis has been to produce more of *typica* × *pumila* F_1 hybrid seed compared with *typica* × *typica* seed, as the demand for the former type exceeds that for the latter.

The pollination programme at Bandirippuwa, Ratmalagara, Walpita, Ambakelle, Kiniyama, Andigedera and Achchitotam Estates was carried out to schedule. Work at the other station (Marandawila Estate) was suspended to enable the palms to recover, and only collection of pollen from pre-potent palms was carried out at that station. A new pollination unit on 350 palms was commenced at Horrekelley Estate, Kudawewa.

Foreign germ plasm has been used in Sri Lanka for the first time, for production of *typica* × *nana* F_1 hybrids. This was in the form of pollen supplied by the IRHO, Paris, through its station in Port Bouet, Ivory Coast (Table 1). The percentage set of female flowers

TABLE 1.—Use of Foreign Germ plasm for the Production of *typica* × *nana* F_1 hybrids

	Period during which pollinations were done							
	Dec. 1972	*Jan.* 1973	*Feb.* 1973	*Mar.* 1973	*Apr.* 1973	*May* 1973	*June* 1973	*July* 1973
Station: Walpita (1)								
No. of female flowers pollinated ..	3,452	3,342	4,406	4,331	2,845	4,328	3,596	3,230
No. of nuts developed	865	891	1,011	1,338	1,007	2,274	2,158	1,883
Percentage set ..	25.0	26.7	22.9	30.9	35.1	52.5	60.0	58.3
Age of pollen (days)	45	75	105	135	165	195	225	255
Station: Ratmalagara (2)								
No. of female flowers pollinated ..	572	858	698	764	425	791	729	1,094
No. of nuts developed	238	306	281	222	147	272	283	514
Percentage set ..	41.6	35.7	40.3	29.0	34.6	34.4	38.8	46.9
Age of pollen (days)	45	75	105	135	165	195	225	255

Station: Bandirippuwa (3)

No. of female flowers pollinated ..	615	484	846	974	428	893	922	948
No. of nuts developed	231	297	363	419	175	400	400	597
Percentage set ..	37.5	61.3	42.7	43.0	40.9	44.7	43.3	62.9
Age of pollen (days)	45	75	105	135	165	195	225	255

Pollen parents (1) *Red Cameroon Dwarf*	(2) *Ghana Yellow Dwarf*	(3) *Brazil Green Dwarf*
Date of receipt in Sri Lanka 72.11.21	72.11.21	72.11.21
IRHO Registration Number: 20 12 19	20 04 17	72 24 16
20 14 04	20 06 08	72 30 10
20 14 05	20 06 10	72 38 19
20 14 22	20 06 14	72 45 05
20 16 10	20 10 06	72 45 11
20 18 11	20 10 21	73 33 19
*Dates of collection at IRHO, Ivory Coast 72.10.23 to 72.10.31	72.10.18 to 72.10.30	72.10.07 to 72.10.23

using this pollen is indeed satisfactory. The variation between stations as well as from month to month is largely a reflection of the prevailing climatic conditions as well as the efficiency of the pollination unit at the station concerned. These factors would largely explain why pollen which had been stored for 225 days gave a 60 percent set of female flowers whereas comparatively fresh pollen of 45 days storage gave only 25 percent. The resulting hybrids will be tested in the field for drought tolerance and other desirable features.

A summary of the entire pollination programme is given in Table 2.

TABLE 2.—Controlled Pollination Work

Station	*Number of female flowers pollinated*	
	Typica × *typica*	*Typica* × *pumila*
Bandirippuwa	—	8,507
Achchitotam	—	12,384
ISG, Ambakelle ..	10,873	—
Ratmalagara	—	9,556
Walpita	—	51,794
Kiniyama	—	56,354
Andigedera	—	47,698
Horekelley	—	45,023
Total	10,873	231,316

Emasculation work for production of *pumila* × *typica* hybrid seed in the Dwarf Palm Block at the Coconut seed Garden, Ambakelle, was suspended in order to obtain sufficient quantities of *pumila* (selfed) seednuts to expedite the planting programme under the Seed Garden Expansion Project.

5,806 *typica* × *typica* and 25,000 *typica* × *pumila* seednuts from crosses done in 1972 were harvested. 398 ampoules of *typica* (prepotent) pollen and 271 ampoules of pumila pollen were issued to the private sector.

2. RESEARCH NURSERIES

The undermentioned quantities of seednuts were planted in the research nurseries at Bandirippuwa and the Seed Garden, Ambakelle.

Typica × *typica*	*Typica* × *pumila*	*Pumila* × *typica*
6,491	26,751	16,023

Besides the above, 12,686 dwarf yellow (*eburnea*) and dwarf green (*pumila*) seednuts have been planted to provide the planting material for the Ambakelle Seed Garden Expansion Project. 2,371 *eburnea* & *pumila* seednuts were planted at Ratmalagara Research Station for the same purpose.

This year 41,462 hand pollinated seedlings have been issued consisting of 13,065 *typica* × *typica* (CRIC 60), 18,308 *typica* × *pumila* and 10,149 *pumila* × *typica* (CRIC 65).

(3) INTRA-SPECIFIC HYBRIDIZATION: *San–Ramon* × *Nana* (*form pumila*) F_1 hybrids.

The success achieved with *typica* × *nana* F_1 hybrids has been emphasised in previous Annual Reports as well as in recent publications, (Liyanage, 1956; Manthriratna 1971, 1972). Other varieties and forms of the coconut (*Cocos nucifera* L.) have been crossed *inter se*, (Annual Report of the Botanist, Coconut Research Institute, 1955), and it is now possible to evaluate the performance of some of the resulting hybrids.

The form *San Ramon* is tall in habit and late flowering and is further characterised by the production of a few large nuts per bunch. The shape of nut, size and endosperm content are similar to that of the form *Kamandala* of the variety *Typica* (Liyanage, 1959). The *San Ramon* was crossed with the form *pumila* of the variety *nana*, the object being to produce a F_1 hybrid which is early bearing with a large number of medium—large sized nuts, together with a high copra and oil content.

A few of the hybrids were grown at Bandirippuwa Estate in 1956 and a substantially larger number at Pothukulama Research Station, Pallama, in 1964, and the performance of the latter group is summarised in Table 3.

TABLE 3.—Performance of *San Ramon* × *Nana* (*form Pumila*) F_1 palms

		YIELD			
No. of progenies	*Period for flowering (months)*	*Nuts/palm*	*Total wt. husked nut (lb.)*	*Wt. per nut (lb.)*	*(g)*
34	50.6	68	117.64	1.73	735

The *San Ramon* × *Nana* F_1 hybrid is early flowering (mean period for flowering 50.6 months) and although the yield per palm is very modest, weight of husked nuts is high and yield of copra is good. These palms are only 9 years old and probably not exhibiting their maximum yield potential.

Oil analysis of the nuts from these hybrids gathered and processed during the period May 1972–April, 1973 is given in Table 4.

TABLE 4.—Oil Analysis of *San Ramon* × *Nana* F_1 hybrids*

Sample	*% Moisture*	*%Oil (wet)*	*% Oil (dry)*
3rd Pick 1972	4.04	65.63	68.45
4th Pick 1972	4.52	66.45	69.59
5th Pick 1972	4.31	66.73	69.74
6th Pick 1973	4.21	65.24	68.11
1st Pick 1973	6.20	64.58	68.84
2nd Pick 1973	6.06	66.75	71.05

*Data kindly supplied by the Division of Chemistry, Coconut Research Institute.

(4) POLLEN STORAGE

In order to increase the longevity of stored pollen and also improve on the percentage set of female flowers when hand pollinated, pollen storage in nitrogen (as reported in the Annual Report of the Botanist for 1972), was given an extended trial under field conditions. The results are given in Table 5.

Pollen sealed in nitrogen and stored at 0°C for 230 days gave on pollination, 50 percent set of female flowers. Here, too, the somewhat inconsistent results of age of pollen and corresponding set of female flowers may be mainly attributed to factors other than the viability of the pollen. This investigation will be published in full elsewhere.

TABLE 5.—Percentage set of female flowers using pollen* sealed in nitrogen and stored at 0°C

Station	*No. of palms*	*No. of female flowers Pollinated*	*Percentage set*	*Age of pollen (days)*
Achchitotam	80	1,786	44.6	180
,, ...	80	1,377	42.7	210
,, ...	80	1,462	39.2	240
Ratmalagara	50	722	17.2	130
,, ...	50	750	25.1	160
,, ...	50	850	37.5	190
Walpita	250	5,117	50.2	230

*Pollen/Lycopodium 1 : 8 mixture.

(5) MOTHER PALM SEED SUPPLY

1,508,650 selected seednuts were supplied to the Planting Division nurseries. Re-selection work was completed on St. Anne's Estate, Mampuri and North Western Fruit Gardens, Angunawila and 3,105 mother palms re-selected.

(6) SEED GARDENS

1. Isolated Seed Garden, Ambakolle

Besides maintaining the 135 acres planted prior to 1966 and the 50 acres of jungle cleared and planted in 1972, 30 acres were cleared and planted in May/June 1973 and an additional 30 acres cleared for planting with the return of favourable weather.

As the Seed Garden is seriously affected by the rainfall pattern experienced in the area, it is hoped to have a coordinated irrigation scheme for the Seed Garden making use of the two reservoirs already constructed, as well as ground water located by the Division of Land Use Irrigation Department who test drilled the plantation.

2. Second Seed Garden

Fields Number 6 & 7 of Horrekelley Estate, Kudawewa, have been identified as suitable for a Second Seed Garden for the mass production of *pumila* × *typica* hybrids and a recommendation has been made to this effect.

(7) FIELD EXPERIMENTS

The field experiments and observation plots at Bandirippuwa (15) Ratmalagara (3), Walpita (1), and Pothukulama Research Station (10) were maintained during the year.

(8) LABORATORY INVESTIGATIONS

1. The investigation on pollen storage in nitrogen has been completed (vide above).
2. The investigations on parthenocarpy and barren nut formation had to be suspended due to the resignation of the officer who handled this investigation.
3. Likewise, the investigation on the relationship between stomatal density and yield had to be suspended owing to difficulties encountered in field work.
4. A trial to study the root system of *typica* × *pumila*, *pumila* × *typica* and *typica* × *typica* seedlings in relation to observed differences in susceptibility to drought has been initiated.

(9) PUBLICATIONS, LECTURES ETC.

Dr. M. A. P. Manthriratna, Botanist, gave a talk on "Maximisation of profit from coconut lands" on the English Service of the Sri Lanka Broadcasting Corporation.

Dr. M. A. P. Manthriratna, Botanist, served as President Section B (Agriculture & Forestry), Ceylon Association for the Advancement of Science, and delivered his Presidential Address on "The impact of old and new tools in plant breeding".

Two papers on pollen development and variation in the genus *Lolium* were published in *Z Pflanzenzuchtg.* 69 : 210–220 and 70 : 11–21.

10. PERSONNEL

Mr. H. I. M. V. Vithanage, B.Sc. Hons. (Ceylon) Research Assistant, resigned to take up an appointment in Australia.

Mr. J. M. Abeysena Field Attendant (Pollination), was transferred to the Agrostology Division.

DR. M. A. P. MANTHRIRATNA,
Botanist/CRB

16th April, 1974.

REFERENCES

Liyanage, D. V. (1956).—Bulletin No. 7, Coconut Research Institute, Ceylon.
———————(1959).—Ceylon Coconut Quarterly 9 : 1–10.
Manthriratna, M. A. P. (1971).—Ceylon Coconut Quarterly 22 107–113.
———————(1972).—Ceylon Coconut Quarterly (in print).

Ceylon Cocon. Q. (1973) 25, 48-62.
Printed in Sri Lanka.

REPORT OF THE SOIL CHEMISTRY DIVISION (1973)

SUMMARY

The ten long term field experiments at Bandirippuwa, Ratmalagara, Bingiriya, Pothukulama, Dankotuwa, Veyangoda and Rathgama were maintained. A new field experiment on the fertilizer requirement of young hybrid palms was commenced during the year. Significant responses to phosphorus and potassium were obtained at Bandirippuwa (4×4×4 NPK), Rathmalagara and Pothukulama (4 × 4 × 4 NPK). At Monrovia Estate significant responses to nitrogen and potassium were obtained. At Veyangoda, as in most of the previous years a significant response to potassium was obtained. There were significant responses to nitrogen and NP, NF and NPF interactions at Pothukulama (Quality of N and P and Frequency of Manuring experiment).

The following short term experiments were carried out during the year:— (i) effect of micronutrients on germination of coconut, (ii) effect of deficiency of micronutrients on uptake and distribution of all nutrients in coconut seedlings, (iii) comparison of Eppawela phosphate fertilizer with saphos phosphate fertilizer (a pot experiment with *Paspalum commersonii*).

Laboratory studies on the sulphur nutrition of coconut were carried out using materials from the B Zn S experiment at Monrovia Estate, Rathgama.

Detailed reconnaissance soil surveys of Negombo 1" sheet, Wariyapola 1" sheet, and abandoned farms from Alutarama to Hemberawa were carried out during the year. Detailed Soil Surveys of the Soil Chemistry Division's field experiments and the New Clearing of the Isolated Seed Garden were undertaken. In addition miscellaneous soil surveys of coconut lands for intercropping, cultivation of hybrid coconut and crop diversification were also carried out.

A. FIELD EXPERIMENTS

1. 4×4×4 NPK Experiment on Adult Palms—Bandirippuwa Estate (Commenced November 1960)

The annual manuring was carried out in November 1973. The data for the year show that the responses to phosphorus and potassium are significant.

The main effects are shown in Table A 1.

TABLE A 1.—Yield Data for 1973—Kg Copra per Hectare—163 Palms per Hectare. Copra yields Adjusted by Covariance Analysis

Treatment Annual per palm		*Kg Copra/ Hectare*	%	*Difference Kg Copra/ Hectare*
N_0	(0.000 Kg Ammonium sulphate)	1,443	100.0	—
N_1	(1.103 Kg ,, ,,)	1,474	102.0	31
N_2	(2.206 Kg ,, ,,)	1,534	106	91
N_3	(3.309 Kg ,, ,,)	1,461	101	18
P_0	(0.000 Kg Saphos phosphate)	1,161	100.0	—
P_1	(0.826 Kg ,, ,,)	1,484	128	323*
P_2	(1.652 Kg ,, ,,)	1,424	123	263*
P_3	(2.478 Kg ,, ,,)	1,843	159	682‡
K_0	(0.000 Kg Muriate of potash)	923	100.0	—
K_1	(0.376 (Kg ,, ,,)	1,427	155	504†
K_2	(0.752 (Kg ,, ,,)	1,732	188	809‡
K_3	(1.128 (Kg ,, ,,)	1,830	198	907‡

Significant difference P 0.05 = 204.6 Kg/*Hectare*
**significant at P* 0.05.
†*significant at P* 0.01.
‡*significant at P* 0.001.

2. 3×3×3 NPK Experiment on Young Palms-Rathmalagara Estate (Commenced December 1948)

The annual manuring was done in November 1973. Phosphorus and Potassium gave significant responses, the former at 0.1% level and the latter at 5% level.

Table A 2 gives the main effects for the year 1973.

TABLE A 2.—Yield Data for 1973—Kg Copra per Hectare. 136 Palms per Hectare

Treatment (annual) per palm		*Kg Copra/Ha*	%	*Difference Kg Copra/Ha*	*Out turn nuts/metric ton*
N_0	(0.681 Kg Ammonium sulphate)	1,678	100.0	—	4,742
N_1	(1.362 Kg ,, ,,)	1,792	106.8	114	4,830
N_2	(2.043 Kg ,, ,,)	1,724	102.8	46	5,055
P_0	(0.454 Kg Saphos phosphate)	1,465	100.0	—	4,760
P_1	(0.908 Kg ,, ,,)	1,861	127.0	396†	4,841
P_2	(1.362 Kg ,, ,,)	1,869	127.6	404†	5,003
K_0	(0.681 Kg Muriate of potash)	1,625	100.0	—	4,995
K_1	(1.362 Kg ,, ,,)	1,756	108.0	131	4,819
K_2	(2.043 Kg ,, ,,)	1,814	111.6	189*	4,826

Significant difference at P 0.05 = 179.1 *Kg/Ha*
**significant at P* 0.05. †*significant at P* 0.01.

3. 4 × 4 × 4 NPK Experiment on Young Palms-Pothukulama Research Station (Commenced December 1960)

The annual manuring was done in December 1973.

The Yield data for the year show a significant-response to phosphorus (0.1%) and Potassium (5%).

The main effects are shown in Table A 3.

TABLE A 3.—Yield Data for 1973. Kg. Copra/Hectare. 178 Palms per Hectare

	Treatment (annual) per palm	*Kg Copra/Ha*	%	*Difference Kg Copra/Ha*	*Out turn nuts per metric ton*
N_0	(0.000 Kg Ammonium sulphate) ..	1,936	100.0	—	4,541
N_1	(1.103 Kg ,, ,,) ..	2,327	120.2	391	4,592
N_2	(2.206 Kg ,, ,,) ..	2,112	109.1	176	4,678
N_3	(3.309 Kg ,, ,,) ..	2,014	104.0	78	4,746
P_0	(0.000 Kg Saphos phosphate) ..	1,677	100.0	—	4,649
P_1	(0.826 Kg ,, ,,) ..	2,106	120.3	339	4,704
P_2	(1.652 Kg ,, ,,) ..	2,273	135.6	596	4,604
P_3	(2.478 Kg ,, ,,) ..	2,424	144.6	747	4,610
K_0	(0.000 Kg Muriate of potash) ..	1,825	100.0	—	4,706
K_1	(0.454 Kg ,, ,,) ..	2,050	112.4	225	4,729
K_2	(0.908 Kg ,, ,,) ..	2,206	120.9	381	4,613
K_3	(1.362 Kg ,, ,,) ..	2,309	126.5	484	4,531

4. Experiment on Quality of Nitrogen and Phosphorus and Frequency of Manuring-Pothukulama Research Station, Pallama. (Commenced June, 1967)

The annual manuring was carried out in August 1973. The biannual application was done in January 1974. Sodium nitrate, being unavailable, the treatment was replaced with ammonium sulphate as in the preceding year.

An outbreak of red weevil was detected in the experimental area in January 1973, affecting about 140 palms. Preventive measures were adopted and the outbreak brought under control.

The yield data for the year 1973 is shown in Table A 4. There were significant responses to nitrogen and NP, NF and NPF interactions. These are shown in Tables A 5, A 6, A 7 and A 8.

TABLE A 4.—Yield Data for 1973–Kg Copra per Hectare–175 Palms/Hectare

Treatment	*Annual Manuring Kg Copra/Ha.*	%	*Difference Kg Copra/Ha*	*Biannual Manuring Kg Copra/Ha*	%	*Difference Kg Copra/Ha*
Control	595	100	—	595	100	—
Ammonium sulphate + Saphos phosphate ..	994	167.1	399	955	160.5	360
Ammonium sulphate + Super phosphate ..	1,829	307.4	1,234†	1,133	190.4	538*
Urea + saphos phosphate ..	901	151.4	306	832	139.8	237
Urea + Super phosphate ..	577	97.0	– 18	1,256	211.1	661*
Sodium nitrate + saphos phosphate ..	835	140.3	240	1,001	168.2	406
Sodium nitrate + super phosphate ..	1,122	188.6	527*	658	110.6	63

**significant difference at P 0.05 = 431.9 Kg/Ha †significant at P 0.01*

TABLE A 5.—N Response–Kg Copra per Hectare

Treatment	*Kg Copra/Ha*
Control	595
Ammonium sulphate ..	1,226
Sodium nitrate	903
Urea	890

TABLE A 6.—NP Interaction–Kg Copra per Hectare

	Saphos phosphate	*Super phosphate*
Ammonium sulphate ..	973	1,478
Sodium nitrate	917	888
Urea	865	915

TABLE A 7.—NF Interaction–Kg Copra per Hectare

	Annual	*Biannual*
Ammonium sulphate ..	1,409	1,042
Sodium nitrate	977	828
Urea	737	1,042

TABLE A 8.—NPF Interaction-Kg Copra per Hectare

	Saphos phosphate		*Super phosphate*	
	Annual	*Biannual*	*Annual*	*Biannual*
Ammonium sulphate ..	995	956	1,831	1,134
Sodium nitrate	836	1,002	1,122	658
Urea	902	832	577	1,258

5. Experiment on Quality of Nitrogen and Frequency of Manuring-Mawatta Estate, Dankotuwa (Commenced December, 1964)

The biannual manuring was carried out in July and December 1973 and the annual manuring in December 1973. Sodium nitrate and ammonium nitrate were not available and the corresponding plots were treated with ammonium sulphate.

TABLE A 5.—Yield Data for 1973—Kg Copra per Hectare. 163 Palms per Hectare. Copra Yield Adjusted by Covariance Analysis

Treatment	*Annual Manuring*		*Biannual Manuring*	
	Kg Copra/Ha	%	*Kg Copra/Ha*	%
Control	795	100	795	100
Ammonium sulphate	869	109	819	103
Urea	848	107	861	108
Ammonium Nitrate (Ammonium sulphate applied from 1972 onwards) ..	855	108	848	107
Sodium Nitrate (Ammonium sulphate applied from 1971 onwards) ..	856	108	894	112

An examination of copra samples for rubberiness showed that the absence of sulphur in the treatments has not affected the quality of the copra.

6. 5×5×5×5 NPK Mg. Experiment on Adult Palms-Monrovia Estate, Rathgama (Commenced November, 1967)

The annual manuring due in October-November 1973, was done in January 1974. As in 1972, the estimated yield data (from the production function) for 1973 show a highly significant response to nitrogen and potassium.

The main effects are shown in Table A 6.

TABLE A 6.—Estimated Yield Data for 1973 Kg Copra/Hectare. 178 Palms per Hectare

Treatment annual (per palm)		*Kg Copra/Ha*	%	*Difference Kg Copra/Ha*
N_0	(0.000 Kg Ammonium sulphate) ..	939	100	—
N_1	(1.103 Kg ,, ,,) ..	1,432	153	493
N_2	(2.206 Kg ,, ,,) ..	1,780	190	841
N_3	(3.309 Kg ,, ,,) ..	1,980	210	1,041
N_4	(4.412 Kg ,, ,,) ..	2,035	217	1,096
P_0	(0.000 Kg Saphos phosphate) ..	1,671	100	—
P_1	(0.826 Kg ,, ,,) ..	1,628	97	-43
P_2	(1.652 Kg ,, ,,) ..	1,609	96	-62
P_3	(2.478 Kg ,, ,,) ..	1,614	97	-57
P_4	(3.304 Kg ,, ,,) ..	1,643	98	-28
K_0	(0.000 Kg Muriate of potash) ..	1,202	100	—
K_1	(0.454 Kg ,, ,,) ..	1,492	124	290
K_2	(0.908 Kg ,, ,,) ..	1,708	142	506
K_3	(1.362 Kg ,, ,,) ..	1,849	154	647
K_4	(1.816 Kg ,, ,,) ..	1,915	159	713
Mg_0	(0.000 Kg kieserite)	1,414	100	—
Mg_1	(0.681 Kg ,,)	1,593	113	179
Mg_2	(1.362 Kg ,,)	1,703	120	289
Mg_3	(2.043 Kg ,,)	1,743	123	329
Mg_4	(2.724 Kg ,,)	1,713	121	299

7. 5 × 5 × 5 NPK Experiment on Adult Palms, Naiwala Estate, Veyangoda (Commenced July, 1967)

Owing to the fact that fertilizers were not available in time, the annual manuring, due in June 1973, was done in August 1973. The soil was moist enough for the application, even though the weather was dry. As in most of the previous years the response to Potassium has been remarkable, the linear response being significant at the 0.1% level.

The estimated yield data (from production function) for the year is given in Table A 7.

TABLE A 7.—Estimated Yield Data for 1973—Kg Copra/Ha
178 Palms per Hectare

Treatment annual (per palm)		*Kg Copra/Ha*	%	*Difference Kg Copra/Ha*
N_0	(0.000 Kg Ammonium sulphate)	1,285	100.0	—
N_1	(1.103 Kg ,, ,,) ..	1,205	93.8	-80
N_2	(2.206 Kg ,, ,,) ..	1,159	90.2	-126
N_3	(3.309 Kg ,, ,,) ..	1,148	89.3	-137
N_4	(4.412 Kg ,, ,,) ..	1,169	91.0	-116
P_0	(0·000 Kg Saphos phosphate) ..	1,249	100.0	—
P_1	(0.826 Kg ,, ,,) ..	1,157	92.6	-92
P_2	(1.652 Kg ,, ,,) ..	1,128	90.3	-121
P_3	(2.478 Kg ,, ,,) ..	1,165	93.2	-84
P_4	(3.304 Kg ,, ,,) ..	1,269	101.6	20
K_0	(0·000 Kg Muriate of potash) ..	843	100.0	—
K_1	(0.454 Kg ,, ,,) ..	858	101.8	15
K_2	(0.908 Kg ,, ,,) ..	1,034	122.6	191
K_3	(1.362 Kg ,, ,,) ..	1,369	162.4	526
K_4	(1.816 Kg ,, ,,) ..	1,863	221.0	1,020

8. 5×5×5×5 NPKMg. Experiment on Adult Palms—Marandawila Estate, Bingiriya (Commenced November, 1967)

The annual manuring was carried out in November, 1973.

9. 5×5×5 BZnS Experiment on Adult Palms—Monrovia Estate, Rathgama (Commenced June, 1969)

Owing to the unavailability of fertilizer in time, the annual manuring which was due in June 1973, was done in November 1973. As in the previous three years, zinc fertilizer was omitted as it was not available.

10. Magnesium Experiment on Young Palms—Bandirippuwa Estate, Lunuwila (Commenced October, 1972).

The first basal fertilizer dressing with the C.R.I., Young Palm Mixture was given in August, 1973. Each seedling received ½ lb. of this fertilizer.

The first differential treatment with Epsom salt was given in November, 1973. The first level dosage was 4 oz. and the second level dosage 8 oz., of Epsom salt per seedling.

11. Fertilizer Experiment on Young Hybrid Palms—Bandirippuwa Estate (Commenced December, 1973)

A new experiment was commenced to determine the growth and yield response curves of Young Hybrid Palms (second plantation) to the application of an inorganic fertilizer mixture and for assessing the optimum level of fertilizer.

The experimental design consists of a randomised block layout with 4 levels of fertilizer and 5 replicates. The experimental area was divided into 5 blocks with 4 plots each, with 12 effective seedlings per plot.

The planting material comprised (Dwarf × Tall) seedlings (from large and small sized nuts). The first two Blocks were planted with seedlings from small nuts and the last three Blocks with seedlings derived from large sized nuts. The seedlings were planted in December, 1973.

Three soil categories were identified in the experimental area:—

(*a*) *Soils of Category* 1. (Covering approximately 10% of the area), well drained and yellowish brown in the surface horizons passing into brownish yellow at depth. The surface texture of loamy sand, grades into sandy loams and sandy clay loams at depth.

(*b*) *Soils of Category* II. (Covering approximately 60% of the area)—Imperfectly drained and pale brown in surface horizons, grading into very pale brown at depths. The texture ranging from loamy sands at the surface to sandy loams at depths.

(*c*) *Soils of Category* III. (Covering approximately 30% of the area)—Poorly drained and light grey loamy sand in texture. The soils belong to the Sudu series.

12. Experiment on Effect of Micronutrients on Germination of Coconut—Bandirippuwa Estate (Commenced March, 1973)

The object of this experiment is to determine whether a supplementary source of micronutrients injected into the husks of seednuts would (i) increase the rate of germination and (ii) promote better initial growth of seedlings.

240 seednuts of uniform maturity, size and weight were chosen and divided into 8 groups, of 30 seednuts each. Each group received one of the following treatments on 8th March 1973.

+Fe	—	100 mg of Fe per nut
+Mn	—	45 mg of Mn per nut
+Cu	—	25 mg of Cu per nut
+Zn	—	45 mg of Zn per nut
+B	—	0.5 mg of B per nut
+Mo	—	0.1 mg of Mo per nut
+All	—	a solution containing all the above nutrients in the same amounts
-All	—	Control.

The seednuts were then laid out in contiguous beds and watered according to needs. The dates of sprouting were recorded, and in mid September, before concluding the experiment height measurements and leaf counts were taken.

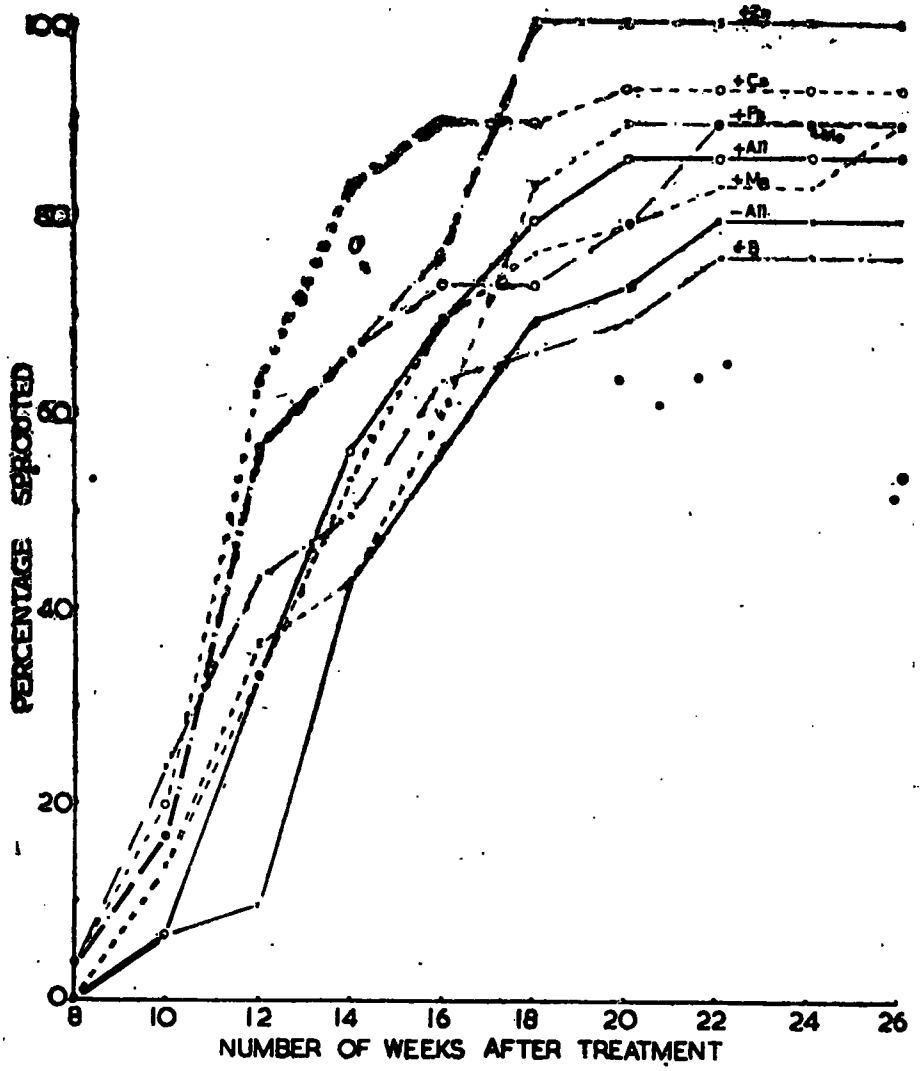


Figure 1.

Data presented in Fig. I show how the treatments affected rates of germination. Cu and Zn treatments consistently gave higher percentages of sprouting, while boron treatments progressively reduced the sprouting rate. The significance to these observations will be discussed in a separate report.

B. POT EXPERIMENTS—BANDIRIPPUWA ESTATE

1. Experiment to Study the Effect of Micronutrient Deficiencies on the Uptake and Distribution of All Nutrients (Commenced August, 1972)

The contents of seednuts removed during amputation stage (November–December 1972) were weighed and analysed for Fe, Mn, Cu and Zn.

Height measurements and leaf counts were taken of all plants at regular intervals. The plants were finally uprooted in December, 1973 and sampled for chemical investigations. A detail report on this study will be presented on completion of the chemical study.

During the course of the experiment the following deficiency symptoms were recorded:—

(i) Iron deficiency was associated with yellowing of leaves, which has a darker shade than that for magnesium deficiency. Thin strips of tissue corresponding to the main veins in the leaf blades, and the strips of tissue on either side of the midrib retained the green colour.

(ii) Yellowing of leaves of an insignificant nature occurred intermittently in plants receiving no manganese.

(iii) Copper deficiency was marked by the less pronounced growth of seedlings and the early separation of leaflets in the young leaves.

(iv) Visual symptoms of zinc deficiency were not observed at any stage of the experiment.

(v) Boron deficiency produced plants with stunted growth and rosette-like foliage. The plants distinctly had a darker shade of green than the "Plus all" plants.

The absence of visual symptoms of deficiencies in plants starved of Mn and Zn is probably due to circulation of these nutrients absorbed before amputation of the seednuts.

2. Experiment on the Comparison of Eppawala Phosphate Fertilizer with Saphos Phosphate Fertilizer.

Hitherto the source of phosphorus has been saphos phosphate, imported from overseas. The discovery of an apatite deposit at Eppawela necessitated the study of this source to assess its relative suitability. Consequently a pot experiment was conducted to compare the two sources of phosphorus.

The two sources were tested at 4 levels (0, 1, 2 and 3 g per pot, containing 2,000 g soil), each treatment being replicated 4 times. The experimental layout consisted of a randomized block and the test plant was *Paspalum Commersonii*.

At the first harvest, taken after 55 days, no significant difference between the two sources was evident .The responses to the different levels were significant. At the second harvest, taken after 93 days, saphos phosphate was found to be superior to Eppawela phosphate. Again the responses to the different levels were significant. The maximum yield was obtained with saphos phosphate at 1.98 g of fertilizer per pot, whereas the same yield was obtained with 2.83 g of Eppawela phosphate per pot.

The analysis of the soil and leaf samples is in progress to compare the phosphorus availability and uptake respectively.

C. LABORATORY INVESTIGATIONS

1. Studies on the Sulphur Nutrition of Coconut

Preliminary studies on the sulphur nutrition of coconut were commenced. Materials for this study were drawn from the BZnS experiment at Monrovia Estate, Rathgama. Investigations to establish a sampling technique for leaf materials, showed that the 6th leaf from the top was

the most sensitive to sulphur treatments. The sulphur content in the 6th leaf was shown to be negatively correlated with treatment. However, the positive correlation of the quadratic effect indicated that the response curve for leaf sulphur content could in fact take a concave form.

Although sulphur shows a tendency to increase the over all yield of copra, it apparently reduces the weight of kernel per nut. In otherwords, sulphur appears to produce more nuts of a smaller size. A paper of this study was presented to the Ceylon Association for the Advancement of Science, Section B, at its Annual Session in December, 1973.

2. Chemical Analysis of Soil Samples from The Soil Chemistry Division's Field Experiments

Estimations of cation exchange capacity, base saturation, exchange acidity, exchangeable calcium, exchangeable magnesium, exchangeable potassium, organic carbon, total nitrogen, and pH of soils from the Naiwala, Monrovia and Marandawila experiments are in progress.

D. SOIL SURVEY

Soil survey of the following were carried out during 1973.

1. Negombo 1" topographical sheet. (Detailed reconnaissance level).
2. Wariyapola 1" topographical sheet. (Detailed reconnaissance level).
3. Abandoned farms from Alutarama to Hemberawa (Detailed reconnaissance level)
4. Soil Chemistry Division's Experimental Blocks (Detailed level).
   (*a*) KPC Experiment (Concluded in 1972) at Rathmalagara Estate.
   (*b*) NPK Experiment at Rathmalagara Estate.
   (*c*) Quality of Nitrogen and Frequency of Manuring Experiment at Mawatte Estate.
5. Isolated Seed Garden Extension, Ambakelle (Detailed).
6. Miscellaneous Soil Surveys for Intercropping, Cultivation of Hybrid coconut and Crop Diversification.

1. Negombo 1" Topographical Sheet

A detailed reconnaissance soil survey of Negombo 1" sheet was commenced in May 1973 in collaboration with the Land Use Division of the Irrigation Department Field work of this survey was completed and the analysis of soil samples is being carried out now.

Provisionally 16 soil series were identified under 5 origin Classes.

(*a*) Soils of the Mantled Plain—
Boralu, Gampaha, and Pallama Series

(*b*) Soils of the Coastal Plain—
Mampitiya, Ratupasa, Katunayaka, Ekala, Sudu, Negombo and Weliketiya series.

(*c*) Soils of the Flood Plain—
Metikotuwa, Halpe and Toppuwa series

(*d*) Soils of the Lagoon Deposits—
Puttalama and Wagura series

(*e*) Anthropic soils
Tudella series.

A provisional soil map of this 1" sheet and a legend were also prepared. A final and complete map and a report on soils and their management will be published when the analysis of soil samples is completed.

2. Wariyapola 1" Topographical Sheet Physiography

The region is geologically complex and this feature is reflected in the land forms identified.

The region is divided into the following categories.

(i) Mantled Plain Khondalite (undulating and level)

(ii) Mantled Plain Vijayan (undulating and level)

(iii) Plains associated with older and younger alluvium (level).

Category (i) has generally a comparatively stronger relief. The slope gradients range from 0 to about 8%.

In category (ii), especially north of Deduru Oya, the landform exhibits more subdued relief than in category (i). The slope gradients range from 0 to 6%.

The mantled plain associated with category (iii) is level.

Geology

The rocks of the area, especially in the southern section of the 1" sheet category (i), belong to the Highland Series consisting mostly of charnokites, structurally controlling the landform.

The rocks underlying the Mantled Plain Vijayan are mostly granites, hornblende gneiss, biotite gneiss and hornblende biotite gneiss. Large areas of the sheet are occupied by undifferentiated meta sediments especially in the geological transition zone.

Climate

The climate of the region north of the Deduruoya belongs to the Dry zone, whilst the areas south of the river belong to the Semi Dry Intermediate Zone.

Soils

Major process of soil formation in the area is *in situ* weathering of parent rocks. In some regions of the sheet the horizons are poly-genetic perhaps due to colluviation.

Soils have also developed in recent and older flood plains of different drainage systems.

The following soil series were identified:—

(*a*) Soils derived from charnokite and rocks of the geological transition zone.

(i) Maho Series*
Moderately deep, moderately well drained, yellowish brown sandy clay loams with abundant manganese concretions.

(ii) Wariyapola Series*
Deep, imperfectly drained, yellowish brown to white sandy loams to sandy clay loams derived probably from colluvial sediments.

(iii) Malangane Series.
Deep well to poorly drained, white loamy sands, derived from recent alluvial sediments.

(iv) Kobeigana Series*
Deep, well drained, red to yellowish red, sandy loams to sandy clay loams with angular quartz derived from undifferentiated crystalline rocks, such as quartz feldspar gneisses.

*The Maho and Wariyapola Series are included in one mapping unit in the attached soil map. The term Maho Series is retained from the Canadian nomenclature though not typical of the Maho area.

(v) Muanwella Series.
Deep, imperfectly drained, brownish yellow, sandy clay loams. This series is a drainage associate of the Kobeigana Series.

(vi) Mudanapola Series.
Moderately deep, well to imperfectly drained yellowish brown, sandy clay loams with quartz gravel.

(*b*) Soils derived from the rocks of the Vijayan Series and undifferentiated crystalline rocks of the geological transition zone.

(i) Waduressagama Series.
Deep, well drained, yellowish red, sandy clay loams with 25 to 75% quartz and manganese gravels.

(ii) Dalukgolla Series.
Moderately deep, well drained, red yellowish brown to brown sandy clay loams with a stone line of manganese and quartz gravel.

(iii) Balala Series.
Moderately deep, poorly drained, pale brown to brownish grey, sandy clay loams to sandy clay.

(iv) Andigama Series Association.
A number of profiles were observed with a lateritic C horizon and lateritic gravels in the upper parts of the profile. Due to minor variations in the profiles the soils are mapped as an association. They are deep, well drained, greyish brown to brown (grading to red to yellowish red at depth) sandy clay loam to sandy clay with ironstone gravel and grading to a lateritic C horizon.

(v) Adipola Series.
Moderately deep, poorly, drained, dark brown to yellowish brown, sandy loams to sandy clay loams with gravel at depth.

(vi) Madampe Series.
Deep, imperfectly drained, greyish brown to yellowish brown, sandy loams to sandy clay loams with gravel at depth.

(vii) Andigedera Series.
Shallow to moderately deep, greyish brown to yellowish brown, loamy sands to sandy loams deposited on gravels resting on probably an Andigama type basement.

3. Isolated Seed Garden Extension, Ambakelle (Eastern and Northern Jungle Areas).

Detailed soil survey of the area in the southern jungle barrier was completed in 1972. In 1973 the eastern and northern jungle areas were surveyed.

Physiography

The landform is a Coastal Sand Plain and the area surveyed is gently sloping with a regional slope of 2 to 3% towards the flood plain of the Rathambala Oya in the north.

Soils

Soils in this area are developed from transported materials on an older lateritic land surface.

The soils on the upper slopes and summits of the low ridges consist of loamy sands passing into sandy loams and sandy clay loams at depth. The soils are imperfectly drained, and the profile resembles the Madampe Series.

On the lower slopes and depressions the soils consist of loamy sands and are poorly drained. These soils resemble the Sudu Series.

4. Detailed Soil Survey of abandoned Farms from Aluterama to Hemberawa in the Mahiyangana Area.

Physiography and Geology

The landform is an undulating mantled plain with a regional slope of 2 to 3% dipping towards the Mahaweli Ganga. The rocks of the area belong to the Highland Series.

Soils

Six categories of soils were observed in relation to physiography and parent materials. In these categories only the soils of the summit phase of the Mahaweli Western slope, consisting of deep, well drained, yellowish red sandy clay loams were suitable for coconut cultivation.

5. Detailed Soil Surveys of Soil Chemistry Division Experimental Blocks.

(i) 3 × 3 × 3 NPK experiment on young palms—Rathmalagara Estate, Madampe. Two soil types were identified.

(ii) KPC experiment—Rathmalagara Estate, Madampe. Two soil types were identified.

(iii) Nitrogen quality experiment—Mawatte Estate, Dankotuwa. Only one soil type was identified.

6. Miscellaneous Surveys were carried out for Intercropping, Cultivation of Coconut Hybrid and Crop Diversification

D. MISCELLANEOUS

(i) The following papers were published during the year.

(*a*) Balasubramaniam, K., T. M. S. Atukorala, S. Wijesundera, A. A. Hoover and M. A. T. de Silva, 1973. Biochemical changes during germination of the Coconut (Cocos nucifera) Ann. Bot. **37** : 439-45.

(*b*) De Silva, M. A. T. 1973. Fertilizer experiments and coconut yields. Ceylon Coconut Planters' Review **7** : 1.

(*c*) De Silva, M. A. T., G. M. Anthonypillai and D. T. Mathes. Preliminary Investigations on the sulphur nutrition of coconut. Paper presented at the Annual Session of the Ceylon Association for the Advancement of Science (1973).

(ii) Mr. A. S. Amerasinghe addressed farmers, agricultural teachers and students of Chilaw district on "Soil Conservation" at a seminar organised by the Lunuwila Maha Vidyalaya.

E. PERSONNEL

The following appointments were made during the year.

Dr. P. Loganathan, Soil Chemist,
8th August, 1973.

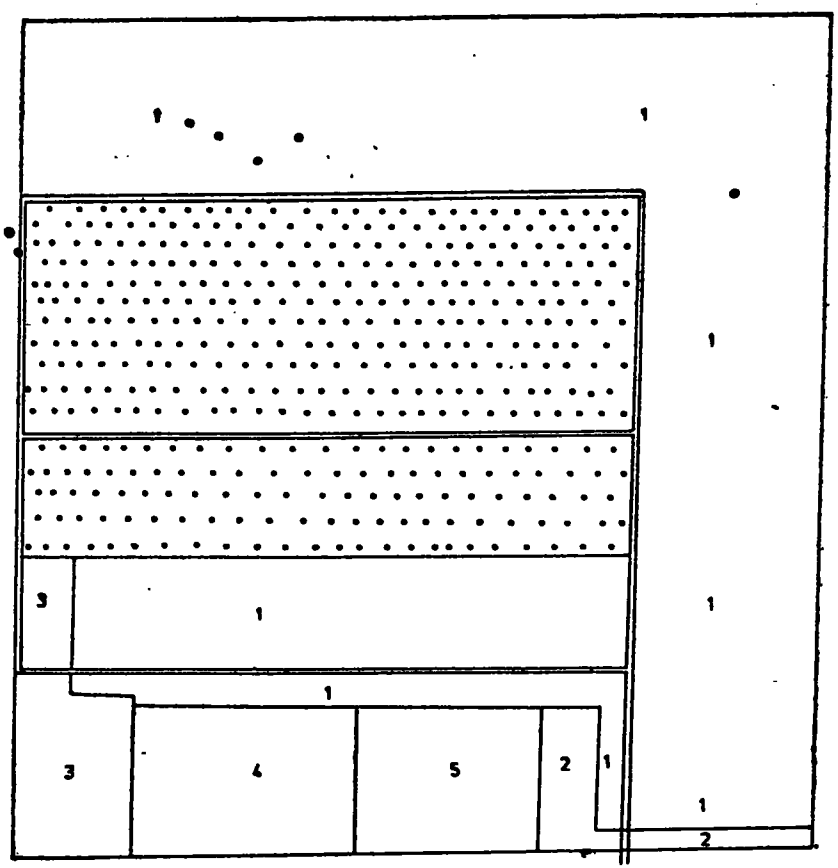
Mr. T. S. Balakrishnamurti, Research Officer,
1st May, 1972.

From January to May 1973, Mr. A. S. Amerasinghe, Research Assistant, underwent training in Geology and Techniques of Soil Survey at the Geological Survey Department and the Land Use Division of Irrigation Department, Colombo.

From October, 1973 to January, 1974, Mr. D. S. Wijetunga underwent training in cartographic techniques of soil survey at the Land Use Division of the Irrigation Department, Colombo.

P. LOGANATHAN
Soil Chemist.

INTERPRETIVE SOIL MAP OF PROPOSED NEW ISOLATED SEED GARDEN PROJECT, AMBAKELLE.



N

Scale: 16 Chains To 1 Inch.

REFERENCE.

Old Plantation.

Road

Boundaries Separating Land Capability For Coconut Cultivation.

LEGEND

MADAMPE & SUDU SERIES.

1 — Imperfectly To Poorly Drained. Suitable for Coconut Cultivation.

2 — Eroded Phase of Madampe Series. Not Suitable for Coconut Cultivation.

ANDIGAMA SERIES & EROSIONAL PHASES

3 — Strongly Eroded. Not Suitable for Coconut Cultivation

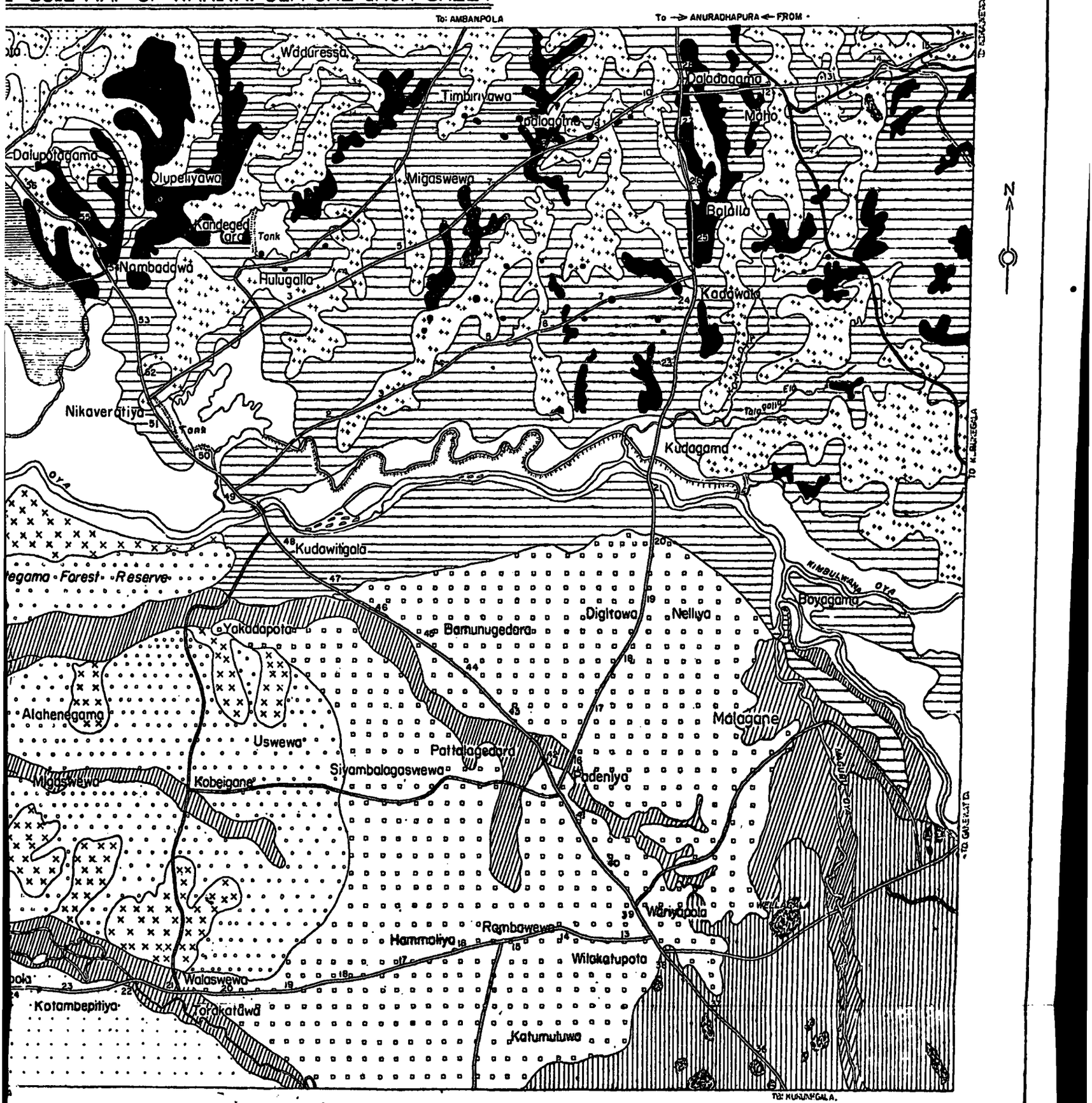
4 — Moderately Eroded. Not Suitable for Coconut Cultivation.

5 — Slightly Eroded. Not Suitable for Coconut Cultivation.

Cartography: D.S.Wijayatunge.

Mapped: PERERA.K.S.D 1973.
Assisted By E.N.Fernando,
D.S.Wijayatunge. P.J.E.Fernando.

SOIL MAP OF WARIYAPOLA ONE INCH SHEET



REFERENCE

- Dalukgolla Series.
- Balalla Series.
- Maho-Wariyapola Complex
- Mudannapola Series.
- Flood Plain.

- SOIL BOUNDARY.
- PRINCIPAL ROAD.
- RAILWAYS.
- RIVER.
- TANK.
- ROCK.

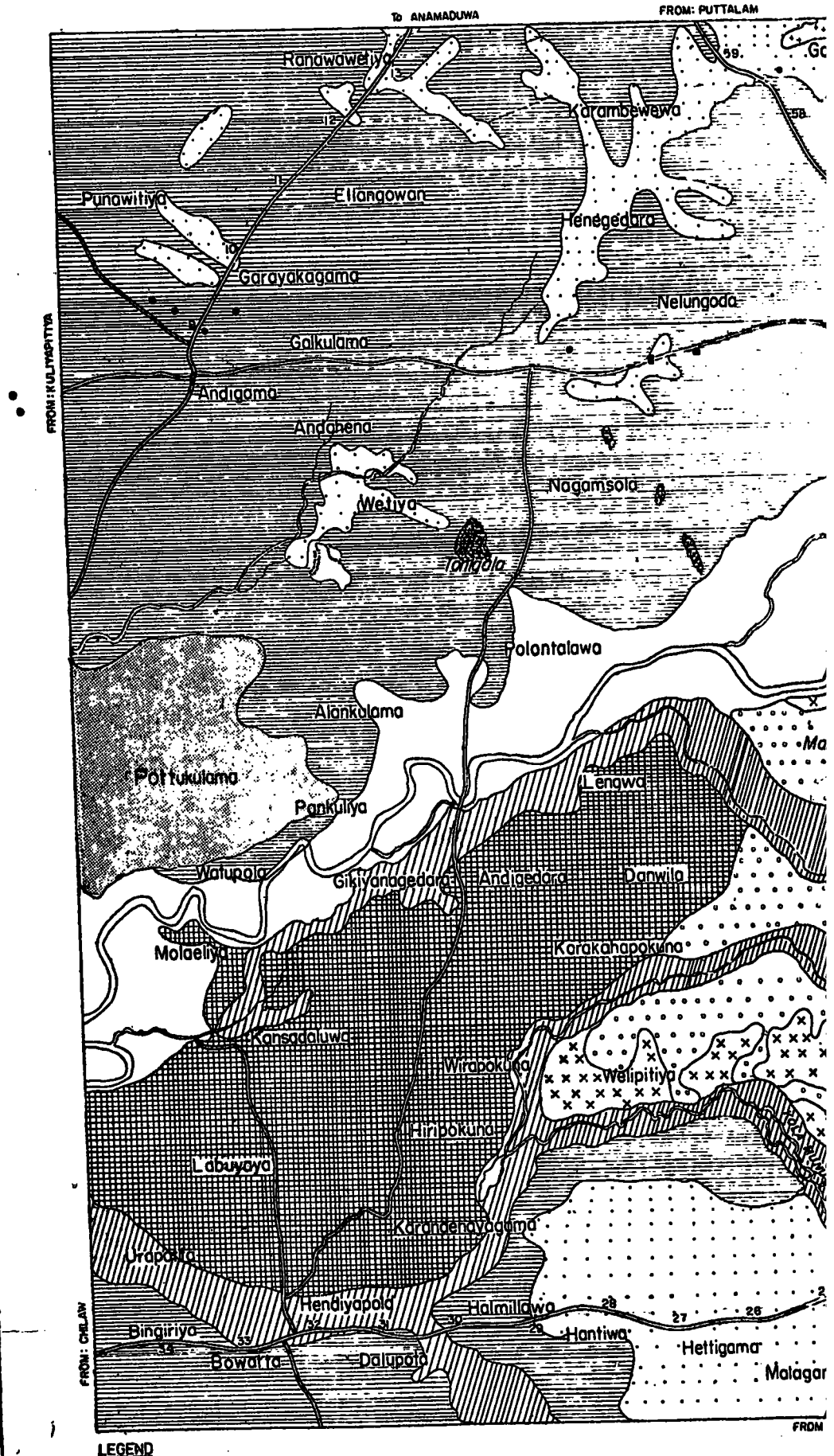
SCALE.

2 Miles to One Inch.

MILES 0 2 4 8

MAPPED BY - Perera K.S.O. 1973.
ASSISTED BY - E.N. Fernando.
D.S. Wijayatunga.
P.J.E. Fernando.

PROVISIONA


To ANAMADUWA
FROM: PUTTALAM
FROM: KULIYAPITIYA
FROM: CHILAW
Ranawaweliya
Karambewewa
Punawitiya
Ellangowan
Henegedara
Garayakagama
Nelungoda
Galkulama
Andigama
Andahena
Wetiya
Nagamsola
Tonigala
Polontalawa
Alankulama
Pottukulama
Lenawa
Pankuliya
Watupola
Gikiyanagedara
Andigedara
Danwila
Molaeliya
Karakahapokuna
Kansadaluwa
Wirapokuna
Welipitiya
Hiripokuna
Labuyaya
Karandenayagama
Urapola
Hendiyapola
Halmillawa
Bingiriya
Bowarra
Dalupola
Hantiwa
Hettigama
Malagar
LEGEND
Malagane Series.
Andigedara Series.
Kobeigane Series.
Muwanwela Series.
Madampe Series.
Andigama Compl
Addippola Series
Waduressagama
CARTOGRAPHY BY - D.S Wijayatunge.

Ceylon Cocon. Q. (1973) 25, 63-70.
Printed in Sri Lanka.

REPORT OF THE AGROSTOLOGY DIVISION (1973)

The work of the Agrostology Division embodies the following fields:—(1) Soil Nutrient Studies, (2) Pasture Management (3) Intercropping and (4) Animal Husbandry.

The activities of the Division were focussed mainly on work pertaining to Pasture Management, Intercropping and Animal Husbandry.

1. SOIL NUTRIENT STUDIES

No work was initiated or undertaken in this field due to lack of staff and exigencies of work in the other fields of study.

2. PASTURE MANAGEMENT

Experiment P_5 (R/E).

Levels of manuring and grazing on a Brachiaria miliiformis cum Cocos nucifera association

This experiment was managed to schedule during the year and the data relating to yield of nuts and herbage are presented in Table I.

TABLE I

Yield of *Brachiaria miliiformis* and *Cocos nucifera* at different levels of grazing and manuring.

Treatments			*Herbage yield Gms/M²*	*Nut yield No. of Nuts/Hectare*
Estate Control (weeds)	FN GO	..	401	8,434
Brachiaria miliiformis	FN GO	..	641	3,430
,, ,,	FN GN	..	1,184	6,787
,, ,,	FN GH	..	776	5,683
,, ,,	FH GN	..	1,123	7,370
,, ,,	FH GH	..	557	8,688

F = *Fertilizer* N = *Normal* G = *Grazing*
O = *Nil* H = *Heavy*

Experiment P_{21} R/E

Levels of fertilizer on a coconut cum pasture association

This experiment is in its third year after the *Brachiaria brizantha* was replaced by *Brachiaria miliiformis*.

It is a 2^3 factorial of levels of N, P and K to study the competition between *Cocos nucifera* and *Brachiaria miliiformis*.

The pasture yield and nut yield data are presented in Table II.

TABLE II

Yield of herbage and nuts due to levels of N, P and K applied broadcast to a coconut cum B. miliiformis association

Treatments	*Herbage yields Gms/M²*	*Nut yield No. of Nuts/Ha.*
N_2 P_1 K_1	1,184	6,787
N_2 P_1 K_2	1,161	11,518
N_4 P_1 K_1	1,321	8,150
N_4 P_1 K_2	1,060	8,282
N_2 P_2 K_1	1,148	8,498
N_2 P_2 K_2	1,188	8,415
N_4 P_2 K_1	1,051	6,938
N_4 P_2 K_2	1,123	7,370

Experiment P_{22}/R/E

Levels of fertilizer × Pasture Management on the yield of coconut and pasture

This is a 4× 2× 3 factorial experiment of four levels of a mixture of N, P and K ($\frac{1}{2}$ normal, normal, twice normal, and four times normal) and two types of pasture management (grazing and mowing) with each of the treatments replicated three times.

The experiment is in its third year after the replacement of *Brachiaria brizantha* with *Brachiaria miliiformis*.

During the year the experiment was not sampled due to the unavailability of a mower.

Experiment P 70/R/E

The effect of frequency of defoliation and levels of nitrogen applied in two forms as Sulphate of Ammonia and Urea on the herbage dry matter yield and the crude protein content of Brachiaria miliiformis.

This is a 3 × 3 × 2 × 3 factorial experiment of three frequencies of cutting (2, 4 and 6 weeks) with three levels of nitrogen (0, 1 and 2 cwts. per acre) applied in two forms $(NH_4)_2SO_4$ and $CO(NH_2)_2$ with each of the treatments being replicated thrice. Two cycles of defoliation were completed during the year.

The dry matter yields of one cycle are presented in Table III whilst the figures for the other cycle had to be discarded as a set of samples were charred while drying in the dehydrator.

TABLE III

Herbage Dry Matter yield in Gms/M² at different frequencies of cutting levels of nitrogen and forms of nitrogen

Treatments			$(NH_4)_2SO_4$	$CO(NH_2)_2$	*Total*
N_0	..	..	484	388	872
N_1	..	..	597	340	937
N_2	..	..	625	318	943
2 Weeks Total	..	..	1,706	1,046	2,752
N_0	..	..	285	185	470
N_1	..	..	495	275	770
N_2	..	..	600	282	882
4 Weeks Total	..	..	1,380	742	2,122
N_0	..	..	177	180	357
N_1	..	..	470	262	732
N_2	..	..	361	328	689
6 Weeks Total	..	..	1,008	770	1,778
Grand Total	..	..	4,094	2,558	6,652

The trend in the herbage yield is similar to that reported last year.

Experiment P 88/BE

This is an experiment to compare the productivity of three fodder species at high levels of N fertilization under coconut. The fodders are Pusa Giant, Guinea B and *Setaria sphacelata.*

The herbage dry matter yield of the first, second, and the total of the two are presented in Tables IV, V & VI respectively.

TABLE IV

Herbage dry matter yield in Kg./ha. (Av./Replicate) of the first sampling

Treatments			*Pusa Giant*	*Guinea B*	*Setaria sphacelata*	*Total*
N_0	..	..	8,750	6,547	7,293	22,590
N_1	..	..	12,781	6,575	8,818	28,174
N_2	..	..	13,620	18,958	9,496	42,074
N_3	..	..	12,160	19,084	8,961	40,205
Total	..	..	47,311	51,164	34,568	133,043

TABLE V

Herbage dry matter yield Kg./ha (Av./Replicate) of the second sampling

Treatments	*Pusa Giant*	*Guinea B*	*Setaria sphacelata*	*Total*
N_0	14,888	8,272	9,126	32,286
N_1	15,074	18,548	15,352	48,974
N_2	19,714	14,620	21,879	56,213
N_3	17,125	21,907	28,136	67,168
Total	66,801	63,347	74,493	204,641

TABLE VI

Total Herbage dry matter yield of the First and Second samplings in Kg./ha. (Average/Replicate)

Treatment	*Pusa Giant*	*Guinea B*	*Setaria sphacelata*	*Total*
N_0	23,638	14,819	16,419	54,876
N_1	27,851	25,113	24,150	77,114
N_2	33,340	33,578	31,375	98,293
N_3	29,285	40,991	37,097	107,373
Total	114,114	114,501	109,041	337,656

Experiment P 89/BE

This is an experiment to study the effects of different levels of Nitrogen fertilization and different frequencies and heights of defoliation on the fodder Pusa Giant Napier, under coconut.

It is a 4 × 2 × 2 × 2 factorial split plot design of four levels of nitrogen. (N_0, N_1 = 150 lbs. N/Ac./yr., N_2 = 300 lbs. N/Ac./yr. N_3 = 450 lbs. N/Ac./yr.) and two frequencies of defoliation (30 days and 60 days intervals) at two intensities of defoliation from ground level (6" and 12") with each of the treatments being replicated twice.

The experiment was planted during yala this year and was cut to a uniform height after the establishment of the fodder.

A cycle of defoliation had not been completed at the end of the year.

Experiment P 90/BE

This is an experiment to study the performance of three pasture species at different levels of Nitrogen fertilization and the effect of these pasture species on the main crop *Cocos nucifera*.

It is a $3 \times 4 \times 3$ factorial split plot design experiment of three pasture species (*Brachiaria miliiformis*, *Brachiaria ruziziensis* and *Digitaria decumbens*) at four levels of Nitrogen fertilization. (N_0, N_1 = 100 lbs. N./Ac./yr., N_2 = 200 lbs. N./Ac./yr., N_3 = 300 lbs. N./Ac./yr.) with each of the treatments being replicated three times.

This experiment was planted during June this year with cuttings of the three pasture varieties.

Owing however, to difficulties in establishing *Brachiaria ruziziensis* and the unavailability of a mower this experiment had not been sampled.

Experiment P 91/RE

This is an experiment set up at Ratmalagara Research Station, Madampe to study the intensities and frequencies of defoliation on three fodder species grown under coconut.

It is a $3 \times 2 \times 2 \times 5$ factorial split plot design of three fodder species (Pusa Giant, Guinea B and *Setaria sphacelata* var. Kazungula) defoliated at two intensities (6" & 12" above ground level) and at two frequencies (30 days and 60 days intervals) with each of the treatments being replicated five times.

This experiment was planted during yala this year and a cycle of defoliation was completed by end of this year.

However, the results of this cycle could not be compiled as a set of samples was lost due to charring whilst drying in the dehydrator.

Experiment P 92

This is an experiment set up at Kirimetiyana Estate, Lunuwila to determine the optimum levels of fertilization of Nitrogen, Phosphorus, and Potassium for the fodder Pusa Giant Napier, and the effect of this fodder fertilized at different levels of N, P and K on the main crop, *Cocos nucifera*.

This is a fully randomized $4 \times 2 \times 2 \times 3$ factorial experiment of four levels of Nitrogen (N_0, N_1 = 100 lbs. N./Ac./yr., N_2 = 200 lbs. N./Ac./yr. and N_3 = 300 lbs. N/Ac./yr.) two levels of phosphorus (P_1 = 100 lbs. P_2O_5/Ac./yr. and P_2 = 200 lbs./P_2O_5/Ac./yr.) and two levels of Potassium (K_1 = 200 lbs. K_2O/Ac./yr. K_2 = 400 lbs. K_2 O/Ac./yr.) with each of the treatments being replicated three times.

The experiment was planted during yala this year and was sampled once. However, the data is not compiled for the same reasons stated for experiment P_{91} above.

Experiment P 85, P 86, and P 87

These are experiments to study the effects of five levels of Nitrogen (applied as Ammonium Sulphate) on the productivity of *Bracharia miliiformis* under coconut at three different rainfall regimes.

These experiments were manured during yala this year.

However no samples were taken later as it was decided to abandon these experiments due to lack of co-operation from the owners of the Estates, at Kobeigana and Baddegama.

3. INTERCROPPING (SUBSIDIARY FOOD CROPS)

Experiment S_1 R/E

This is an observation trial to study the yield components and growth patterns of Soyabean and Green Gram growing under varying degrees of moisture stress, nutrient availability and light intensity within a coconut square.

The experiment was planted during yala this year and data including plant heights node counts, pod counts, seed weights etc. were collected.

The results of the above experiment would be published in due course.

Experiment S_2 B/E

This is an experiment on Casava (*Manihot esculenta*) conducted in collaboration with Dr. H. P. M. Gunasena, of the Faculty of Agriculture, University of Sri Lanka, Peradeniya.

This is to determine the optimum levels of Nitrogen and spacing on the growth and yield of manioc and the effect of this crop on the main crop, *Cocos nucifera*.

It is a $4 \times 3 \times 3$ factorial randomised block design experiment of four levels of spacing ($3' \times 2'$, $3' \times 3'$, $3' \times 4'$ and $3' \times 5'$) and three levels of Nitrogen (40 lbs. N/Ac., 60 lbs. N/Ac., 80 lbs. N/Ac.) with each of the treatments being replicated three times.

The experiment was planted during yala this year and as at the end of the year seven samples had been taken commencing from two months after planting. The first three samples were taken at fortnightly intervals while the other four samplings were done at monthly intervals.

Observations such as the number of stems per hill, height of stems, commencement of swelling of roots, leaf area index (using disc method) fresh and dry weight of roots, shoots, and starch of tubers were made.

The experiment is in progress.

However, for the purpose of this report the fresh weights of roots of the seven samplings are presented in Table VII.

There appear to be differences in yields (at all levels of spacing) due to the lower level of nitrogen application (N_1), and to higher levels of Nitrogen fertilization (N_2 and N_3).

There appears to be no appreciable difference between the two higher levels of nitrogen application. However, the yield at the second level of Nitrogen (N_2) application is higher than the third level (N_3) of Nitrogen fertilization. The second (S_2) and third (S_3) levels of spacing have yielded more than the first (S_1) and the fourth (S_4) levels of spacing.

In general a progressive increase in yield of fresh root weight is observed.

Experiment S_3 R/E

This is an experiment to investigate the effects of Nitrogen fertilization and planting density on the growth pattern and yield of the Soyabean variety Bragg grown under a mature stand of *Cocos nucifera*.

It is a 5 × 4 × 3 factorial split plot design experiment of five levels of Nitrogen (N_0, N_1 = 10 lbs., N_2 = 20 lbs., N_3 = 30 lbs., and N_4 = 40 lbs.) and four levels of spacing between rows (S_1 = 15", S_2 = 18", S_3 = 21", S_4 = 24") the nitrogen treatments being in main plots and the spacing in sub plots with each of the treatments being replicated three times.

The experiment was planted during Maha this year; and is in progress. A detailed study of the data collected would appear in a separate publication.

Total fresh weight of the samples that were taken at various times after planting (Weight given in gms.; mts. for months)

		2 *mts.*	2½ *mts.*	3 *mts.*	4 *mts.*	5 *mts.*	6 *mts.*	7 *mts.*	*Total*
S_1	N_1 ..	41	120	1,316	1,750	3,875	9,100	6,600	22,802
	N_2 ..	84	618	1,444	2,775	3,750	7,722	8,650	25,043
	N_3 ..	33	262	986	4,165	3,875	6,588	7,300	23,209
S_1 Total ..		158	1,000	3,746	8,690	11,500	23,410	22,550	71,054
S_2	N_1 ..	86	796	1,112	2,815	5,325	6,804	8,550	25,485
	N_2 ..	99	792	776	2,050	6,075	9,548	6,550	25,890
	N_3 ..	106	830	1,408	2,385	4,400	9,576	14,200	32,905
S_2 Total ..		291	2,418	3,296	7,250	15,800	25,928	29,300	84,283
S_3	N_1 ..	33	271	910	1,850	5,600	9,268	9,725	27,657
	N_2 ..	186	632	2,208	2,725	6,425	8,494	12,030	32,700
	N_3 ..	166	400	914	2,465	4,525	6,008	10,900	25,378
S_3 Total ..		385	1,303	4,032	7,040	16,550	23,770	32,655	85,735
S_4	N_1 ..	60	290	706	1,335	2,650	4,536	4,650	14,227
	N_2 ..	202	552	681	2,325	4,150	4,900	8,800	21,610
	N_3 ..	81	422	982	1,750	4,650	4,564	6,500	18,949
S_4 Total ..		343	1,264	2,369	5,410	11,450	14,000	19,950	54,786
Grand Total ..		1,177	5,985	13,443	28,390	55,300	87,108	104,455	—

Experiment S_4 R/E

This is the International Soyabean varietal Trial done in collaboration with the Department of Agriculture, Sri Lanka organized by the Agronomy Department of the University of Illinois in the United States of America.

This is a randomised block design of twenty varieties of Soyabean (Glycine Max. L.) each variety being replicated four times.

This was planted during early December and is in its initial stages as at the end of the year.

Experiment S_5 R/E

This is an experiment to study the effect of plant density on the growth and yield of Soyabean (Glycine max.) variety Bragg.

It is a 3×3×4 factorial experiment of three levels of spacing in each, between and within rows (Between rows – 18", 24" & 36") (within rows 3", 6" and 9") with each of the treatments being replicated four times.

The experiment was planted during Maha and is in its harvesting stages.

Experiment S_6 R/E

This experiment is similar to the experiment above (S_6) except its location. However it was abandoned due to failure of rains at the Ratmalagara Research Station.

Ramie (*Boehmeria nivea*)

During the year the above crop was established at Bandirippuwa Estate for purposes of propagation in order to lay down experiments on this crop during yala next year.

4. ANIMAL HUSBANDRY

The rotational cross breeding programme suggested by Professor Mahadevan (Dean of the Faculty of Agriculture, University of West Indies) is in the stages of its second generation (F_2).

The F_1 Progeny of (Jersey × Sinhala) has been crossed to the Sindhi and 30 heifer calves and 18 bull calves were born up to the end of the year. During the year the entire herd was immunised against the infectious diseases Haemorrhagic septicaemia, and Foot and Mouth.

The total milk production during the year was 117,963 pints.

There were 139 births and 37 deaths during the year at both the stations (Bandirippuwa and Ratmalagara Estates).

The herd strength as at 31.12.73 is as follows:—

	Bulls	*Cows*	*H.C.*	*B.C.*	*Total*
Bandirippuwa	2	89	172	24	287
Ratmalagara	2	49	21	4	76
Total	4	138	193	28	363

GENERAL ACTIVITIES

During the year the Officer-in-Charge of the Division and the Research Assistants attended the in-service training course on Inter-cropping held at Gannoruwa, and conferences on Rubber, Ramie and Soyabean.

The Technical Assistant of the Division was permitted to follow the Laboratory Technicians' Training Course organised by the Institute of Chemistry and conducted at the Aquinas University College, Colombo.

PERSONNEL

Miss V. Thambiah, B.Sc. (Ceylon), Technical Assistant in the Division left the service of the Institute in February.

Mr V. M. F. Alles, B.Sc. (Agric.) Allahabad, was appointed as Officer-in-Charge of this Division with effect from 15th July 1973.

During the year Mr K. C. Muthuchchamy Field Assistant and Mr D. Amerasinghe, Field Attendant were transferred from Ratmalagara to Bandirippuwa Estate, while Mr A. G. K. Silva Lab./Field Assistant and Mr K. M. Punchi Banda, Field Attendant were transferred from Bandirippuwa Research Station to Ratmalagara Research Station.

Mr Mervyn J. Fernando, Field and Lab. Attendant was transferred from this Division to the Chemistry Division while Messrs T. Keerthiratne and J. M. Abeysena, Lab./Field Attendants were transferred to this Division from Chemistry and Botany Divisions respectively.

M. BASTIAN
for Agrostologist.

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REPORT OF THE CROP PROTECTION DIVISION (1973)

Greater emphasis was laid during the year on studies for the control of the pests *Promecotheca cumingi*, *Nephantis serinopa*, *Aspidiotus destructor* and the disorder, Leaf 'Scorch Decline'. The other pests and diseases of coconut were studied to a lesser extent. With guidance from the F.A.O. Expert, Dr. P. R. Dharmadhikari, attempts were made to control the pests of the Coconut Palm by biological means.

(1) Pests

The Coconut Caterpillar—*Nephantis serinopa* Meyr (Cryptophasidae).

The insectaries at Lunuwila and Mylambavely continued to breed for field release the parasites of the Coconut Caterpillar throughout the year under review. The following parasites were multiplied at the Pest Breeding Station at Mylambavely on the East coast.—*Perisierola nephantidis* M. (Bethylidae), *Spoggosia-bezziana* Bar. (Tachinidae), *Eriborus trochanteratus* (Ichneumonidae) and *Trichogramma braziliensis* (Trichogrammatidae).

In addition to the above, *Brachymeria nephantidis* Gah (Chalcididae), *Trichospilus pupivora* F. (Eulophidae), *Tetrastichus israeli* M & K (Tetrastichidae) and *Elasmus nephantidis* Roh. (Elasmidae) were multiplied in the insectary at Lunuwila. Towards the end of the year large numbers of Coconut Caterpillars were obtained from the PBS, Mylambavely for the multiplication of *Elasmus nephantidis* in the insectary at Lunuwila.

There was an excessive production of males of *Eriborus trochanteratus* in both the laboratories. Although the parasitization of the pupae of *N. serinopa* by the pupal parasites, *T. pupivora* and *T. israeli* in the laboratories was high, only poor recoveries of these parasites were made from the field. The culture of *T. pupivora* was lost during the second quarter of the year due to an unknown disorder of the parasitised pupae in the insectary at Lunuwila. *Microbracon brevicornis* W. was bred and used to paralyse the larvae of *Corcyra cephalonica* after oviposition on the latter by the parasite *S. bezziana*. The new egg parasite *T. braziliensis* was multiplied successfully in the insectaries at Lunuwila and Mylambavely and released in the estates where pest infestations were found. Field recoveries of it were made from two estates in the Eastern Province.

Population counts of the pest and its parasites were made in the laboratories from leaf samples brought from the caterpillar infested areas. As far as possible suitable parasites were released to effect parasitization of the particular stage of the pest found in the field. Most of the parasites were released by the staff of the Crop Protection Division. The rest were sent by post to the pest infested areas for release by the owners of the lands.

TABLE I

Field Releases of the Parasites of the Coconut Caterpillar (*Nephantis serinopa*) for 1973

Name of parasite	*E.P.*	*W.P.*	*S.P.*	*N.W.P.*	*N.P.*	*Total*
P. nephantidis	146,025	57,675	56,650	176,600	1,250	488,200
E. trochanteratus	9,020	4,505	720	7,218	—	21,468
S. bezziana	14,100	2,075	340	1,835	—	18,350
B. nephantidis	—	1,575	520	1,875	—	3,970
T. braziliensis	417,550	40,000	75,200	288,800	—	821,550
T. israeli	—	14,400	—	60,400	—	74,800
T. pupivora	—	—	9,600	28,200	—	37,800
E. nephantidis	—	950	—	105	—	1,055
Total	586,695	121,180	143,030	565,033	1,250	1,417,188

Eastern Province

Caterpillar infestation was found in 17 estates in the Eastern Province. It was possible to bring down the pest population to a sub-economic level in many estates by releasing parasites. However, continuous heavy damage was caused by the pest at Akkaraipattu, Thirukkovil and Pothuwil throughout 1973. Due to lack of proper transport facilities the parasites could not be released regularly in these areas of infestation. In addition, owners of the coconut lands in the Akkaraipattu area continued to light night fires (contrary to our advice) after release of the parasites thereby endangering their survival. In general it was found that the parasites that had been released did not get established well in the field. It would appear that attack by hyperparasites checked the building up of the parasite population in the field to a certain extent. The prolonged spell of drought experienced in the Eastern Province during 1973 was probably another factor that encouraged the continued ravages of the pest in the field.

It is felt that a temperature controlled room at the Parasite Breeding Station at Mylambavely would be a useful facility for the mass breeding of parasites.

Western Province

Nine fresh reports were received from this province. All these infestations were reduced to sub-economic levels by the release of parasites.

North Western Province

Fourteen instances of Caterpillar attack were reported, but they were not heavy. Towards the end of the year moderate infestation persisted only in one estate whilst the others were brought under control.

Coconut Scale.—*Aspidiotus destructor Sign* (*Diaspididae*)

Ten new reports of Coconut Scale infestation were received during the year. The possibilities of effecting their control by biological means were investigated in greater measure than in the past. During the year under review a technique for the mass breeding of *Chilocorus nigritus*, an indigenous predator of coconut scale was evolved. Cultures of the coconut scale were built up in the laboratory at Lunuwila in cages using pumpkin fruits as alternate host material. The

pumpkin fruits with the scales were then inoculated with a few adults of *C. nigritus*. The beetles laid fertile eggs, and the emerged larvae were found to feed vigorously on the scales, becoming gregarious at the time of pupation. The adults which emerged from these pupae were found to be healthy and fertile. The programme of breeding this predator was continued throughout the year 1973, and they have been found to be prolific breeders in the laboratory when supplied with plenty of scales. Those multiplied in the laboratory were released in an estate at Pannala.

Even though this indigenous predator is a prolific breeder and can bring down the scale population to sub-economic levels when present in large numbers in the field, it has been observed under certain conditions that outbreaks of scale could yet cause heavy damage to coconut palms in Sri Lanka. There may be many factors which prevent the building up of the population of this indigenous predator. In one instance parasitized larvae of this predator were observed in an estate in Chilaw District during the year under review, indicating the presence of hyper parasites. It is expected to carry out further studies on this aspect in 1974. Biological control for its greater effectiveness depends to a large extent on the natural agents introduced from other countries in addition to conservation of the native beneficial agents. Imported natural agents also have the great advantage of being usually free from hyperparasites. As it was found possible to breed the Coccinellid beetles (*C. nigritus*) in the laboratoy, it was proposed to import and breed exotic predators which have contributed to the control of the Coconut Scale in other countries.

Arrangements have already been made with Dr. F. J. Simmonds, Director of the Commonwealth Institute of Biological Control, Trinidad to obtain consignments of exotic predatory coccinellid beetles for the control of Coconut Scale. The exotic predators expected are *Cryptognatha nodiceps*, *Azya trinitatis*, *Lindorus lophanthae*, and *Nephus aeneipennis*. Anticipating the arrival of these exotic predators, cultures of Coconut Scale are being maintained on pumpkins in the laboratories at Lunuwila and Colombo.

Parasite of Coconut Scale,

Aphytis sp., Order-*Hymenoptera*, Family–*Aphelinidae*.

This is an active yellow indigenous external parasite of the Coconut Scale. It was found in large numbers in two estates in Kurunegala district where a heavy scale infestation was found. The predator *C. nigritus* was also found in the above estates. Spraying of insecticides was not recommended as these estates were under our observation. Towards the end of the year, it was found that the scale infestation was brought under control by the indigenous predators and parasites. Our attempts to breed *Aphytis sp.* in the laboratory however were not successful.

Chemical Control of Scale.

Wherever Scale infestations were found to be free of predators and parasites spraying with an emulsion of kerosene oil and soap in water was found to give effective control.

(3) *Promecotheca cumingi* Baly (Coleoptera; Hispidae)

All work in connection with the control of this pest was handled by the Biological Control Laboratory. The BCL was taken over by the Coconut Research Board on 4th January 1973 from the leadership of Dr. H. E. Fernando under the Campaign Committee. Mr. P. A. C. R.

Perera was in charge of the BCL in 1973. All the biological control activities were carried out under the supervision of the FAO Expert, Dr. P. R. Dharmadhikari. The BCL continued to function very efficiently throughout the year under review.

The Red Weevil, *Rhynchophorus ferrugineus F.* **(*Curculionidae*)**

Several reports of attack by the red weevil were received during the year 1973. The red weevil trap that was introduced previously was tried out again to test its efficiency in trapping weevils in four estates with the following results.

Location	*No. of traps used*	*No. of Weevils caught*
1	32	1,584 in 12 months
2	8	415 ,,
3	10	189 ,,
4	12	58 in 4 months

***Platymeris laevicollis Dist.* (Reduviidae)—a predator of the Red weevil**

This predator was not bred on a large scale during 1973. However, a laboratory culture of it is being maintained.

Nettle grub., *Parasa lepida Cram.* **(*Limacodidae*)**

There was only one outbreak during the year 1973. It occurred in the Isolated Seed Garden at Ambakelle in Chilaw district. This pest was brought under control by spraying D.D.T.

Xyleborus similis ferr. (Coleoptera; Scolitidae)

No fresh reports of attack by this pest were received during the year under review. Some coconut palms in an estate at Eluthumadduwal (N.P.) died off as a result of attack by this pest. Metasystox was recommended for injection into the bole region of the other affected palms.

Diocalandra frumenti F. (Coleoptera: Curculionidae)

Only one report was received during the year under review. The larvae and adults of this weevil were found in large numbers in the inner tissues of the bole region of the palm. The fronds of the palm showed symptoms of water-deficiency. There was no outbreak of this pest.

Crop losses due to pest damage

Pre-experimental yield records were continued on 282 palms at Bandirippuwa Estate which will be used in a proposed field trial to assess crop losses due to defoliation and insecticidal spraying.

(2) Diseases of Coconut.

Bud Rot

There was no outbreak of this disease. Trials initiated earlier to study the efficacy of placing fungicidal bags in the crowns of palms were continued and it was found that the area treated in this fashion was free of the disease. Similar trials using fungicidal soap cubes were also continued. Here too there was no evidence of disease among the treated palms, whereas in the untreated area one palm was affected by the disease.

Stem bleeding

Five new instances of stem bleeding were reported during the year under review. The disease was controlled using the conventional method.

Leaf Blight

Eleven new reports were received during the year under review but there were no outbreaks of this disease as such. No research was carried out in 1973 on this problem.

(3) Leaf Scorch Decline.

Soil improvement by drainage in affected areas

The field trials which were started earlier were continued during 1973. Observations were recorded throughout the year from the two plots at Kirimetiya estate, Elpitiya and the other two plots located at Râthmehera estate, Gonapinuwela.

Investigations for Mycoplasma like bodies

Prof. Kurt Heinze of Germany had very kindly agreed to examine tissues from Coconut palms showing symptoms of Leaf Scorch Decline in order to determine whether Mycoplasma like bodies are present in the phloem tissue. Samples for this study have already been sent to Prof. Heinze for electron microscopic investigations.

Assessment of the situation in respect of pests and diseases of coconut in Sri Lanka

Two questionnaires pertaining to pests and diseases prevailing in the Coconut estates were prepared and sent to coconut growers in the Island. The response has been fair and it is expected to analyse the information during 1974.

(4) Biological Control of the Weed ***Eupatorium odoratum.*** **(*Podisingho Maran*).**

Work on the biological control of this weed was started in December 1973. *Anmalo insulata* (order. Lepidoptera), a beneficial insect for the control of *E. odoratum* was obtained through the Commonwealth Institute of Biological Control. The leaf eating caterpillars of this insect are expected to control the weed by destroying the green leaves of the plant. The first consignment of about 2,500 larvae and eggs was received on 15th December 1973. A laboratory culture was maintained for breeding and subsequent releases in various parts of the country. The balance was released in the field at three different locations.

(5) Personnel.

Mr. R. Mahindapala, Research Assistant-in-Charge of the Division left for U.K., in September 1973 for post-graduate studies in Plant Pathology. Mr. B. H. Rohitha, Research Assistant was appointed to be in charge of the Division thereafter.

Four, three-month FAO Fellowships were awarded to officers in the Division for training in rotation at the Commonwealth Institute of Biological Control in Bangalore, India.

Messrs. P. A. C. R. Perera, Senior Technical Assistant and T. M. F. Hassen, Technical Assistant have already completed their training under this award. Mr. M. S. Velu, Technical Assistant is now away on training in Biological Control. The fourth officer selected—Mr. J. L. J. G. Pinto, Senior Field Assistant is likely to proceed for training early in 1974.

Talks

A radio talk on "Pests and Diseases of Coconut and their Control" was given by Mr. R. Mahindapala, Research Assistant-in-Charge of the Crop Protection Division, on 16th August 1973. He also delivered a lecture on "Pests of the Coconut Palm" to the toddy tappers at the Toddy Tappers' Training Centre, Bandirippuwa Estate, Lunuwila on 26th April 1973.

P. KANAGARATNAM,
Research Assistant-in-Charge,
Crop Protection Division.

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REPORT OF THE BIOLOGICAL CONTROL LABORATORY (1973)

The Biological Control Laboratory and all work in connection with the control of the coconut pest *Promecotheca cumingi* Baly., was taken over by the Coconut Research Board on 4th January 1973 from the leadership of Dr. H. E. Fernando under the Campaign Committee.

Distribution of *Promecotheca*

After the laboratory was taken over a quick survey was immediately carried out to locate the areas where the pest was still present, either in the recognised areas of previous infestation, or in previously undetected areas. This survey revealed the presence of the pest in the following areas:—North of Colombo the pest was observed in the Hendala, Kelaniya, Peliyagoda and Welisera areas, South of Colombo in the Galle and Uyankele areas, and East of Colombo in the Polgasowita area. The pest was still present in fairly substantial numbers in the areas mentioned above. Nearly 32,000 palms on an area of over 400 acres of Mattegoda estate were severely infested by *cumingi*. In the residential area of Galle (at and around Havelock Place) the pest population was on the increase. At Hendala, Kelaniya, Peliyagoda, Uyankele and Welisera the pest infestation was moderate and mostly in patches, comprising a total of less than 8,000 palms.

Breeding and Release of Parasites

Both *Dimmockia javanica* and *Pediobius parvulus* were found to be very host specific and so far no alternative host has been found for the laboratory mass breeding of these parasites. During the first half of the year the laboratory breeding of *D. javanica* and *P. parvulus* was stepped up to enable systematic releases of sufficient numbers of parasites in the areas where the pest was still active. During the first four months of 1973 over 10,000 settings of *D. javanica* were made. These yielded over 20,000 adults of which 18,000 were released in the field. These releases were made in the Galle, Hendala, Kelaniya, Peliyagoda, Polgasowita, Uyankele and Welisera areas. Over 1,000 settings of *P. parvulus* were made during the same period and nearly 10,000 adults were obtained, of which 8,000 were released at 15 selected sites.

During the second half of the year it was noticed that the intensity of infestation in most of the badly affected areas was very much reduced. In view of this the laboratory breeding of the two parasites was also reduced, care being taken, however, to maintain cultures of these insects in the laboratory. Periodic booster releases of small numbers of parasites were made in the areas where the pest was still present.

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Parasite Recoveries

Samples of larval mines of *Promecotheca* were brought in regularly from the field, which provided information on the progress of parasite establishment in the field. These recovery studies provided ample evidence of the overall and satisfactory presence of the parasite *D. javanica* in all the areas of *Promecotheca* infestation. Although no recoveries of the parasite *P. parvulus* were obtained in the early part of the year, in July 1973 very good recoveries of this parasite were obtained from Galle, Kelaniya, Polgasowita and Welisara areas. This indicates that *P. parvulus* is still present in the field. Releases of *P. parvulus* in these areas were last done in February 1973.

Field Work and Observations

In addition to surveys, parasite releases, and sampling for parasite recoveries, regular visits, inspections, and observations were also made in all the previously affected areas to detect any pockets of live insects which could be potential sources of re-infestation. Previously unaffected areas where possibilities of pest introduction existed were also kept under observation. These inspections revealed that the incidence of live stages of the pest was very low and localised to the same areas of infestation detected at the beginning of the year. Fresh (live) mines were very scarce in the field and considerable searching had to be done, especially towards the latter part of the year, in order to obtain the few mines necessary to maintain the parasite cultures in the laboratory. Regular counts of adults (beetles) were made in some of these areas. These adult counts were carried out on six randomly selected palms on each recording date, and counts were made on every other leaf, beginning with the first fully opened leaf. The information collected will be presented separately in the form of a note for publication. Part of the data however is tabulated below in summary form. The figures reveal that there was a relatively steady and unmistakable decline in field populations of adults, throughout the period during which these records were maintained.

Adult counts at Galle—(Havelock Place and surroundings)

Date of sampling	*No. of palms sampled*	*Total No. of adults counted*	*Estimated total adults per 6 palms*	*Average No. of adults per palm*
20-2-73	6	482	964	160.66
2-3-73	6	202	404	67.33
13-3-73	6	121	242	40.33
21-3-73	6	101	202	33.66
02-4-73	6	46	92	15.33
11-4-73	6	2	4	0.66
23-4-73	6	23	46	7.66
03-5-73	6	89	178	29.66
14-5-73	6	150	300	50.00
24-5-73	6	22	44	7.33
18-6-73	6	6	12	2.00
18-7-73	6	5	10	1.66

Adult counts at Polgasowita—(Mattegoda estate)

Date of sampling	*No. of palms sampled*	*Total No. of adults counted*	*Estimated total adults per 6 palms*	*Avcrage No. of adults per palm*
28-2-73	6	28	56	9.33
05-3-73	6	47	94	15.66
15-3-73	6	18	36	6.00
26-3-73	6	2	4	0.66
05-4-73	6	0	0	0.00
18-4-73	6	0	0	0.00
28-4-73	6	3	6	0.10
04-5-73	6	11	22	3.66
12-5-73	6	0	0	0.00
26-5-73	6	0	0	0.00

Survey for new infestations

A statistically designed survey (1) to locate areas where *P. cumingi* was still active, whether as a new infestation (previously unaffected) or as an old infestation and (2) to assess the degree and rate of recovery of palms attacked by the pest was undertaken and carried out. For purposes of practical application this survey was classified and dealt with as follows:—

(*a*) The main area of infestation which is more or less restricted to Colombo and its suburbs.

(*b*) The pockets which include all the areas of localised infestation away from the main area.

Results of Survey

The preliminary analysis of the survey revealed live stages of the pest in the following areas of the main survey viz. Dehiwala, (Nedimale), Kelaniya, Peliyagoda, Panadura, Wadduwa, Alubomulla, Hendala, Rajagiriya and Kotahena.

The survey for pockets of infestation carried out in August 1973 revealed live stages of the pest in the following areas:—North of Colombo at Boralessa, Divulapitiya, Ja-ela and Welisera and South of Colombo at Horana, Hikkaduwa, Galle, Wanchawela, Weligama and Kamburugamuwa.

Pest Situation at Present

The pest is now well under control. In all the previously affected areas the crowns of the palms are now completely green. Live mines are very scarce and careful searching had revealed a few of them in Kelaniya, Kamburugamuwa, Galle, Ja-ela, Wattala, and Weligama in the month of December 1973. Field trips to other previously affected areas did not reveal any live stages of the pest.

Work on *Aspidiotus destructor* control

Arrangements have already been made with Dr. F. J. Simmonds, Director, of the Commonwealth Institute of Biological Control, Trinidad, to obtain consignments of exotic predatory coccinellid beetles, for the control of Coconut Scale. The exotic predators expected are *Cryptognatha nodiceps*, *Azya trinitatis*, *Lindorus lophantae* and *Nephus aeneipennis*. The first consignment of predators is expected in early January 1974. In the meantime, laboratory cultures of *Aspidiotus destructor* are being maintained on pumpkins.

Work on *Eupatorium odoratum* Control

An exotic phytophagous lepidopteron insect, by name *Ammalo insulata* was obtained through the Commonwealth Institute of Biological Control for the control of *E. odoratum*, (locally known as "Podisingho maran"). The first consignment of about 2,500 larvae and eggs was received on 15th December 1973. These were released close to Bandirippuwa estate, near Pottuvil, and at Belihul Oya on *Eupatorium*. A small number of this species was retained in the laboratory for breeding and subsequent releases. Follow up studies to see whether these insects are getting established, and the degree of control effected by them will be carried out in 1974.

Staff

The strength of the staff at the Biological Control Laboratory was reduced from 28 to 6 (six). The staff transferred from Colombo to Lunuwila is now engaged in breeding of beneficial insects required to control other coconut pests.

P. A. C. R. PERERA
Officer-in-Charge,
Biological Control Laboratory,
Coconut Research Board.