

COCONUT RESEARCH BOARD

**COCONUT RESEARCH INSTITUTE
OF SRI LANKA**

REPORT FOR 1989

COCONUT RESEARCH INSTITUTE - REPORT FOR 1989

COCONUT RESEARCH BOARD

**REPORT OF THE
COCONUT RESEARCH INSTITUTE
FOR 1989**

Editor

R. Mahindapala, Ph D (Exon), F I Biol (S L)

COCONUT RESEARCH BOARD
(as at 31 December, 1989)

Mr. R. I. Fernandopulle (*Chairman*)

Mr. G. P. P. N. Perera

Dr. L. S. K. B. Herath

Mr. J. L. Amaratunga

Mr. H. P. N. Soysa

Vidya Jyothi Dr. C. R. Panabokke

Mr. K. A. Karunaratne

Mr. M. L. Wijsekera*

(Representative of the State Ministry of Coconut Industries)

*** Observer Member**

COMMITTEES OF THE COCONUT RESEARCH BOARD
(as at 31st December, 1989)

1. The Research Committee

Mr. R. I. Fernandopulle (*Chairman*)
Vidya Jyothi Mr. P. R. Wijewardene
Dr. U. Pethiyagoda
Dr. L. S. K. B. Herath
Mr. T. R. Jayawardene (Janatha Estates Development Board)
Mr. K. Karunanayake (Coconut Cultivation Board)
Vidya Jyothi Dr. C. R. Panabokke
Dr. R. Mahindapala (Director/CRI)

2. The Administrative Committee

Mr. R. I. Fernandopulle (*Chairman*)
Mr. J. L. Amaratunga
Mr. R. M. C. Bandaranayake
Dr. R. Mahindapala
Mr. M. L. Wijsekera
Mr. D. N. B. Perera (*Convenor*)

3. The Estates Committee

Mr. G. P. P. N. Perera (*Chairman*)
Mr. J. L. Amaratunga
Mr. Naomal S. Dias
Mr. H. P. N. Soysa
Mr. D. V. Jayasuriya
Mr. B. R. T. de Tissera (Janatha Estates Development Board)
Dr. R Mahindapala

CONTENTS

	Page
Report of the Director	10
Report of the Agronomy Division	36
Report of the Genetics and Plant Breeding Division	57
Report of the Soils and Plant Nutrition Division	88
Report of the Crop Protection Division	119
Report of the Biometry Unit	127
Report of the Tissue Culture Unit	139
Report of the Plant Physiology Unit	143
Report of the Information Services Division	157
Report of the Library	161
Report of the Estates Management Division	163
Report of the Agricultural Research Project (ARP)	187
Report of the Administration Division	189

COCONUT RESEARCH INSTITUTE OF SRI LANKA

THE STAFF *

(as at 31 December, 1989)

DIRECTORATE

Director - R Mahindapala, B Sc, M Sc (Exon), Ph D (Exon), F I Biol (SL)

Acting Deputy Director (Research) - R Mahindapala, B Sc, M Sc (Exon), Ph D (Exon), F I Biol (SL)

Deputy Director (Administration and Finance) - D N B Perera, B Sc

RESEARCH DIVISIONS

Agronomy Division

Head

M de S Liyanage, B Sc Agric
M Sc (New England)

Assistant Agronomists

K B Dassanayake, B Sc Agric
D N S Fernando, B Sc Agric**
M T N Fernando, B Sc Agric
T G L G Gunasekera, B Sc Agric
H A J Gunathilake, B Sc Agric**
H P S Jayasundera, B Sc Agric
R A J R Perera, B Sc Agric**

Senior Technical Assistant

M Bastian

Technical Assistants

H A Abeysoma
M J I Costa
R Marasinghe
Mrs K C P Perera, B Sc
S D J N Subasinghe, Dip Agric
A M U Wijeratne

Lab & Field Assistants

D Amarasinghe
E M Gunaratne Banda
W S M A Fernando
M D V Saparamadu
B D Benet Silvan
W E J Tissera
A A D N Athauda

Clerk/Typist

Genetics & Plant Breeding Division

Head

Assistant Genetisists/Plant Breeders

VACANT
Mrs W M U Fernando, B Sc**
K R R A Peries, B Sc Agric

Technical Assistants

Miss M A S Fernando
Mrs W B S Fernando
Miss H S G Kularatne
M H L Padmasiri

Lab & Field Assistants

W T H C Fernando
T M W Peiris

Clerk

M Victor

Clerk/Typist

K P W Perera

Miss I N Jayawardene

Seed Production Unit

Seed Production Officer

P Kariyawasam, Dip Agr

Lab & Field Assistant

H Bandappuhamy

Clerk/Typist

Miss W Kalyani Dondeenu

Isolated Seed Garden

Superintendent

D M Pathirage

Field Officer

G B A Wijesekera

Lab & Field Assistants

R B Attanayake

U V M Fernando

Clerk/Typist

R P Victor

42

Soils & Plant Nutrition Division

Officer-in-Charge

K S Jayasekara, B Sc, C Chem,
M I Chem C

Senior Research Officer

M Jeganathan, M Phil

Assistant Soil Scientists

Miss M B M N Dias, B Sc Agric,
M Phil**

Mrs F Jayasundara, B Sc Agric

L L W Somasiri, B Sc**

N A Tennakoon, B Sc Agric

L P Vidana Arachchi, B Sc Agric**

T W Fernando, L I Chem C

G D George***

Senior Technical Assistants

Miss S Periathamby, N D S

Mrs N H R M de Silva, B Sc

Technical Assistants

E M A T Banda

Mrs S D Hemamala Bandara, B Sc

N S Jayalath

Miss G D Jayasundara

S Malavipathirane

D P Panditharatne

U S S Perera

Mrs D M D I Wijebandara, B Sc

Lab & Field Assistants

A A Fernando

K Murugiah

B C E Perera

D S Wijetunga

Mrs H M W S Athauda

Clerk/Typist

Crop Protection Division

Head

P A C R Perera, B Sc (Lond)

M Sc (Lond) Ph D (Lond) D I C

Senior Crop Protection Officer

P Kanagaratnam*** B Sc Agric

Ph D (Lond) D I C, M I Biol (SL)

68

Asst. Crop Protection Officer

Mrs L C P Fernando, B Sc Agric**

Mrs C N K Rajapakse, B Sc Agric**

Technical Assistants

K A S Chandrasiri

H M D T N Mudalige

A H Norman ***

K F G Perera

Ms P H A P Siriwardana

Clerk

Mrs A de Zoysa

Senior Field Assistant

D M Jayakody***

Lab & Field Assistants

W E A Fernando

A S M Premalal

Biometry Unit

Officer-in-Charge

D T Mathes, F I S (Lond), B Sc

Dip. Stat. (Vidyodaya),

Dip. Biometry (Reading)

Biometrician

T S G Peiris, B Sc, M Sc

(Canterbury), F S S

Technical Assistants

H P de Zoysa

J D J S Kularatne

Senior Field Assistant

E R Fernando

Lab & Field Assistants

A Dasanayake

W M L G Fernando

P J C Fernando

W E R C Fernando

W B P Fernando

U T G Fernando

D T Fernandopulle

W K M K Herath

J Wijedasa

A Wilson

Clerk/Typist

Mrs D M T Marasinghe

Tissue Culture Unit

Officer-in-Charge

Mrs S M Karunaratne, B Sc,
M Sc (Qld)

Research Assistant

Miss L K Periyapperuma, B Sc**

Technical Assistants

Miss C K A Gamage

E S Santha

Lab & Field Assistant

W H N Jayatissa

Plant Physiology Unit

Officer-in-Charge

Mrs C Jayasekara, Ph D (Qld)

Assistant Physiologists

Miss C S Ranasinghe, B Sc

Miss S P Suriyapperuma, B Sc

Technical Assistants

Mrs W P K K Fernando

R D N Premasiri

Miss P S A de Saram

L R S Silva

Lab & Field Assistant

A Jayathilake

Information Services Division

Officer-in-Charge

P A H N Appuhamy, B Sc Agric

Assistant Information Officer

J L J G Pinto

Technical Assistant (Photography)

T R W Weralupitiya

Clerk/Typist

R A L C Fernando

Library/Coconut Information Centre

Librarian/Project Leader

M J C Perera ALA

Documentation Officer

Mrs P A S F Perera, B Sc

Documentation Assistant

D B Jayasinghe

Library Assistants

Mrs P D U C Dharmapala

Miss T I I Peiris

Clerk/Typist

Miss S N Gunathilake

Machine Operator

W G L Rodrigo

119

Estates Management Division

Manager

P S Liyanagama, B Sc Agric

Assistant Manager(Farms)

K P de Silva

Clerk/Typists

Mrs N R Ayagama

W P R Fernando

Mrs K A D N S Marian

P P Jayasundara

Field Assistant

Bandirippuwa Estate

Officer-in-Charge

M F H G Ivan Appuhamy

Field Assistants

K P C Fernando

W L B Silva

Supervisors

M Chandrasoma

H H D B K Dissanayake

M P W Fernando

U C Hettiarachchi

T H M D P Peiris

H H J E Appuhamy

Clerk/Typist

Poththukulama Research Station

Superintendent

S M Wijeratne Banda

Supervisor

M J David

Estate Clerk

J A Rexi Reginold

Ratmalagara Estate

Superintendent

G Vithanage

Field Officer

D L J Nettasinghe

Field Assistant

E W A G Gunasinghe

Supervisor

I A N Hemasiri

Estate Clerk

B L Senaghosha

Walpita Estate

Officer-in-Charge

N Gamage

Makandura Seed Garden

Superintendent

M R L A Perera

Supervisor

W M U Ratnayake

Maduruoya Seed Garden

Superintendent

A N Ekneligoda

Supervisor

T M Keertiratne

Passekudah Research & Demonstration Farm

Assistant Manager(Farms)

A Thavaratnarajah

Minneriya Research & Demonstration Farm

Officer-in-Charge

M S Perera

ADMINISTRATION

Deputy Director

D N B Perera, B Sc

(Administration & Finance)

Project Coordinator

M Jeganathan, M Phil

Agricultural Research Project

Establishment Unit

Administrative Officer

D G Manamudali, B A, L ICA

Office Assistant

J E A Dalpathado

Personnel Officer

P Daluwatta

Administrative Assistant

M Leelaratne, B A

Supplies Officer

M A Somadasa

Secretary to the Chairman

Mrs T M H Fernando

Chief Clerk

T Gunadasa

Stenographers (English)

Mrs M J Ariyadasa***

Mrs M P Premaratne

Mrs S Z Suhair

Supplies Assistant

W F T Fernando

162

Clerk/Typists

Miss W E M Coonghe***
Mrs P C A Fernando
C B B P Fernando
Mrs M M M R Fernando
Miss W S Renuka Fernando
B R Fernando
Miss U I Gunasekara
K D Jathiratne
W A W Wijesuriya
B M Dingiribanda
A I F Fernando
Miss H D Mangalika, B A
I H Nelson
Miss L M N Jansz***
G M R Karunasekara, B Sc

Clerks

Record Keeper

Receptionist/Telephone Operator

Experimental Officer

Internal Audit Unit

Internal Auditor

Checking Officer

Internal Audit Clerks

Typist

M M P Wijesekara, L ICA
Dip. in Business Mgt, M A A T
P R Fernandopulle
M R U Attanayake
Mrs M M J R Fernando
Mrs R D Indrani Somasiri
Mrs W J M D M A Dias

Accounts Unit

Chief Accountant

Accountant

Assistant Accountant

Book Keepers

R M G D Rajapakse
D R C M Handalage
I K Rahatungoda
Mrs D M R Fernando
B M Jayathilakabanda
A S Nanayakkara
Mrs K M A Nonis
T M S Peiris

19/7

Store Keeper
Shroff
Assistant Shroff
Clerk/Typists

M B Upali
P A Nonis
H B Thalghagoda
D M C B Dissanayake
Mrs A R S Hettiarachchi
Mrs J K F Perera
Mrs C M B I Salwatura
Y H Wijesena
Mrs C Munasinghe
Mrs P H C M G Rodrigo

Clerks

Engineering Unit

Resident Engineer
Works Superintendent
Foreman (Electrical)
Foreman (Mechanical)
Foreman (Building)
Draughtsman
Clerk
Clerk/Typists

L U Jayawardene, Dip (C. Eng)T
K N A S Perera, Dip (Mech. Eng)T
M D Bernard Praxidus
M J M D S Jayawardene
R M Dayaratne
Mrs R M S Ratnayake
P Premaratne Fernando, B A
Mrs K A P Chandani

* When more than one officer is listed under a designation, the names appear in alphabetical order. Unless otherwise stated, all Bachelor's degrees indicated in the staff list are from Universities in Sri Lanka.

** On study leave.

*** On overseas no-pay leave.

REPORT OF THE DIRECTOR

R Mahindapala Ph D

GENERAL

The year 1989 was devoted to a further review of the results obtained from the five-year research programme launched in 1984 and completed in 1988. In particular, the results of long-term experiments were analysed and reviewed. New areas of research needing attention were identified, and prioritization of the research programme was undertaken. Manpower resources were carefully considered in formulating the new research programme. Towards the end of the year, it was possible to formulate a new four-year research programme to be launched in 1990. This programme was designed to address some of the pressing problems faced by the industry, and used the data obtained from the earlier programme to refine and fine-tune the technology developed earlier. Also, plans were made to launch adaptive research programmes, particularly in relation to the use of organic and green manures, so that the results obtained earlier could be translated to growers conditions. Reducing cost of production continued to be an important area needing attention, and in this regard, it was essential that some of the research recommendations on inputs be tested under growers conditions. For example, the Differential Fertilizer Recommendation for larger holdings based on foliar analysis was tested widely under different conditions.

During the year, the Coconut Research Institute (CRI) introduced a fertilizer mixture for adult coconut, containing potassium, phosphorus and magnesium. This mixture has several advantages. It can be stored for a long period since it does not have urea and can be applied any time of the year. The use of this mixture will also ensure a regular supply of magnesium, which appears to be a major limitation to increasing production.

Arrangements were made to launch three multi-disciplinary research projects on immature nutfall, Leaf Scorch Decline and Earthworms. Almost all divisions will actively participate in these programmes.

The Institute continued to provide assistance to the estate sector, and the estate owners/managers continued to seek assistance from the CRI. This has provided an opportunity to re-establish a close rapport between the CRI and the planting community, which is essential to have a feed-back from the grower on their research needs.

The newly-established seed gardens continued to perform satisfactorily. A considerable number of seedlings at the Makandura Seed Garden came into flower in the fourth year after planting indicating the clear advantages of replanting and better management practices adopted at the seed garden. The Institute continued to provide seednuts to the estate sector who have the necessary infrastructure to establish nurseries and raise seedlings to meet their own requirements.

The Institute continued to expand the number of coconut-based farm models in small-holdings. These were established in the different agroclimatic zones.

The World Bank-funded Agricultural Research Project awarded a contract research grant to conduct an Inter-Institutional Research Programme on intercropping and animal husbandry. This fulfils a long-felt need to conduct a concerted multi-disciplinary programme on the very important aspect of intercropping and maximising land use. The group consists of the Coconut Research Institute as the lead organization and the Dept. of Agriculture (Makandura Research Station), Veterinary Research Institute and the Dept. of Export Agriculture.

The Agricultural Research Project pledged considerable assistance to improve infrastructural facilities at Bandirippuwa Estate and at other stations. At Bandirippuwa Estate, new housing units will be provided together with several amenities buildings. An auditorium is planned and the library building will be improved. Early action is planned to improve the water supply scheme at Bandirippuwa Estate.

The disturbances in the country, particularly during the last six months of the year, was a major constraint to the conduct of field experiments. Some experimental sites could not be visited and the data recording had to be postponed on several occasions. The Research & Demonstration Farm at Passekudah, Kalkudah was occupied by the Indian Peace Keeping Force and the CRI staff were forced to leave the station. The problems were aggravated during the last quarter of the year due to the inability of the Treasury to release the allocated funds. Several programmes had to be curtailed and field visits were stopped.

In spite of the disturbances in the country, most of the field experiments were conducted satisfactorily. Majority of these experiments are in estates belonging to the Janatha Estates Development Board. The Institute staff continued to work in close cooperation with the staff of the JEDB in the conduct of these experiments.

The CRI is totally financed by the government and from the profits of its estates. The benefits provided to the staff are therefore minimal, compared with these at the other plantation research institutes which are funded by a cess collected from exports. Since about 70% of the coconut production is consumed locally, the cess collection is meagre. The crop provides nutrition to the population, and because of local consumption and consequent low exports, the industry and support staff are denied certain benefits. This aspect needs close and careful scrutiny, and funds for coconut research should be provided based on the total value of the production, since it is an important commodity in the nutrition of Sri Lankans.

2. THE COCONUT RESEARCH BOARD

The Coconut Research Board was reconstituted in March, and Mr R I Fernandopulle Actg. Chairman, was appointed Chairman of the Board.

The membership and attendance at meetings of the Board upto March are given below:

Mr R I Fernandopulle	(Actg. Chairman)	(attendance 1/1)
Mr K F J Perera		(attendance 1/1)
Mr Naomal S Dias		(attendance 1/1)
Mr P Ray Wijewardena		(attendance 1/1)
Mr Merle E Dalpathado		(attendance 0/1)
*Dr R T Wijewantha *		(attendance 0/1)
Mr G P P N Perera		(attendance 0/1)
Mr P A S Prathirajah		(attendance 1/1)
(Ministry Representative)		
* On overseas leave		

The membership and attendance at meetings from April are given below:

Mr R I Fernandopulle	(Chairman)	(attendance 7/7)
Mr G P P N Perera		(attendance 6/7)
Dr L S K B Herath		(attendance 5/7)
Mr J L Amaratunga		(attendance 7/7)
Mr J M Piyasena	(upto August)	(attendance 0/4)
Mr H P N Soysa		(attendance 5/7)
Dr C R Panabokke	(from September)	(attendance 3/3)

Mr K A Karunaratne (from September) (attendance 2/3)
Mr M L Wijesekera (attendance 7/7)
(Ministry Representative)

The Board could hold only eight meetings (207th to 214th) during the year. Three scheduled meetings could not be held due to lack of a quorum. With the exception of 211th, 212th and 214th meetings which were held in Colombo, the meetings were held at the Coconut Research Institute, Lunuwila.

Mr D N B Perera, Deputy Director (Adm. & Finance) continued to function as the Secretary to the Board. Dr R Mahindapala, Director, Coconut Research Institute participated in all Board meetings.

The Board appointed Mr A S Ranatunga as a Consultant in Farming Systems Research for a further period of one year.

3. COMMITTEES OF THE COCONUT RESEARCH BOARD

3.1 Research Committee

The Research Committee held four meetings, which were exclusively devoted towards formulating the research programme for the period 1990 to 1993. The Committee was able to prioritize the research projects, and the Research Programme and the Implementation Schedule for 1990 to June, 1991 were prepared towards the end of the year.

The membership and attendance at the meetings are as follows:

Mr R I Fernandopulle	(Chairman)	(attendance 4/4)
Mr P Ray Wijewardena		(attendance 4/4)
Dr U Pethiyagoda		(attendance 3/4)
Dr L S K B Herath		(attendance 0/4)
Mr T R Jayawardena	(JEDB)	(attendance 4/4)
Mr K Karunanayake	(CCB)	(attendance 4/4)
Dr R Mahindapala	(D/CRI)	(attendance 4/4)
Dr C R Panabokke	(from September)	(attendance 1/2)

In the absence of the Deputy Director (Research), the Director functioned as the Convenor also.

3.2 Administrative Committee

The Administrative Committee met four times to consider matters referred to it by the Board. The Committee was requested to examine a report of the Auditor General on the accounts of the CRI. Another important matter examined by the Committee related to the outstanding dues to the Board from various sources, including the Coconut Cultivation Board for nurseries handed over to them.

The membership and attendance at the meetings are given below:

Mr R I Fernandopulle (Chairman)	(attendance 4/4)
Mr J L Amaratunga	(attendance 4/4)
Mr R M C Bandaranayake	(attendance 2/4)
Dr R Mahindapala	(attendance 4/4)
Mr M L Wijsekera	(attendance 4/4)
(Ministry of Coconut Industries)	

Mr D N B Perera, Deputy Director (Adm. & Finance) continued to function as the Convenor, and was present at all meetings.

3.3 Estates Committee

The Estates Committee met three times during the year. The Committee continued to monitor the data recording systems and cost control methods introduced earlier. The agricultural conditions of several estates and seed gardens were further improved by the measures introduced by the Committee.

The Committee paid special attention to the agricultural conditions at Bandirippuwa Estate towards the latter half of the year.

The Committee at its second meeting met with the Administrative Committee to examine some of the routine administrative and financial procedures as applicable to estates.

A group of members from the Committee made four visits to the Board's properties to assess the agricultural standards and to recommend measures for further improvements.

The membership and attendance at the meetings are given below:

Mr G P P N Perera	(Chairman)	(attendance 3/3)
Mr J L Amaratunga		(attendance 3/3)
Mr Naomal S Dias		(attendance 3/3)
Mr H P N Soysa		(attendance 2/3)
Mr D V Jayasuriya		(attendance 3/3)
Mr B R T de Tissera	(JEDB)	(attendance 3/3)
Dr R Mahindapala	(D/CRI)	(attendance 3/3)

Mr P S Liyanagama, Manager (Estates) continued to function as the Convenor and participated in all meetings and in all field visits.

3.4 Other Statutory Committees

1. Provident Fund Committee

The Provident Fund Committee met regularly regarding the administration of the staff Provident Fund. The representatives of the members upto 7 June were M/S D M C B Dissanayake and H H J E Appuhamy. Mr D T Mathes and Mr P Premaratne Fernando were elected by the members to represent them in the Committee from 8 June. Mr R M G D Rajapakse was the nominee of the CRB. Mr G D Manamudali was appointed Secretary from 17 May.

The membership and attendance at the meetings upto 7 June are given below:

Mr R I Fernandopulle	(Chairman)	(attendance 2/3)
Dr R Mahindapala		(attendance 2/3)
Mr D M C B Dissanayake		(attendance 2/3)
Mr H H J E Appuhamy		(attendance 3/3)
Mr R M G D Rajapakse		(attendance 3/3)
(Secretary and CRB nominee)		

The membership and attendance at the meetings from 8 June are given below:

Mr R I Fernandopulle	(Chairman)	(attendance 6/6)
Dr R Mahindapala		(attendance 6/6)
Mr D T Mathes		(attendance 6/6)
Mr P P Fernando		(attendance 5/6)
Mr R M G D Rajapakse		(attendance 4/6)
Mr G D Manamudali	(Secretary)	(attendance 6/6)
Mr D N B Perera,	Deputy Director (Adm. & Finance)	

was present on invitation at 8 out of 9 meetings.

2. Board of Trustees - Medical Aid Scheme

The Board of Trustees met regularly to attend to matters relating to the administration of the Medical Aid Scheme.

Mr K S Jayasekera and Mr P Premaratne Fernando were the Board's nominees in the Board of Trustees.

The Board's contribution to this scheme was about Rs. 600,000. The provisional balance at the end of the year was Rs. 434,000.00.

The membership and attendance at the meetings are given below:

Dr R Mahindapala	(Chairman)	(attendance 15/15)
Mr D N B Perera		(attendance 13/15)
Mr K S Jayasekera		(attendance 15/15)
Mr P Premaratne Fernando		(attendance 14/15)
Mr P Daluwatta	(Secretary)	(attendance 15/15)

The membership at the end of the year was 389.

4. THE COCONUT RESEARCH INSTITUTE

A brief report of activities of the Coconut Research Institute is given below.

4.1 Agronomy Division

Research projects on moisture conservation and improvement of soil organic matter, rehabilitation of low-yielding palms, establishment and management of replantings/newplantings, nutrient requirement of coconut and on coconut-based farming systems progressed satisfactorily. A multi-disciplinary research programme was initiated to promote collaborative studies within the institute. At the end of the year, 24 experiments were in progress.

In soil moisture conservation studies, shallow ploughing to a depth of 25 cm improved the moisture status and the physical structure of both gravelly and sandy soils, irrespective of the frequency of ploughing. However, ploughing treatments failed to exert a significant beneficial effect on coconut yield in both soils. In contrast, the use of a mixture of husk and coir dust in pits of 2.4 x 1.2 x 0.9 m between two palms or husk alone in single pits of 1.2 x 1.2 x 0.9 m on one side of individual palms or a layer of husk mulch around the palm caused a significant improvement in nut and copra yield and in soil moisture in gravelly soil. Husk pits of 2.4 x 1.2 x 0.9 m between two palms or a single husk pit of 1.2 x 1.2 x 0.9 m showed a better response in coconut production and in conserving soil moisture retention, ranging from 28 - 35%, was achieved by a layer of husk mulch around the palm.

Studies on management practices of ground covers showed that *Pueraria phaseoloides* responded well to various management practices and produced top dry matter yield of 4700 - 5300 kg/ha/year, irrespective of the agroclimatic zone and soil type. In addition, *P phaseoloides* was able to suppress weed growth most effectively. Amongst other species, *Centrosema pubescens* performed well on sandy soil in the dry intermediate zone, producing top dry matter yield of 4300 kg/ha/year.

Studies on the use of gliricidia as a green manure showed that two-month old poly-bagged seedlings gave 100% establishment compared with only 50% survival in the case of stem cuttings.

Investigations on the rehabilitation of low-yielding palms in gravelly soils showed that new root formation is better when quarter circle trenches, cut around the palm, are filled with either gliricidia leaves, goat manure or sand.

In the integrated farming system involving pasture/tree fodder and cattle, nut and copra yields of palms improved as much as 17.5% and 11%, respectively, compared with those in monoculture system receiving 3 kg of inorganic fertilizer per palm. In addition to the substantial reduction on cost of inorganic fertilizer, the integrated system provided a supplementary income from milk and animals.

As a source of fuelwood in coconut plantations, Ipil Ipil grown in double rows produced the highest wood biomass yield of 10,000 kg/ha, and coconut in turn benefited from this as evident by a 6% and 3% increase in nut and copra yield, respectively. However, the growth and performance of ipil ipil were affected by a serious outbreak of a psyllid pest.

Of the several provenances of *Gliricidia* introduced from other countries, selections OFI 14/84 and OFI 24/86 demonstrated a greater potential for use as a green manure and a renewable source of fuelwood in the low-country humid zone.

Since cacao is a potential intercrop in mature coconut plantations in the wet zone, investigations were carried out to increase the bean yield by the application of nitrogen and potassium fertilizer. Results show that nitrogen at 100 g/tree/year and potassium at 120 g/tree/year would be the optimum levels for obtaining maximum bean yield of cacao under coconut.

A trial was planned to study the performance of mulberry under coconut in the intermediate zone, in view of the very high profitability projected for sericulture.

Preliminary studies on the multi-disciplinary research programme on earthworms in coconut lands were commenced. Results obtained so far suggest that agronomic practices such as cover cropping, manuring with green matter or organic matter and intercropping with cacao, pepper and pasture increased earthworm population, which would contribute towards restoration of fertility in the soil.

4.2 Genetics & Plant Breeding Division

The collection and analysis of research data fell behind schedule due to the unrest prevailed in the country and the restrictions imposed on expenditure during the last quarter of the year. However, every effort was made to continue the research programme with minimum interruption.

The trial on the evaluation of cultivars planted at five different locations were maintained satisfactorily during the year. Growth measurements were recorded at six-monthly intervals. The cultivar dwarf green (DG) x tall (T) continued to perform better than the cultivar dwarf yellow (DY) x tall (see Annual Report, 1988) this year too, at all locations.

Bandirippuwa, Thammenna and Dambakande trials were in their fourth year from planting. The flowering amongst the cultivars was highest in the Bandirippuwa trial

(52%) followed by the Thammenna trial (45.5%). In the Kurunegala district (Dambakande trial) flowering was poor (6.5%), probably due to the more severe soil water deficit resulting from a poor rainfall distribution on a heavy-textured soil.

The Palugaswewa and Suriyapura trials were planted in 1985 and 1986 respectively. The severe infestation of black beetle in the Palugaswewa trial caused a major set-back to its early growth resulting in delayed flowering. Hybrids in the Suriyapura trial were 11% in flower at the end of the year.

The six progeny trials located in the different agroclimatic zones were maintained during the year. Growth measurements were taken as scheduled at six-monthly intervals. These trials are still in their vegetative phase. The leaf production was highest in the DG x T hybrid. T x San Ramon (SR) also appeared to be superior to T x T in leaf production.

Four observational trial blocks were planted during the year. They are: Monrovia State Plantation at Ratgama in the Southern Province, Correctional Centre for Youthful Offenders at Dalupotha in Negombo, Bandirippuwa Estate (BE) and Ratmalagara Estate (RE). The first two trials consist of four crosses each. They are T x DG, T x DY, T x T and T x SR. The trial planted at BE consists only of the T x SR cross. The trial at RE consists of DG x T, DY x T, DG x SR and DY x SR crosses.

The germplasm conservation programme was expanded by adding new accessions identified from locations at Melsiripura, Mundel, Marawila, Puttalam and Kurunegala. Seedlings produced from Hambantota, Puttalam (Palugaswewa) and Kurunegala (Clovis) accessions were planted at Bandirippuwa Estate. Accessions from Kurunegala and Puttalam districts were planted at the Poththukulama Research Station.

Cameroon Red Dwarf and the Brazilian Green Dwarf palms at BE which showed poor nut-set from self pollination were rested during the year. The programme had a set-back due to the loss of nuts.

Yield recording was carried out in all fields at the Isolated Seed Garden (ISG), Ambakelle during the year. Recording of split-nut weight was done in both tall (fields 4 and 9) and in dwarf (fields 5, 9, 10A and 10B). Pollinations were carried out on selected tall palms in field no. 3 using pollen from selected palms in fields 1 and 2. Collection of dwarf pollen from field nos. 9 and 10 B was discontinued. Pollen from old palms of field no. 5 was used for back-crossing with the second generation of dwarf in the same field. The production of self pollinated dwarf seedlings was discontinued due to surplus in production. Maintenance operations were carried out in the trial block planted with 'Ambakelle super' (Field 11A).

The seednut production at the Isolated Seed Garden showed a remarkable increase compared to the previous year. A total of 1,225,700 nuts were produced which represents an increase of 140% over the previous year. Of the total crop, 70% was produced by the tall palms and recorded an increase of 118% over the previous year. The dwarf palm yield also showed a 264% increase. The yield per palm was 116 and 89 nuts for tall and dwarf palms, respectively. The yield increase is mainly attributable to the favourable rainfall distribution during 1988 (1520 mm over 90 days) and intensive moisture conservation practices. In contrast, the rainfall during 1989 was the lowest in 10 years, with only 850 mm and 73 wet days.

A total of 1,952,163 seednuts were supplied to the nurseries of the Coconut Cultivation Board. There was a shortfall of 91,782 seednuts, which was mainly due to disturbances in the country. Of the total supply, 39% were produced at the Isolated Seed Garden.

Due to the prevailing disturbances in the country there was a delay in the removal of seednuts from the estates in time which made it necessary to carry out several re-selections over a period. A high percentage of selection (80 - 90%) was maintained throughout the year. A total of 35,000 seednuts of improved varieties were also issued to other state-owned departments and organizations during the year.

Pollen production was continued and 1,264 ampoules of pollen were produced. Of this, 300 ampoules were issued to the Janatha Estates Development Board (JEDB). The balance was used for the pollination programmes of the division. The bulk of the typica pollen was used by Palugaswewa, Pitiyakanda and Daisy Valley (JEDB) Estates. In addition to typica, pollen from varieties such as pumilla, eburnea, San Ramon and Brazilian dwarf green was processed. There were no requests for pollen from private estates during the year.

4.3 Soils and Plant Nutrition Division

Eleven long-term field experiments on nutritional, soil physical and water use aspects of coconut progressed satisfactorily. Eight short-term trials on fertilizers, rainfall, weeds, hydroponics, sea water and coir dust provided some important basic information.

Laboratory studies on leaching indicated the significantly high leaching losses of potassium and magnesium which need to be further investigated. Several common weeds in coconut plantations were found to have high levels of nutrients fixed in their biomass.

In an organic fertilizer experiment in sandy soils, application of inorganic fertilizer with extra goat dung showed yield increases of 42% and 45% for nuts and copra, respectively, at the end of five years. However, in gravelly soils, goat dung supplementation did not show significant yield increases in nut or copra even after five years of manuring. Nevertheless, application of goat dung improved several soil physical and microbiological parameters.

In another experiment, significant nut and copra yield increases were recorded under high rates of application of muriate of potash (KCl) in gravelly soils only, in the wet zone. Application of KCl showed a significant decreasing quadratic response in leaf potassium. Nut water analysis also showed similar effects showing the depressive effect on the uptake of sodium by coconut with increased rates of applied KCl as a fertilizer.

Inoculation with mycorrhizae, *Glomus fasciculatum* and *Gigaspora gigantea*, significantly improved the root and leaf dry mass of two-year-old coconut seedlings treated with Eppawala Rock Phosphate (ERP). However, coconut seedlings treated with saphos phosphate gave 18% higher leaf mass and 53% higher root mass compared to the coconut seedlings grown with ERP inoculated with mycorrhizae.

The leaf analytical data from the joint FAO/CRI/CCB study on increasing yield in small holdings by the use of fertilizer were examined. The results revealed that about 70 - 85% of the coconut lands have adequate or excess levels of leaf nitrogen while 85 - 90% lands have excess/adequate levels of phosphorus. However, about 60 - 65% of the coconut lands are deficient in potassium while 65 - 80% lands are deficient in magnesium. These studies clearly show that currently, potassium and magnesium deficiencies are the main nutritional impediments to coconut production in Sri Lanka. The present nutritional order of priority for adult coconut in Sri Lanka was found to be KMgNP.

Rainfall interception studies show a high degree of stem flow and canopy dripping during rain by the coconut palm. Canopy drippings were found to contain significant amounts of nitrogen and potassium. Hydroponic studies with coconut seedlings indicated a high rate of nitrogen uptake and the adaptation of the roots to this system.

The results of the FAO/CRI/CCB study were used in introducing a new fertilizer mixture, called "Adult Coconut" (0-6-32-5). The main features of this mixture are the inclusion of Eppawala Rock Phosphate (to supply 50% of the P requirement) and dolomite as constituents in the mixture and the exclusion of urea. "Adult coconut" mixture has advantages in packing, storing, and application as it does not contain

hygroscopic urea. The "Adult Coconut" mixture could be applied any time of the year (even in dry weather) when labour is available, which is a common constraint particularly during the monsoons. "Adult Coconut" (0- 6-32-5) could be used as a supplement with organic manures, which would provide nitrogen, and will also ensure regular supply of magnesium. If correctly practised, the package provided is less expensive, easier to manage and saves labour.

The division participated in the International Plant/Soil- Analytical Exchange and has shown a high level of accuracy in analytical measurements.

Requests to provide the computer-modelled Differential Fertilizer Recommendation (DFR) based on leaf/soil nutrients and present/"potential/target" productivity of coconut plantation were high during the year and 104 large estates covering an area of about 2,800 ha were provided with the services.

The division also prepared car stickers for the promotion of fertilizer usage in the coconut sector.

4.4 Crop Protection Division

The division continued with laboratory and field investigations on integrated pest management with particular reference to the coconut caterpillar, *Opisina arenosella*.

Field studies on the integrated chemical and biological control for the management of *O. arenosella* where alternate palms in an infested plantation were treated with systemic insecticides as a trunk implantation revealed the advantages of this method with the infestation being completely controlled within two months. This enables considerable saving through reduced insecticide use and labour requirements.

An insecticidal trial on *O. arenosella* to evaluate the minimum effective dose of monocrotophos used as trunk injection on tall coconut revealed that 8 ml of a 30% concentration of monocrotophos is as effective as 8 ml of a 60% concentration thus reducing insecticide costs by 50%.

Studies on leaf blight at an estate at Vanathavillu (Puttalam district) indicated that the condition was possibly caused by the prolonged drought and low nutrient levels.

As in the previous year, the coconut caterpillar proved to be the most serious coconut pest and a total of 61,000 palms covering about 400 ha were treated with systemic insecticides.

A collaborative research project entitled "Pesticides from Sri Lankan Plants for the control of coconut pests" between Munster University (West Germany), University of Peradeniya and the Coconut Research Institute was initiated.

The pest control service continued to provide assistance to growers.

4.5 Tissue Culture Unit

In experiments on clonal propagation of coconut, the immature zygotic embryo was found to be the best explant. Callus formation and somatic embryogenesis were achieved successfully from the immature embryo explant when cultured in a special medium developed by the Unit. Germination of the somatic embryos leading to complete plant formation was rather difficult. However, a few embryos developed further and produced plantlets of about 1-3 cm in height, when cultured in a pre-conditioned medium. Work on this programme continues.

The experiment on development of a method for screening drought tolerant coconut germplasm by in vitro methods was continued using drought-susceptible and "putative" drought tolerant cultivars of coconut. The experiment is still in progress and the results gathered to date indicate better survival of embryos derived from "putative" drought tolerant cultivars, compared to those derived from the drought susceptible cultivars. However, the extent of stress tolerance was observed to be variable.

4.6 Plant Physiology Unit

Physiological investigations of the coconut palm progressed well.

The glass house experiment to elucidate the role of nitrogen, potassium and chlorine on drought tolerance of coconut seedlings revealed a correlation between potassium and water relations effecting a high transpiration rate and a low stomatal diffusive resistance.

A screening method for drought tolerance was established by linear regression analysis of physiological data collected on "putative" drought tolerant palms at the Isolated Seed Garden, Ambakelle. Forty percent of the palms investigated showed average or high stability to the studied physiological parameters under fluctuating environmental conditions. This procedure will continue in future to screen all the "putative" drought tolerant palms.

Identification of physiological and biochemical characters which determine high yield and drought tolerance of different varieties, improved cultivars and hybrid crosses was continued with satisfactory progress. High yielding cultivars and hybrids generally have high chlorophyll content as well as high sugar and starch concentration in leaves. Drought tolerant cultivars like San Ramon, Moorock tall and hybrid cross between tall x San Ramon recorded high leaf proline content.

Investigations on physiological characters of palms affected with Leaf Scorch Decline (LSD) were continued and the results were encouraging. With increasing severity of symptoms, LSD-affected palms showed high internal water deficit. These palms also recorded very low leaf water potential and transpiration rates under soil moisture saturated conditions. Studies on foliar macro- and micro-nutrients indicated a significant reduction of nitrogen, phosphorus and potassium levels with increasing age of the leaves and severity of LSD symptoms. Leaf organic nutrients also decreased with increasing severity whilst leaf proline concentration increased, confirming the physiological stress in LSD-affected palms.

Experiments to improve growth and viability of amputated poly-bagged seedlings were continued. Root application of Indole acetic acid, Kinetin or Gibberallin at a concentration of 100 ppm improved the vegetative growth of the seedlings.

Miscellaneous investigations during the year included study of sugar and vitamin components in young coconut water and morphology and biochemistry of germinating coconut seedlings. Young coconut water was found to be rich in reducing sugars, sucrose, Vitamin C and traceable quantities of Vitamin B components in addition to the mineral nutrients. During germination, kernel and nut water sugar levels were maintained as at maturity. However, high concentrations of reducing sugars, sucrose, sorbitol, and galactose were observed in the developing cotyledon.

4.7 Biometry Unit

The Unit continued to assist the Research Divisions in designing field experiments, analysis and interpretation of data. Nearly 900 analyses were carried out during the year.

The computer facilities were expanded during the year, and a number of new computer programmes was developed.

The calibration trial recorded an increase of 12.9% and 70.5% for number of bunches and nuts per palm, respectively. A very high yield of 18,329 nuts per hectare

was recorded in the experimental area. The copra yield per hectare showed an increase of 51.2% over 1988. The female flower production averaged 52,397 per hectare of which 36,552 buttons were aborted.

The three agri-meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained satisfactorily. The distribution of rainfall during the first half of the year was unsatisfactory compared to the second half. The Isolated Seed Garden recorded an all time low rainfall of 850.2 mm with 73 wet days.

4.8 Estates Management Division

The division managed five estates, two research and demonstration farms and two seed gardens.

The general condition of the properties continued to improve. Better agricultural standards and enhanced profitability were sustained without a decline. Use of herbicides in cultural practices, especially in maintenance of manure circles and roadways became increasingly popular resulting in a considerable saving in costs.

The Differential Fertilizer Recommendations based on foliar analysis were introduced to all estates and seed gardens during the year.

An overall increase of coconut yield by about 90% was achieved during the year, which can be attributed to the improved weather conditions and better management.

Soil and moisture conservation measures continued to receive priority attention as practised earlier. Mulching and husk/coir dust burying were intensified. A total of 8.5 ha were newly planted using improved cultivars. The total extent of the young plantation at the end of the year was 262 ha.

Both Makandura Seed Garden (MSG) and Maduru Oya Seed Garden (MOSG) were maintained in good order. Flowering at MSG and MOSG at the end of the year was 26% and 4%, respectively.

Although the disturbances due to subversive activities did not hamper the estate activities in general, some programmes had to be curtailed, particularly new planting at MOSG.

Elephants continued to damage the young plantations at the Minneriya Research & Demonstration Farm and at MOSG. Substantial yield losses due to monkey damage were reported from the Poththukulama Research Station and Isolated Seed Garden.

The rainfall and its distribution during the year were poorer than the previous year's and this could affect the yield in 1990.

4.9 Information Services Division, Library and the Coconut Information Centre

The Information Services Division continued to provide the required technical assistance to the estate sector. A large number of estates and holdings were inspected and advice given.

Two issues of Pol Pawath and Coconut Bulletin and volume No. 6 of the COCOS journal were published during the year. Volume No. 7 of the COCOS journal was with the printer at the end of the year. The Annual Report for 1987 was also published. One advisory circular in the new series on Soil and Moisture conservation in coconut lands was also issued.

The Institute participated in a Mobile Secretariat organized by the Office of the Hon. State Minister of Coconut Industries at Kurunegala.

A field day was arranged for October, but this had to be cancelled owing to the disturbances in the country. A Training Programme was conducted for a group of CRI Estate Supervisors from 13 November to 23 November.

The Library continued to provide its normal services satisfactorily. Routine work such as book acquisition, classification, cataloguing and indexing were carried out effectively. It also provided a current awareness service and an inter-library loan service to CRI staff. A new "Books Announcement Service" was introduced. Library automation activities showed much improvement. The number of books at the end of the year was 4616. With the financial assistance from the International Development Research Centre (IDRC), Canada, the Coconut Information Centre (CIC) continued its activities satisfactorily. The publications programmes, information collection, storage, dissemination and microfiching of literature continued as scheduled.

The first set of microfiched literature was deposited at four centres, viz. University of Los Banos in the Philippines, International Institute of Tropical Agriculture in Nigeria, Caribbean Agriculture Research & Development Institute in Trinidad & Tobago and at the University of South Pacific, Fiji.

The CIC also incorporated two new data bases, viz, Database for newly accessed items and database on desiccated coconut. The centre is now geared to offer information in the form of computer print outs, diskettes or in the form of microfiche, depending on the client's choice.

4.10 Administration Division

The total expenditure during the year was Rs. 42.7 million. The normal welfare activities were continued. The employer-employee relationship was cordially maintained.

The availability of funds during the year was very much restricted by the Treasury. As a result, several activities had to be curtailed, the most affected being the use of vehicles. Building maintenance work too had to be suspended, and no new contracts were awarded.

The staff Provident Fund Scheme and the Medical Aid Scheme progressed satisfactorily. During the last quarter, the grant of distress and transport loans had to be suspended due to financial difficulties.

A new plant house was constructed. At Bandirippuwa Estate, a new toilet was constructed for the workmen.

5. OUTSIDE-FUNDED PROJECTS

5.1 Agricultural Research Project (ARP)

The Agricultural Research Project, funded by the World Bank continued its activities on the development of infrastructural facilities at CRI and substations. However, due to the financial restrictions imposed by the government, construction work was suspended.

Whilst three officers continued their postgraduate studies under the sponsorship of the ARP, two other officers were awarded scholarships for postgraduate studies.

The Inter-Institutional Research Programme fell behind schedule as the component activities of the Department of Agriculture (Makandura) and Export Agriculture Department could not be carried out due to the disturbances in the country.

5.2 Other Projects

The foreign-aided projects namely the Coconut Information Centre (funded by the International Development & Research Centre, Canada), Tissue Culture Project (funded by the United States Agency for International Development), agronomic projects (funded by the Canadian International Development Agency) and the fertilizer project for small-holders (funded by the Food & Agriculture Organization) progressed satisfactorily.

6. FIELD DAYS, SEMINARS

A 'Coconut Day' and a Field Day organized for the owners and managers of coconut estates had to be cancelled due to the disturbances in the country.

Several short programmes were conducted for visitors/trainees from Sri Lanka and abroad.

A series of discussions amongst research staff was organized to discuss the research highlights and new recommendations arising from the research programme.

The Institute personnel also participated in a number of seminars on coconut research and development. Notable activities included the seminars held in the coconut triangle on Janasaviya (poverty alleviation) programme and Agro Mart programme.

7. VISITORS

The important visitors to the Institute during the year included the following:

Mr Gray Alex, USAID

J Alwis, Secretary to the Minister of State for Coconut Industries

Mr O Cruz, UCAP, Philippines

Mr M A T de Silva, Addl. Director General, NARESA

Mr John B Flynn, USAID

Prof. G C N Jayasuriya, Director General, NARA

Dr G Kemmler, Federal Republic of Germany

Mr S Lampe, FAO

Dr M J Lawrance, University of Birmingham, UK

Mr S M L Marikar, Secretary, Ministry of Plantation Industries

Mr J J Neeteson, FAO

Mr C L M Nethsinghe, Sri Lanka Library Association

Mr B Prunieres, Cultural Attach, French Embassy

The Hon. Sarathchandra Rajakaruna, Minister of State for Coconut Industries

Mr P V Ramakrishna, World Bank

Dr M Rezanla, FAO

Dr I Serejski, World Bank

Prof. M U S Sultanbawa, Chairman, CISIR

8. STAFF MATTERS

8.1 Overseas Training

Mrs W M U Fernando, Assistant Genetist & Plant Breeder left the island on 1 June to pursue postgraduate studies at the University of Birmingham, UK.

Dr (Mrs) C Jayasekera, Officer-in-Charge, Plant Physiology Unit attended a Training course on Isotopes and Radiation Techniques in Soil/Plant Relationships, in Malaysia from 06 November, to 08 December.

Mrs S M Karunaratne, Officer-in-Charge, Tissue Culture Unit attended a workshop on Biotechnology and Allied Science, in India from 22-28 January.

Mr U S S Perera, Technical Assistant, Soils & Plant Nutrition Division participated in a study tour on Fertilizer Usage in India from 04 to 14 September.

Mrs C N K Rajapakse, Assistant Crop Protection Officer, left the island on 15 September, to pursue postgraduate studies at the Texas A & M University, USA.

Mr L P Vidhana Arachchi, Assistant Soil Scientist, attended a College in Soil Physics, in Italy from 02 to 27 October.

Mr L P Vidhana Arachchi, Assistant Soil Scientist, left the island on 29 November, to pursue postgraduate studies at the University Sains Malaysia, Malaysia.

Mrs L K Weerakoon, Assistant Botanist, left the island on 15 August, to pursue postgraduate studies at the University of Illinois, USA.

The following officers continued their postgraduate studies:

Ms M B M N Dias, Asst. Soil Scientist, University of Queensland, Australia

Mr D N S Fernando, Asst. Agronomist, University of Reading, U K

Mrs L C P Fernando, Asst. Crop Protection Officer, University of Queensland,
Australia

Mr H A J Gunatilaka, Asst. Agronomist, University of North Wales, U K

Mr R A J R Perera, Asst. Agricultural Economist, University of North Carolina,
U S A

Mr L L W Somasiri, Asst. Soil Scientist, University of Aberdeen, U K

8.2 Overseas Visits

Mr M Jeganathan, Senior Research Officer, Soils & Plant Nutrition Division attended the XI International Plant Nutrition Colloquium, in the Netherlands from 30 July to 09 August.

Mrs S M Karunaratne, Officer-in-Charge, Tissue Culture Unit attended the meeting of the Permanent Panel on Coconut Technology (COCOTECH) in Thailand from 15 to 19 May.

Mr M de S Liyanage, Head, Agronomy Division attended the Regional Symposium on Recent Developments in Tree Plantations in the Tropics, in Malaysia from 04 to 10 June.

Dr R Mahindapala, Director attended the meeting of the Permanent Panel on Coconut Technology (COCOTECH) in Thailand from 15 to 19 May.

Dr R Mahindapala, Director attended a meeting of Research Managers in Coconut Research, Singapore from 12 to 14 September.

Mr T S G Peiris, Biometrician attended a conference on Statistics for Repeated Measurements, in Italy from 07 to 09 September.

Mr M J C Perera, Project Leader, Coconut Information Centre attended a meeting on Integrated Coconut Information System for Asia & the Pacific, in Indonesia from 12 to 19 August.

Dr M R T Wickramaratne, Head, Genetics & Plant Breeding Division attended the meeting of the Permanent Panel on Coconut Technology (COCOTECH) in Thailand from 15 to 19 May.

8.3 Participation of CRI staff in other Statutory bodies, Committees etc.

The following CRI staff members served in Boards/Committees as indicated below:

Dr R Mahindapala

Member, Board of Governors, National Institute of Plantation Management.

Member, Board of Management, Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya.

Member, Working Committee on Agriculture and Animal Husbandry, Natural Resources, Energy and Science Authority of Sri Lanka.

Member, Committee on Biological Control of Salvinia, Natural Resources, Energy & Science Authority of Sri Lanka.

Member, Editorial Committee, Natural Resources, Energy and Science Authority of Sri Lanka.

Mr M Jeganathan

Member, Drafting Committee on Fertilizer, Sri Lanka Standards Institution.

Mr K S Jayasekera

Member, Fertilizer Coordinating Committee of the National Fertilizer Secretariat.

Member, Committee on the use of Organic Manures, Ministry of Agriculture Development & Research.

Mrs S M Karunaratne

Member, Sub-Committee on Biotechnology, University Grants Commission.

Mr T S G Peiris

Secretary, Section B, Sri Lanka Association for the Advancement of Science.

Dr P A C R Perera

Member, Sri Lanka Pesticides Formulary Committee.

9. PUBLICATIONS AND COMMUNICATIONS AT SCIENTIFIC MEETINGS

Dassanayake, K B (1989) Impact of coconut-based cropping systems on coconut production and soil properties. Research Seminar for Young Scientists, Institute of Biology, Dec. 1989, Colombo.

Gunasekera, T G L G (1989) Rehabilitation of low-yielding coconut palms. Coconut Bulletin 6 (1): 14-15.

Henry Nimal, P A (1989) Coconut Cultivation in the Muthurajawela marsh Coconut Bulletin 6 (1): 5-8.

Henry Nimal, P A (1989) Place of coconut in home gardens. Coconut Bulletin 6 (1): 16-19.

Jayasekera, C & W P K K Fernando (1989) Studies on sugars and vitamins in coconut water by High Performance Liquid Chromatography. Annual sessions of the Sri Lanka Association for the Advancement of Science, Dec. 1989, Colombo.

Jayasekera, K S (1989). Efficient Use of Fertilizers in Coconut. "Symposium on Fertilizer and their Efficient Fertilizer Utilization" organised by the Institute of Chemistry, Ceylon. University of Peradeniya, March, 1989 Kandy.

Jayasekera, K S (1989). Boron Deficiency in Coconut. Coconut Bulletin 6 (2): 19-20.

Jayasekera, K S (1989). Efficient Use of Dolomite in Coconut Cultivation. Coconut Bulletin 6 (2): 9.

Jayasekera K S (1989). Use of Eppawala Rock Phosphate in coconut. "National Symposium on the Eppawala Phosphate Deposit-Recent Advances in Knowledge" organised by the Institute of Fundamental Studies, 16- 17 Dec. 1989, Kandy.

- Jayasekera, K S & P Loganathan (1988).** Born deficiency in young coconut *Cocos nucifera* L) in Sri Lanka - Symptoms and corrective measures *Cocos* 6: 31- 37.
- Jayasekera, K S, S Periyathamby, & N S Jayalath, (1989).** Measure your Fertilizer Easily. *Coconut Bulletin* 6 (2): 7-8.
- Jayasundara, H P S (1989).** Effect of green manuring with *Gliricidia sepium* and *Leucaena leucocephala* on soil properties and coconut production. Research Seminar for Young Scientists. Institute of Biology, Dec. 1989, Colombo.
- Jayasundara, H P S, L V K Liyanage & M Bastian (1989)** Improvement of soil properties using Nitrogen Fixing Trees as green manure for coconut. Annual Sessions of the Sri Lanka Association for the Advancement of Science, 1989, Colombo.
- Jayasundara, H P S, D T Mathes & M de S Liyanage (1989)** Impact of an integrated farming model on the productivity of coconut lands. Annual Sessions of the Sri Lanka Association for the Advancement of Science, 1989, Colombo.
- Jayasundara, M G F S (1989).** Mycorrhizae in coconut. Paper presented at the Research Seminar for Young Scientists, Institute of Biology, Dec. 1989, Colombo.
- Jeganathan, M (1989).** Hazards in Perennial Crop Nutrition. Presidential Address to Section B. Annual Sessions of the Sri Lanka Association for the Advancement of Science, Dec. 1989, Colombo.
- Karunaratne, S M (1989)** Current state-of-the-art of the use of tissue culture techniques in vegetative propagation of coconut in Sri Lanka. In *Coconut Production and Productivity; Proceedings of the 26th COCOTECH meeting* (ed. Sumith de Silva) Asian & Pacific Coconut Community. PP 298- 302.
- Karunaratne, S M & Kaushalya Periyapperuma (1989)** Culture of immature embryos of coconut, *COCOS NUCIFERA* L: Callus proliferation and Somatic embryogenesis. *Plant Science* 62 (2): 247-253.
- Liyanage, D V, M R T Wickramaratne & C Jayasekera (1988)** Coconut breeding in Sri Lanka *COCOS* 6: 1-26.
- Liyanage, L V K, H P S Jayasundara, D T Mathes & D N S Fernando (1989)** Integration of pasture/tree fodder/cattle in coconut smallholding *CORD*, 5:53-66.

- Liyanage, M de S & H P S Jayasundara (1989)** Effects of shading on seedling growth of *Gliricidia sepium*.. Nitrogen Fixing Tree Research Report. 7, 95-96
- Liyanage, M de S, K B B Dassanayake & M J I Costa (1989).** Effect of nitrogen and potassium fertilizer levels on the growth and yield of cocoa intercropped with coconut in the wet zone of Sri Lanka. CIDA/NARESA Grantees seminar, 16-17 May, Kalutara.
- Liyanage, M de S, K B Dassanayake, H P S Jayasundara & T G L G Gunasekera (1989)** Productive land use systems in coconut plantations of Sri Lanka. Regional Symposium in Recent Development on Tree Plantations of the humid/sub-humid tropics of Asia. June, Malaysia.
- Mahindapala, R (1989)** Coconut diseases in Sri Lanka. In Coconut Production and Productivity; Proceedings of the 26th COCOTECH meeting (ed. Sumith de Silva) Asian & Pacific Coconut Community. pp 236-251.
- Peiris, T S G (1989)** Forecasting the crop yield of a coconut estate. *CORD* 5 (2): 67-76.
- Peiris, T S G (1989).** An alternative approach for analysing repeated measurements data in perennial crops. Presented at the conference held in Bressanone, Italy. Sep. 1989.
- Peiris, T S G & R D Stern (1988).** Use of Statistical package SAS: A case from Coconut Research Institute. *Cocos* 6: 38-52.
- Peiris, T S G & E K Seneviratne (1989).** The use of daily rainfall in analysing repeated measurements data in perennial crops. Annual Session of the Sri Lanka Association for the Advancement of Science, Dec. 1989, Colombo.
- Perera, P A C R, R Mahindapala & U Pethiyagoda (1989)** A Technique for the application of systemic insecticides through petiolar wells in coconut. *COCOS* 7, 30-35.
- Perera, P A C R, M P Hassell & H C J Godfray (1989).** Population dynamics of the coconut caterpillar, *Opisina arenosella* Walker (Lepidoptera: Xylorictidae), in Sri Lanka. *COCOS* 7, 37-42 (Reprinted from *Bull ent. Res.*).
- Pinto, J L J G (1989).** Toxins in copra and by-products. *Coconut Bulletin* 6 (1): 9-10.
- Ranasinghe, C S (1989).** Physiological and biochemical characters of different varieties and cultivars of coconut. Research Seminar for young scientists, Institute of Biology, Dec. 1989, Colombo.

Tennekoon, N A & D T Mathes, (1989). Decomposition of goat dung and the availability of nutrients to the coconut palm. Paper presented at the 45th Annual Sessions of Sri Lanka Association for the Advancement of Science. Dec. 1989, Colombo.

Way, M J, M E Cammell, B Bolton & P Kanagaratnam (1989) Ants (Hymenoptera: Formicidae) as egg predators of coconut pests, especially in relation to biological control of the coconut caterpillar, *Opisina arenosella* Walker (Lepidoptera: Xylorictidae), in Sri Lanka. Bulletin of Entomological Research 79 (2): 219-233.

Wickramaratne, M R T (1989). Assesement of experience with high yielding varieties of coconut in Sri Lanka. In Coconut Production and Productivity; Proceedings of the 26th COCOTECH meeting, (ed. Sumith de Silva) Asian & Pacific Coconut Community. pp 66-75.

10. ACKNOWLEDGEMENTS

The assistance of the staff of the Coconut Research Institute in the implementation of the programme of work is gratefully acknowledged. Some staff members, in particular in the outstations, had to undergo considerable hardship in the discharge of duties due to the disturbed conditions in the country. Their service is deeply appreciated.

The valuable assistance rendered by the members of various committees appointed by the Board is gratefully acknowledged.

The assistance of the following organizations is also acknowledged:

The United States Agency for International Development
Natural Resources, Energy and Science Authority of Sri Lanka
International Development & Research Centre, Canada
Food & Agriculture Organization
The British Council & the Overseas Development Administration
The International Atomic Energy Agency
The Australian Development Assistance Bureau
The Agricultural Research Project funded by the World Bank
Ministry of Coconut Industries
The Coconut Development Authority

REPORT OF THE AGRONOMY DIVISION

Head - M de S Liyanage, MSc

1. GENERAL

1.1 Staff matters

Appointments:

Mr M T N Fernando, as Assistant Agricultural Economist with effect from 19 June.

Mr M de S Liyanage, Agronomist, as Head of Agronomy Division with effect from 01 July.

Promotions:

Technical Grade:

Mr W M U Wijeratne - Class II to I with effect from 01 January, 1987.

Mr H A Abeysoma - Class II to I with effect from 01 January.

Clerical & Allied Grade:

Mr A A D N Athauda - Class I to Special Class with effect from 01 January.

Operative Grade:

Mr D Amarasinghe - Class I to Special Class with effect from 01 January.

Messrs P D Benet Silven, M D V Saparamadu and

E M Gunarathnabanda - Class II to I with effect from 01 January, 1987.

Minor Grade:

Messrs K J S Perera, W Primus Fernando and F H A J Ryle Silva - Class I to Special Class with effect from 01 January, 1987.

Messrs A Dayawansa, K D D Appuhamy and P W A Fernando - Class I to Special Class with effect from 01 January, 1988.

Mr Peter Peiris - Class II to I with effect from 01 January, 1987.

Transfers:

Mr M H F G Ivan Appuhamy, Technical Assistant, to Estate Management Division as Officer-in-charge, Bandirippuwa Estate with effect from 01 January.

Resignations:

Messrs J M J Jayamanna and K M Punchibanda Lab/Field Attendants resigned from the Institute on 01 July.

Study Leave:

Messrs D N S Fernando and H A J Gunathilake, Assistant Agronomists continued post-graduate studies in the United Kingdom at the University of Reading and University College of North Wales, respectively.

Mr R A J R Perera, Assistant Agricultural Economist continued post-graduate studies at North Carolina State University, USA.

1.2 Consultancy:

Mr A S Ranatunga continued to function as a Consultant in Agricultural Economics.

2. RESEARCH PROJECTS

PROJECT 1 - STUDIES ON THE IMPROVEMENT OF SOIL ORGANIC MATTER STATUS AND WATER HOLDING CAPACITY.

Experiment 1.6 - In each of the following experiments 1.6.1 and 1.6.2 once a year ploughing treatment was not imposed due to severe drought during the Maha season (Oct/Nov). However, soil physical parameters such as moisture content, bulk density and porosity were measured during the dry season. Records on nut yield, copra weight, number of female flowers and fallen immature nuts were maintained.

Experiment 1.6.1 - Effect of three frequencies and two depths of ploughing on the performance of coconut in sandy soil. Jacintha Estate, Palavi - 1984.

There was no significant difference in various yield components of coconut due to treatments. However, soil moisture content at 25 cm depth in ploughed plots increased by 5.2% over the control. Also, soil samples collected from ploughed plots registered a higher porosity and lower bulk density over those in control plots.

The experiment is in progress.

T G L G Gunasekera and A M U Wijeratne

Experiment 1.6.2 - Effect of three frequencies and two depths of ploughing on the performance of coconut in lateritic soil. Heenmaliyagara Estate, Dummalasuriya - 1984.

There was no significant difference in various yield parameters of coconut among treatments. However, ploughing treatment increased moisture content of soil at 25 cm depth by 4.5%, improved total porosity and reduced bulk density of soil over that of control plots.

The experiment is in progress.

T G L G Gunasekera and A M U Wijeratne

Experiment 1.9.1 - Effect of different methods of placement of husk and coir dust on moisture conservation in lateritic gravel soil. Kinyama Estate, Bingiriya - 1984.

During the year, records on nut yield, copra weight, number of female flowers and fallen immature nuts were maintained. Routine management practices such as fertilizer application and weeding were completed. Soil moisture content was measured during the dry period using the gravimetric method.

Among treatments, pits measuring 2.4 m x 1.2 m x 1.9 m (8x4x3 ft.) filled with husk and coir dust, single husk pits of 1.2 m x 1.2 m x 0.9 m (4x4x3 ft.) dimensions and single layer of husk mulch were more effective than control as indicated by an increase of higher moisture content in the soil which varied from 9-28% during the dry period. Of the treatments, yield of palms treated with a layer of husk mulch was significantly better ($P=0.05$), and soil under the mulch retained more moisture than in the others.

The experiment is in progress.

M de S Liyanage and H A Abeysoma

Experiment 1.9.2 - Effect of different methods of placement of husk and coir dust on moisture conservation in sandy soil. Jacintha Estate, Palavi - 1984.

Records on nut yield, copra weight, number of female flowers and fallen immature nuts were maintained throughout the year. Moisture content of soil was measured during the dry period.

In this experiment, palms treated with 2.4 m x 1.2 m x 0.9 m husk pits and those treated with an individual husk pits of 1.2 m x 1.2m x 0.9 m showed a better response than those in control plots, giving 2-5% increase in copra yield.

Soil samples drawn near the husk pits and underneath husk mulch registered a higher moisture content ranging from 31.5 to 35.8%, compared with the control.

The experiment is in progress.

M de S Liyanage and H A Abeysoma

Experiment 1.10 - Effect of five different methods of management practices on the performance of three ground covers and their effects on coconut production - 1987.

Experiment 1.10.1 - Saddhatissa Estate, Divulapitiya (Wet Zone Lateritic gravel).

Two samples were taken during the year to estimate the biomass yield of cover crops. Of these, *Pueraria phaseoloides* produced the highest top dry matter of around 4700 kg/ha/year and suppressed weed growth as much as 90% compared with control plots. Both *Calopogonium mucunoides* and *Centrosema pubescens* performed poorly in this regard (Table 1).

Table 1 - Mean biomass yield of three Leguminous cover crops and weed species in the wet zone (experiment 1.10.1).

<i>Cover crop</i>	<i>Dry biomass yield (kg/ha/year)</i>	
	<i>Cover crop</i>	<i>Weeds</i>
<i>Pueraria</i>	4707	236
<i>Centrosema</i>	1002	1386
<i>Calopogonium</i>	1623	1501
<i>Coconut only (control)</i>	-	3122

Records on nut yield, copra weight, female flowers and setting percentage were maintained throughout the year.

The experiment is in progress.

H P S Jayasundara, M de S Liyanage and K C P Perera

Experiment 1.10.2 - Poththukulama Research Station, Pallama (Dry Intermediate Zone, Sandy loam soil).

Four samples of the cover crop species were taken to estimate top dry matter yields. Here too, *Pueraria* produced the highest dry matter (5300 kg/ha/year) and suppressed weed growth by about 50% over the control, while *Macroptilium atropurpureum* performed poorly giving 3000 kg/ha/year. The performance of *Centrosema pubescens* was also very satisfactory, which produced 4300 kg/ha/year of top dry matter and the highest leaf litter yields of around 3500 kg/ha/year (Table 2).

Table 2 - Mean Biomass yield of three Leguminous cover crops and weed species in the Dry-Intermediate Zone (experiment 1.10.2).

<i>Cover crop</i>	<i>Top dry matter yield</i>	<i>Leaf litter yield</i>	<i>Weeds</i>
	-----kg/ha/year-----		
<i>Pueraria</i>	5286	2889	1880
<i>Centrosema</i>	4339	3453	2518
<i>Macroptilium</i>	2960	2715	2802
<i>Coconut only (control)</i>	-	-	3775

Records on nut yields, copra weight, female flowers and percentage setting were maintained throughout the year.

The experiment is in progress.

H P S Jayasundara, M de S Liyanage and R Marasinghe

Experiment 1.11 - Maximisation of biomass production of *Gliricidia sepium* under coconut. Ratmalagara Estate, Madampe - 1989.

In recent years, *Gliricidia* has received increasing attention as a multipurpose tree for coconut-based farming systems. Research conducted in the past demonstrated that *Gliricidia* is adaptable to a wide range of soils and climates and capable of producing large quantities of biomass. Reports from other countries indicate that biomass production of *Gliricidia* is affected by the type of planting material and pruning regime. Information on these aspects is meagre in Sri Lanka, especially in relation to the coconut system.

Objectives: (1) Compare biomass production of seedlings and mature cuttings at different pruning cycles under coconut. (2) Effect of *Gliricidia* on coconut production.

- Treatments:**
1. Type of planting material
 - 1.1 Poly-bagged seedlings
 - 1.2 Mature stem cuttings
 2. Pruning regimes
 - 2.1 Six monthly interval (two cutbacks/year)
 - 2.2 Four monthly interval (three cutbacks/year)

Design: 2x3 factorial design arranged in a randomised complete block design with five replications.

Mature stem cuttings of 1.5 m long and 2-3 cm in diameter and two-month old seedlings of *Gliricidia* were planted in 30cm x 30cm x 30cm pits at a spacing of 2m x 0.5m in double rows giving a density of 4000 plants/ha. The initial survival and growth rate for seedlings and cuttings were measured six months after planting. It was observed that initial field establishment of seedlings was superior to cuttings showing almost 100% survival compared with 56% for cuttings. At the early stages, however, production of branches/tree raised from cuttings appeared to be higher than that from seedlings.

Records on nut yield, copra weight, female flowers and setting percentage were maintained.

The experiment is in progress.

H P S Jayasundara, M de S Liyanage and M Bastian

PROJECT 2 - REHABILITATION OF LOW YIELDING PLANTATIONS

Experiment 2.2.1 - Effect of cultural operations designed to induce root formation on the rehabilitation of low yielding plantations in lateritic gravel soil. Heenmaliyagara Estate, Dummalasuriya - 1984

Records on coconut yield, copra weight, number of female flowers and immature nutfall were maintained during the year.

Results given in Table 3 show that treatments caused a significant difference in number of nuts/palm, copra weight and copra content compared with control. Among these, treatments consisting of opening quarter circle trenches around the palm and filling up with either *Gliricidia* loppings (T₁), goat manure (T₂) or sand (T₃) significantly increased the number of nuts/palm, copra weight (P=0.01) and copra content (P=0.05) over the control.

The experiment is in progress.

T G L G Gunasekera and A M U Wijeratne

Experiment 2.2.2 - Effect of cultural operations designed to induce root formation on the rehabilitation of low yielding plantations in lateritic gravel soil. Puwakwatta Estate, Kotadeniyawa - 1984.

During the year, records on nut yields, copra weight, number of female flowers and immature nutfall were kept.

Results given in Table 4 indicate that treatments induced a significant increase only in copra content over the control. Here again, opening of quarter circle trenches around the palm showed a better response in terms of nut yield/palm and copra weight.

The experiment is in progress.

T G L G Gunasekera and A M U Wijeratne

Table 3 - *Effect of cultural operations on coconut and copra production (experiment 2.2.1).*

<i>Treatments</i>	<i>Nut yield (nuts/palm/year)</i>	<i>Copra content (g/nut)</i>	<i>Copra yield (MT/ha)</i>
T ₁	72.1	193.9	2.24
T ₂	66.3	195.9	2.07
T ₃	76.1	177.2	2.14
T ₄	59.6	176.9	1.68
T ₅	61.7	187.8	1.85
T ₆	67.6	192.0	2.07
T ₇	58.0	184.5	1.70
T ₈	51.6	180.8	1.49
T ₉	50.4	181.1	1.45
T ₁₀	56.4	172.9	1.55
T ₁₁ (Control)	65.5	177.4	1.85
Significance	**	*	**
LSD (P=0.05)	12.83	14.85	0.382
CV (%)	12.05	4.73	12.25

- T₁ = Opening up of 1/4 circle trench and filled with Gliricidia leaves.
T₂ = Opening up of 1/4 circle trench and filled with Goat dung.
T₃ = Opening up of 1/4 circle trench and filled with Sandy soil.
T₄ = Opening up of 1/2 circle trench and filled with Gliricidia leaves.
T₅ = Opening up of 1/2 circle trench and filled with Goat dung.
T₆ = Opening up of 1/2 circle trench and filled with Sandy soil.
T₇ = Opening up of full circle trench and filled with Gliricidia leaves.
T₈ = Opening up of full circle trench and filled with Goat dung.
T₉ = Opening up of full circle trench and filled with Sandy soil.
T₁₀ = Opening up of full circle trench and filled with same soil.
T₁₁ = Control.

Table 4 - *Effect of cultural operations on coconut and copra production (experiment 2.2.2).*

<i>Treatments</i>	<i>Nut yield (nuts/palm/year)</i>	<i>Copra content (g/nut)</i>	<i>Copra yield (MT/ha)</i>
T ₁	62.0	194.2	1.93
T ₂	51.7	196.2	1.60
T ₃	50.5	191.0	1.54
T ₄	50.0	193.8	1.53
T ₅	48.5	206.2	1.61
T ₆	48.6	200.5	1.56
T ₇	42.9	182.4	1.25
T ₈	50.2	180.0	1.44
T ₉	41.6	164.0	1.09
T ₁₀	47.8	176.3	1.34
T ₁₁ (Control)	49.2	180.2	1.41
Significance	n.s	**	n.s
LSD (P=0.05)	-	18.01	-
CV (%)	17.10	5.62	19.12

Treatments as in Table 3.

PROJECT 3 - STUDIES ON THE ESTABLISHMENT AND MANAGEMENT OF NEWPLANTINGS/REPLANTINGS.

Experiment 3.1 - Effect of management practices on the establishment and growth of coconut seedlings in the dry zone. Poththukulama Research Station, Pallama - 1989.

The treatments of the experiment were amended and relocated at the above site. After clearing and field preparation, poly-bagged coconut seedlings of tall x tall (CRIC 60) variety were planted during the 'Maha' season (October/November), at a spacing of 7.3m x 6.3m, giving a density of 210 palms/ha.

The following treatments will be arranged in a randomized block design with four replicates.

- Treatments:** T₁ - Coconut only (Control)
T₂ - Ground cover of Pueraria
T₃ - Double rows of Gliricidia seedlings
T₄ - Pitcher irrigation (two pitchers/palm)
T₅ - Husk trench around coconut seedlings (half circle)

The experiment is in progress.

M de S Liyanage, K B Dassanayake and H A Abeysona

Experiment 3.2 - Development of suitable cropping systems to increase productivity of land in new plantings/replantings in the dry zone. Poththukulama Research Station, Pallama - 1989.

Despite the agronomic superiority and long-term economic benefits of replanting over under-planting of coconut, the majority of coconut growers still prefer under-planting, purely for economic reasons. Thus, an income generating catch cropping systems would form an integral part of the strategy to encourage replanting in the dry zone. The development of a rectangular planting system to accommodate such cropping systems is another aspect which needs to be looked into. Therefore, an experiment was designed to include the following objectives:

1. To develop a viable, stable and sustainable food and forage crop production system.
2. To study the effect of such cropping systems on the growth and establishment of coconut seedlings.

The following treatments are included in a randomized complete block design with four replications.

- Treatments:** T₁ - Coconut + *Leucaena* (cv. K 636) + Annual food crops
T₂ - Coconut + *Gliricidia* + Annual food crops
T₃ - Coconut + *Leucaena* (cv. K 636) + *Brachiaria brizantha*
T₄ - Coconut + *Gliricidia* + *B. brizantha*
T₅ - Coconut only (control)

Land preparation was completed and poly-bagged coconut seedlings of variety *tall x tall* (CRIC 60) were planted during 'Maha' (October/November) season, at a spacing of 10m x 5m giving 200 palm/ha.

The experiment is in progress.

K B Dassanayake, M de S Liyanage and H A Abeysoma

PROJECT 4 - STUDIES ON FIELD MANAGEMENT SYSTEMS

Experiment 4.1.2 - Utilization of animal husbandry for optimization of coconut production. Ratmalagara Estate, Madampe - 1985.

During the year, this experiment was maintained as a model to demonstrate the feasibility of integrating legume-based pasture, tree fodder and cattle with coconut and for supplementing inorganic fertilizer with cattle manure for the palms.

Routine management practices such as lopping of fodder trees, rotational grazing and recording of coconut yield were carried out during the year. Coconut palms in the integrated system were supplied with only sub-optimal levels of 750 g muriate of potash and 180 g saphos phosphate while those in the control plot were fertilized with 3 kg/palm of Adult Palm Mixture.

During the year, palms in the integrated system showed an increase of 17.5% in nut and 11.4% in copra yields over monoculture system (Table 5). Also, in the integrated system, leaf nutrient levels of palms were above the critical levels and soil organic matter, total nitrogen and available phosphorus levels were significantly higher than in the monoculture system. In the first lactation period which commenced during the year, cattle produced 7-10 litres of milk per day, providing an additional income.

The experiment is in progress.

H P S Jayasundara and R Marasinghe

Table 5 - Effect of Pasture (Fodder and Cattle Integration on Coconut Production (experiment 4.1.2).

System	Coconut yield (nuts/ha/year)			Copra Yield (kg/ha/year)	
	1986	1987	1988	1989	1989
Integrated system	13856	12624	10592	16072	3319
Monoculture system (control)	13728	12416	10642	13600	2980
% increase over control	-	-	-	17.5	11.4

Experiment 4.2.3 - On-farm cropping models in the wet and wet- intermediate zone of coconut triangle - 1987.

Of the 23 crop models established, six had to be abandoned due to various management problems.

During the year, data on external inputs, crop yields and socio- economic aspects were collected from 17 crop models.

Guidance and advice to the farmers were provided regularly.

The experiment is in progress.

A S Ranatunga, K B Dassanayake, M T N Fernando and S D J N Subasinghe

Experiment 4.2.4 - Coconut-based farming systems in small- holdings.

During the year, coconut intercropping programme was initiated under the Inter-Institutional Research Project. The main purpose of this programme is to establish eight crop models and four crop/livestock farm models in coconut small-holdings in the wet, wet-intermediate, dry-intermediate and dry zone of the coconut triangle. In the implementation of farm models, agronomy division will collaborate with pasture division of the Veterinary Research Institute, Gannoruwa, Peradeniya.

During the year, two crop models and three farm models were established in the wet, wet-intermediate and dry zone.

The experiment is in progress.

M de S Liyanage, K B Dassanayake, M T N Fernando and S D J N Subasinghe

Experiment 4.3 - Quantitative study on the production of fuelwood in *Leucaena leucocephala* grown in different planting systems under coconut and its effect on nut production. Ratmalagara Estate, Madampe - 1986.

During the year, records on nut yield, copra weight, number of female flowers and immature nutfall of effective palms were maintained. Wood biomass yield of *Leucaena* was estimated by cutting the stem to a height of 1.0 m above ground.

No significant difference in yield components of coconut was observed in *Leucaena* plots compared with the control. In plots where double rows of *Leucaena* were planted in alternate avenues, palms showed an increase of 6% in nut and 3.2% in copra weight over those in control plots. *Leucaena* in the double row system produced a wood yield of 10,000 kg/ha compared with 5600 kg/ha in the single row system.

The experiment is in progress.

T G L G Gunasekera and A M U Wijeratne

Experiment 4.4 - Evaluation of *Gliricidia sepium* provenances in the intermediate zone of coconut triangle. Ratmalagara Estate, Madampe - 1987.

Experiment 4.4.1 - Alley cropping system.

During the year, four prunings were done on *Gliricidia* provenances to determine biomass yields. Data on primary growth and fresh biomass yield of five most promising provenances are summarised in Table 6. Provenances OFI 14/84, 24/86, 17/84, 15/84 and 13/84 produced a mean biomass yield of 8.3 kg/tree/year compared with 6.6 kg/tree/year in the local cultivar.

The experiment was concluded.

H P S Jayasundara, M de S Liyanage and R Marasinghe

Table 6 - Growth and fresh Biomass yield of high yielding Gliricidia Provenances 12 months after planting in the Intermediate Zone (experiment 4.4.1).

<i>Provenance</i>	<i>Tree height (cm)</i>	<i>Stem girth (cm)</i>	<i>Fresh biomass yield (kg/tree/year)</i>
OFI 14/84	363	18.6	10.18
OFI 13/84	354	17.4	7.36
OFI 15/84	333	17.0	7.79
OFI 24/86	327	15.8	8.36
OFI 17/84	296	14.9	7.84
Local cultivar	318	17.1	6.59
CV %	9.29	12.36	24.47

Experiment 4.4.2 - Monocropping system.

Growth measurements of Gliricidia provenances were taken 15 months after planting. During the year, half of the trees from each plot were cutback to determine fresh wood biomass. Three trees from each plot were sun-dried for estimation of dry wood yield and the remaining trees were cutback 24 months after planting. In terms of dry wood yield, provenances 14/84, 24/84, 15/84 and 13/84 were identified as promising.

The experiment was concluded.

H P S Jayasundara, M de S Liyanage and R Marasinghe

PROJECT 7 - STUDIES ON THE NUTRIENT REQUIREMENT OF COCONUT

Experiment 7.12.1: Demonstration on the use of cover crops and gliricidia in coconut lands

(Note - Expt. No. 4.5 in 1988 report changed as above)

During the year, *Pueraria* cover and gliricidia trees were maintained satisfactorily. Manuring of coconut palms was completed as per treatments at both locations (Ratmalagara and Walpita Estates).

Records in nut and copra yield, female flowers and setting percentage were maintained.

The experiment is in progress.

H P S Jayasundara, L L W Somasiri and K C P Perera

PROJECT 20 - INTERCROPPING

Experiment 20.2 - Mixed cropping model 1, to study the agronomic and economic feasibility of growing cocoa, coffee and pepper together as mixed crops under coconut. Walpita Estate, Kotadeniyawa - 1977.

The experiment was concluded in April.

K B Dassanayake and M J I Costa

Experiment 20.4 - Mixed cropping model 11, to study the agronomic and economic feasibility of growing cocoa and pepper together as mixed crops under coconut. Walpita Estate, Kotadeniyawa - 1977.

The experiment was concluded in April.

K B Dassanayake and M J I Costa

Experiment 20.5 - Effect of four levels of nitrogen and five levels of potassium on the growth and yield of cocoa mixed with coconut. Walpita Estate, Kotadeniyawa - 1981.

(CIDP/85/16 fertilizer project)

The yield parameters of Cocoa cv. F4 Amazon, measured during the year, are given in Table 7.

Table 7 - Yield of Cocoa due to different levels of nitrogen and potassium (experiment 20.5).

<i>Treatments</i>	<i>Number of pods/tree/year</i>	<i>Number of beans/pod</i>	<i>Weight of 100 beans (g)</i>	<i>Dry bean yield g/tree/year</i>
Nitrogen levels				
N ₀	23.5	36.4	90.91	801.41
N ₁	34.9	38.2	101.00	1397.60
N ₂	40.3	39.7	104.96	1687.58
N ₃	37.2	40.9	105.69	1573.50
Potassium levels				
K ₀	24.4	35.9	94.39	845.50
K ₁	27.6	37.9	98.39	1159.92
K ₂	36.9	39.4	101.13	1410.52
K ₃	42.1	40.5	104.66	1772.02
K ₄	38.9	40.2	104.61	1647.60
Significance N	***	***	***	***
K	***	***	***	***
N & K	*	*	**	n.s
Std. Error (±) N	2.64	0.48	1.54	123.06
K	2.95	0.54	1.73	137.90
CV (%) 12.28	2.94	2.42	14.28	

As in the previous year, nitrogen (N) and potassium (K) levels exerted a significant difference in yield characters. Among nitrogen treatments, both N₂ and N₃ levels significantly increased the number of beans/pod, weight of 100 beans and dry bean yield per tree. Different levels of potassium showed a similar trend in yield response reaching an optimum at K₃ level for all parameters. Thus, it is apparent that moderately high levels of nitrogen (N₂) and potassium (K₃) are required for obtaining optimum bean yield of cocoa under coconut. There was also a significant positive interaction between N and K levels for all yield parameters except dry bean yield/tree.

The experiment is in progress.

M de S Liyanage, K B Dassanayake and M J I Costa

**Experiment 20.6 - Demonstration of mixed cropping systems in coconut lands.
Dambuwa Mukalana Estate, Nattandiya - 1981.**

During the year, coconuts and intercrops were maintained satisfactorily. The coconut yield was 11,570 nuts/ha/year giving an average of 73 nuts/palm/year, which indicates a 4% increase over the previous year. Although the annual rainfall (1522 mm) was lower than the average (1875 mm) for the area, it was well distributed throughout the year. The irrigated palms showed a 25% increase in nut yield compared with those maintained under rainfed conditions. This emphasises the importance of supplementary irrigation during the dry period.

Among perennial intercrops, coffee and cocoa performed satisfactorily. Some of the pepper vines were affected by root wilt disease and had to be uprooted. Several pigeon pea selections were introduced and of these, I.C.P.L 84,009 performed well and suppressed weed growth. A nursery to raise coffee, pepper, cocoa, papaw, chilli and brinjal plants was maintained.

Technical advice and issue of planting material to growers continued as in the previous year.

M de S Liyanage and K D D Appuhamy

MULTI-DISCIPLINARY RESEARCH PROGRAMME

1. STUDIES ON REHABILITATION OF TAPERING PALMS AND PALMS SHOWING LEAF SCORCH DECLINE USING CULTURAL PRACTICES. WALPITA ESTATE, KOTADENIYAWA - 1989 (in collaboration with Plant Physiology Division).

Leaf Scorch Decline (LSD), is a disorder of the coconut palms, first recorded in Southern province around 1955. This condition appears to be associated with one or more reasons and, to date there is no definite remedy to suppress the incidence of LSD. It has been suspected that soil physical conditions leading to poor root growth is one of the reasons for the occurrence of LSD. The aim of the study is to promote and induce new root formation around the base of affected palms by means of cultural practices.

Several palms affected with LSD were selected from Walpita estate. The following treatments will be imposed around each palm.

- T₁ - Opening two quarter-circle trenches (30 cm wide and 30 cm deep) on opposite sides of each palm and filling with green manure.
- T₂ - Opening two quarter-circle trenches and filling with cattle manure.
- T₃ - Opening two quarter-circle trenches and filling with soil in the same locality.
- T₄ - Opening two quarter-circle trenches and filling with sandy soil.
- T₅ - Soil building with a mixture of soil and organic matter
- T₆ - Control

The study is in progress.

T. G. L. G. Gunasekera, C. Jayasekera, A. M. U. Wijeratne

2. STUDIES ON EARTHWORMS IN RELATION TO COCONUTS - 1989

The contribution to soil improvement and crop productivity by earthworms is well known. In spite of their beneficial role, earthworm activity still remains to be the least studied component of the soil environment. Since earthworms are very sensitive to changes in the environment, it is expected that management practices undertaken in coconut lands could influence their population and activity.

During the year, a preliminary study was carried out to estimate earthworm population as influenced by agronomic practices (such as green manuring, inorganic/organic fertilizer, cover-cropping mulching, shading, ploughing) and intercropping.

Preliminary results obtained so far indicate that green manuring with *Gliricidia* leaf loppings, organic manuring with goat manure and cover cropping with *Pueraria* improved earthworm population in lateritic soil. Application of inorganic fertilizer mixture consisting of urea, saphos phosphate, muriate of potash and dolomite was detrimental to earthworms. Among intercrops, earthworm population in pepper, cocoa and pasture plots was higher than in control plots.

The study is in progress.

*M de S Liyanage, K B Dassanayake, N A Tennakoon,
M J I Costa and K C P Perera*

3. VISITS, LECTURES AND SYMPOSIA

Messrs. M de S Liyanage and K B Dassanayake participated in the CIDA/NARESA grantees seminar from 16 - 17 May, at Tangerine Beach Hotel, Kalutara.

Mr H P S Jayasundara participated in the Multipurpose Research Network Meeting, from 03 - 04 June, at Hotel Topaz, Kandy.

Mr M de S Liyanage visited Malaysia from 05 - 09 June, to participate at the Regional Symposium in Recent Development of Tree Plantations of the Humid-Subhumid tropics of Asia, held at the University of Pertanian, Malaysia.

Messrs. M de S Liyanage, H P S Jayasundara and K B Dassanayake participated in the Research Seminar for Young Scientists organized by the Institute of Biology held in Colombo on 15 December.

Mr K B Dassanayake delivered a lecture on "Coconut Intercropping and its importance in increasing land productivity and agricultural productions", at the Seminar organised by the Agromart on 28 October at St. Mary's College, Chilaw.

4. EXTENSION ACTIVITIES

The division staff undertook a number of advisory visits to holdings and attended to advisory correspondence received by the division.

Several small-holdings in different agro-ecological zones have been selected to demonstrate new recommendations in relation to cover cropping, use of coir dust for moisture conservation and use of gliricidia as a green manure for coconut plantation.

5. PUBLICATIONS/COMMUNICATIONS

Gunasekera, T G L G (1989) Rehabilitation of low-yielding coconut palms. *Coconut Bulletin* (1), 14-15.

Liyanage, L V K, H P S Jayasundara, D T Mathes and D N S Fernando (1989) Integration of pasture/tree fodder/cattle in coconut small-holding *CORD* 5, 53-66.

Liyanage, M de S (1989) Gliricidia : A multipurpose leguminous tree *J. Nat. Inst. Plant. Mgmt*, 9 (2). Accepted for publication.

Liyanage, M de S and H P S Jayasundara (1989) Effects of shading on seedling growth of *Gliricidia sepium*. *Nitrogen Fixing Tree Research Report*, 7 95-96.

Dassanayake, K B (1989) Impact of coconut based cropping systems on coconut production and soil properties. Research Seminar on Biological Sciences for Young Scientists (Institute of Biology). 15 December, Colombo.

Jayasundara, H P S, L V K Liyanage and M Bastian (1989) Improvement of soil properties using Nitrogen Fixing Trees as green manure for coconut. 45th Annual Sessions of SLAAS, 06 December, Colombo.

Jayasundara, H P S, D T Mathes and M de S Liyanage (1989) Impact of an integrated farming model on the productivity of coconut lands. 45th Annual Sessions of SLAAS. 07 December, Colombo.

Jayasundara, H P S (1989) Effect of green manuring with *Gliricidia sepium* and *Leucaena leucocephala* on soil properties and coconut production. Research Seminar on Biological Sciences for Young Scientists. 15 December, Colombo.

Liyanage, M de S, K B Dassanayake and M J I Costa (1989). Effect of Nitrogen and Potassium fertilizer levels on the growth and yield of cocoa intercropped with coconut in the wet zone of Sri Lanka. CIDA/NARESA grantees seminar, 16 - 17 May, Kalutara.

Liyanage, M de S, K B Dassanayake, H P S Jayasundara and T G L G Gunasekera (1989) Productive land use systems in coconut plantations of Sri Lanka. Regional Symposium in Recent Development on Tree Plantations of the humid/sub-humid tropics of Asia. 05-09 June, Malaysia.

6. ACKNOWLEDGEMENTS

The Co-operation and assistance given by the staff of Agronomy Division in conducting the experiments and, in the preparation of this report is gratefully acknowledged. Thanks are due to Mr D T Mathes, Head, and staff of the Biometry Division for assistance in designing the experiments and statistical analysis of data.

REPORT OF THE GENETICS AND PLANT BREEDING DIVISION

Officer in Charge - R R A Peries B.Sc (Agric)

1. GENERAL

1.1 Staff matters

Appointments:

Ms. Kalyani Dondeenu, Clerk/Typist from the Coconut Development Authority assumed duties on 16 January.

Resignations:

Dr M R T Wickramaratne, Head/Genetics and Plant Breeding resigned with effect from 30 June after completion of eight years service.

Mr W G A Ratnasiri, Research Assistant also resigned with effect from 21 December, after three years service.

Promotions:

The following officers were promoted with retrospective effect from 01 January, 1987.

Mr R P Victor, Clerical & Allied Grade Class I to Special Class and Mr K P W Perera, Clerical & Allied Grade Class II to Class I.

Transfers:

Mrs Manel Rodrigo, Clerk/Typist was transferred to the Coconut Development Authority at her request on 16 January.

Study Leave:

Mr R R A Peries, Research Assistant, resumed work in the division on 28 December after completion of postgraduate studies at the University of Queensland, Australia.

Mrs W M U Fernando, Research Assistant, proceeded for postgraduate studies at the University of Birmingham, England on 01 June.

2. RESEARCH PROJECTS

PROJECT 5 - PRODUCTION OF IMPROVED COCONUT VARIETIES

Experiment 5.1.1 - Evaluation of five improved cultivars at Bandirippuwa Estate, Lunuwila (1984)

W. G. A. Ratnasiri and W. B. S. Fernando

Experiment 5.1.2 - Evaluation of five improved cultivars at Thammenna Estate, Puttalam (1984)

W G A Ratnasiri and M H L Padmasiri

Experiment 5.1.3 - Evaluation of five improved cultivars at Dambakande Estate, Kurunegala (1984)

W G A Ratnasiri and M A S Fernando

These experiments are now in their fourth year from planting and were maintained satisfactorily during the year. Application of fertilizer was done twice during the year at the rate of 1400 g/palm of the young palm mixture (YPM).

Vegetative growth

While observations were made monthly on the number of palms in flower, measurements on vegetative growth were recorded twice during the year, in January and August. Table 1 shows data on leaf number and the increase in leaf production during the year.

Cultivar differences in leaf production in this experiment were reported last year (Wickramaratne, 1988). At all three sites, the leaf production in hybrids (*DG x T*, *DY x T*) was significantly higher than the talls (*T x T*, *MT*, *PPT*). The main cultivar x site interaction was seen at Dambakande, where, with a possible increase in the soil water deficit (SWD) (due to poor rainfall distribution), a significant difference in leaf number was evident between the hybrids.

Table 1 - The number of leaves produced by different cultivars as at August 1989 and the increase in leaf number between January and August (experiment 5.1).

Site	Cultivar					LSD 5%	LSD 1%
	*DG x T	DY x T	T x T	MT	PPT		
-----Leaf Number-----							
Bandirippuwa	18.1	17.5	15.3	15.0	14.6	0.97	1.4
Thammenna	19.7	19.5	16.5	16.1	17.0	1.1	1.7
Dambakande	14.0	12.7	8.9	9.9	8.8	1.3	1.9
-----Increase in leaf number-----							
Bandirippuwa	6.3	6.1	5.9	5.7	6.0	ns	ns
Thammenna	6.9	6.6	6.3	6.1	6.5	0.5	ns
Dambakande	5.2	4.5	3.5	3.3	3.4	0.45	0.63

* DG - dwarf green; DY - dwarf yellow

T x T - tall x tall, MT - Moorock tall, PPT - Plus palm tall

LSD - least significant difference (LSD 5% = LSD (P < 0.05))

ns = not significant.

While the increase in leaf number during the period January to August was not different between cultivars at Bandirippuwa, a significant difference between the hybrids and *Moorock tall (MT)* was evident at Thammenna. It is also noteworthy that there was a general trend toward a lower leaf number and lower rate of leaf production in cv *MT* compared to the other two tall cvv *TT* and *PPT*. In the Dambakande trial, the rate of leaf production in *DG x T* was significantly higher than *DY x T*. It would appear that with increase in SWD, *DY x T* would succumb more rapidly than *DY x T* to stress injury during early growth.

Flowering: The total number of palms in flower at the end of the year in each trial is summarised in Table 2.

Table 2 - The number of palms in flower at the end of the year (experiment 5.1).

Site	Cultivar					Total	Percentage in flower
	DG x T	DY x T	T x T	MT	PPT		
-----palms in flower-----							
Bandirippuwa	71	59	29	26	23	208	52
Thammenna	62	48	20	18	34	182	45.5
Dambakande	23	3	-	-	-	26	6.5

Cultivar x site interactions were again evident with poor flowering in the Dambakande trial. From the general observations made during the year it would appear that,

- (a) Superior vegetative growth may be expected from both *DG x T* and *DY x T* in the absence of severe SWD.
- (b) With increasing SWD the time to flowering is delayed more in *DY x T* than in *DG x T*.

It is also noteworthy that cv *PPT* had a higher percentage flowering (43%) compared to the other two tall cvv *T x T* (25%) and *MT* (23%) in the Thammenna trial. This could be an indication of the better adaptability of this cultivar for the Puttlam District. Trends in leaf production appear to support this hypothesis (see Table 1).

Experiment 5.1.4 - Evaluation of five improved cultivars at Palugaswewa Estate, Rajakadaluwa (1985)

W M U Fernando and M A S Fernando

Experiment 5.1.5 - Evaluation of five improved cultivars at Suriyapura Estate, Henegama (1986)

W M U Fernando and H S G Kularatne

These two experiments were also maintained satisfactorily during the year. The trend towards superior vegetative growth observed in the previous year (Wickramaratne, 1988) was maintained. The total leaf number as at August and the rate of leaf production between January and August 1989 are summarised in Table 3.

Table 3 - *The number of leaves produced by the different cultivars as at August 1989 and the increase in leaf number between January and August. (experiment 5.1).*

Site	Cultivar					LSD 5%	LSD 1%
	DG x T	DY x T	T x T	MT	PPT		
	-----Leaf Number-----						
Palugaswewa	12.4	12.1	10.2	10.1	10.2	1.56	ns
Suriyapura	14.7	13.3	10.4	11.1	10.1	1.18	1.63
	-----Increase in leaf number-----						
Palugaswewa	4.1	4.0	3.5	3.3	3.5	0.29	0.42
Suriyapura	4.6	4.3	3.3	3.5	3.0	0.55	0.77

ns = not significant

The Suriyapura trial maintained its superiority in vegetative growth compared to the Palugaswewa trial particularly in relation to the hybrids. There were no noticeable differences in vegetative growth between the tall cultivars.

Despite the set-back to the Palugaswewa trial, due to repeated Black beetle damage, the general performance in relation to vegetative growth was not very different to the Suriyapura trial. However, no flowering was recorded in the Palugaswewa trial during the year. A total of 34 palms (11%) in the Suriyapura trial were in flower at the end of the year. This consisted of 18 *DG x T*, 14 *DY x T* and one each of cvv *PP* and *MT*.

Experiment 5.2 - Identification of parent palms for use in the breeding programme. Response of genotypes to year-to-year changes in weather at ISG, Ambakelle (1982)

The programme continues as Experiment 5.4.5.1.

M R T Wickramaratne and W M U Fernando

Experiment 5.3 - Pollen processing - To improve techniques of collection, processing and storage of coconut pollen (1983)

Negotiations were made for the commissioning of the freeze dryer and the flower stripper with little success. Improved techniques could not be utilized during the year.

M R T Wickramaratne

Experiment 5.4 - Pollination of selected palms at the Isolated Seed Garden, Ambakelle, in different combinations and evaluation of the progeny (1984)

Experiment 5.4.1 - Combination 1. Tall (Ambakelle Special) seed palms using tall, dwarf green or San Ramon pollen from palms believed to be drought tolerant.

Progeny trials arising from the above crosses are as follows:

Experiment 5.4.1.1 - Trial at Bandirippuwa Estate, Lunuwila, (50 acre block) for the evaluation of progeny (1986)

Experiment 5.4.1.2 - Trial at Ratmalagara Estate, Madampe, (field No. 2) for the evaluation of progeny (1986)

Experiment 5.4.1.3 - Trial at NLDB Andigama Farm, Giriulla, (Mudalihamy block) for the evaluation of progeny (1986)

Experiment 5.4.1.4 - Trial at JEDB Mangala Eliya Estate, Puttalam, for the evaluation of progeny (1987)

These experiments were maintained satisfactorily during the year. Vegetative growth measurements were recorded twice during the year. No analysis of data was undertaken.

*W M U Fernando, W B S Fernando, M A S Fernando, H S G Kularatne
and M H L Padmasiri*

Experiment 5.4.2 - Combination 2. Ambakelle special and selected dwarf green seed palms using tall, dwarf green and San Ramon pollen from palms selected for high and stable yields.

The progeny trials arising from the above crosses are as follows:

Experiment 5.4.2.1 - Trial at NLDB Andigama Farm, Giriulla (Puras block), for the evaluation of progeny (1987)

Experiment 5.4.2.2 - Trial at JEDB Daisy Valley Estate, Mawathagama, for the evaluation of progeny (1987)

These experiments were maintained satisfactorily during the year. Vegetative growth parameters were recorded at six-month intervals. No analysis of data was undertaken.

W G A Ratnasiri and M H L Padmasiri

Experiment 5.4.4 - Self pollination of selected dwarf green and dwarf yellow palms at ISG, Ambakelle (1982)

A total of 311 *DG* and 786 *DY* seedlings raised from self pollination were used for in-filling in field Nos. 9 and 10A. A further 376 *DG* and 1664 *DY* seedlings which were over 5 months old remained in the nursery at the end of the year.

M R T Wickramaratne, W M U Fernando and M H L Padmasiri

Experiment 5.4.5 - Production of planting material at ISG, for the proposed "super" seed garden (1986)

Hand pollinations were limited to field No. 3 subsequent to the decision to abandon the super seed garden project. Seedlings resulting from hand pollinations are in the nursery ready for planting out in the field.

M R T Wickramaratne, W M U Fernando and M H L Padmasiri

Experiment 5.4.5.1 - Progeny trial for testing of putative drought tolerant palms by the performance of their progeny (Ambakelle super seednuts) at ISG (1988)

Casualties resulting from water logging were replaced during the year. A total of 161 *T x T* seedlings in the trial area were replanted. Ambakelle special seedlings (07) were used to fill vacancies in the guard rows.

W M U Fernando, M H L Padmasiri and M R T Wickramaratne

Experiment 5.4.6 Backcrossing of dwarf green palms at ISG, (1987)

Due to poor nut-set, the project was abandoned during the year.

M R T Wickramaratne, W M U Fernando, M H L Padmasiri and W B S Fernando

Experiment 5.4.7 - Pollinations at ISG, using *spicata* pollen (1987)

Seednuts resulting from the pollination have been laid at both B/E and ISG nurseries.

*W M U Fernando, W B S Fernando, M H L Padmasiri
and M R T Wickramaratne*

Experiment 5.5 - Establishment of germplasm collections (1983)

Experiment 5.5.1 - New Variety Block or Crop Museum, at block No. 5, Bandirippuwa Estate, Lunuwila (1983)

The block was satisfactorily maintained during the year. Eight vacancies (5 *navasi thambili*, 2 *Pora pol* and 1 *Gon thambili*) were filled during the year. Hand pollinations were carried out in a private home garden in Colombo on cv *Rathran thambili* to raise seedlings for the vacancies in the block.

W G A Ratnasiri and M H L Padmasiri

Experiment 5.5.2 - Purification of local (indigenous) germplasm, Bandirippuwa Estate, Lunuwila (1984)

Seednuts resulting from hand pollinations carried out in field No. 9, B/E have been laid in the nursery as follows: *Gon thambili* 125; *Ran thambili* 43; *Navasi* 47; *Kamandala* 36; *San Ramon* 293; *Bodiri* 82; *Navasi thambili* 66. The germination was observed to be poor. The resulting seedlings will be used for filling the vacancies in the experiment.

M R T Wickramaratne, W G A Ratnasiri and M A S Fernando

Experiment 5.5.3: Conservation of *San Ramon*, (1986)

The experiment was maintained satisfactorily during the year. Growth measurements were recorded twice during the year at six-month intervals. The experiment was established in three stages, depending on the availability of seedlings. Fertilizer (urea-based Young Palm Mixture) was applied twice during the year at the rate of 1200 g/seedling on seedlings which were 3 1/2 yrs old. Seedlings which were 1 1/2 yrs received 900 g/plant and younger seedlings (6 months) received 675 g/seedling of the same mixture.

W G A Ratnasiri and H S G Kularatne

Experiment 5.5.4 - Establishment of "field gene bank" for dwarf palms at Bandirippuwa Estate, Lunuwila (1987)

The following numbers of seedlings were replaced in this experiment. *DG* 25; *DY* 10; *DR* 7; *DG x DY* 11. Routine operations were carried out satisfactorily.

W G A Ratnasiri, M R T Wickramaratne and M A S Fernando

Experiment 5.5.5 - Germplasm from other countries (1985)

Experiment 5.5.5.1 - Import of exotic material

No further developments were made on this experiment. (See Wickramaratne, 1988)

M R T Wickramaratne and M A S Fernando

Experiment 5.5.5.2 - Purification and multiplication of exotic material already available

Cameroon red dwarf palms (CRD); Brazilian green dwarf (BGD)

Pollinations which were suspended in 1988 were resumed in October this year. Six inflorescences were pollinated in BGD which had a total of 94 female flowers. Ten inflorescences of CRD were also pollinated. Several nuts were lost due to theft. Only eight nuts could be recovered in CRD from pollinations done in early 1989. Forty four seednuts of CRD and 10 of BGD were harvested from pollinations done in 1988.

M R T Wickramaratne and H S G Kularatne

Experiment 5.5.6 - To survey, collect, evaluate and utilize coconut germplasm (1986)

Experiment 5.5.6.1 - Collection of germplasm of the commercial tall variety (*Typica typica*)

Seedlings raised from selections at Palugaswewa were planted in the germplasm conservation block, at BE. No progress was made with regard to the Keenakelle selections.

Assembly and evaluation of collected material

In addition to selections from Moorock, Pitiyakande and Mudunawatte estates, planted in the Kotakande germplasm collection (field No. 1) (Wickramaratne, 1988), the following accessions from selections carried out in 1988 were also included:

Namalwatte (*Talls*), 84 seedlings; Dabarayaya (*Talls*), 63 seedlings; Clovis (*San Ramon*), 85 seedlings; Palugaswewa (*Talls*), 81 seedlings; and Ambakelle special (for comparison) 245 seedlings.

A new germplasm conservation block was established in the new clearing at Pothukulama Research Station with the following accessions:

Pitiyakande 84 seedlings; Moorock 82 seedlings; Palugaswewa 85, and Ambakelle (guard rows) 40 seedlings.

W G A Ratnasiri and M A S Fernando

Experiment 5.5.6.2 Collection of germplasm of different forms of coconut: (a) San Ramon (b) Dwarf forms (c) Indigenous tall forms (d) Others

No progress could be made in these experiments due to the unsettled conditions in the country.

*W G A Ratnasiri, W M U Fernando, P Kariyawasam
and M A S Fernando*

Collection of drought tolerant germplasm

Selections made from Namalwatte and Dabarayaya estates were planted in the BE germplasm block (see 5.5.6.1). The selection programme in the Southern province was interrupted by the disturbances in the country and no progress could therefore be made.

3 MISCELLANEOUS EXPERIMENTS

Experiment G 3.8 - Evaluation of the performance of tall x tall, dwarf x tall and Moorock tall in dry zone, Minneriya (1983)

This trial was maintained by the estate.

M R T Wickramaratne

Experiment G 1.3 - Flowering and cropping patterns in dwarf palms (1983)

Collection of data continued during the year. The experiment is due to be terminated in 1990.

M R T Wickramaratne, W M U Fernando and M H L Padmasiri

3.8 - Transmission of colours in coconut crosses (1987)

No progress was made in this experiment.

M R T Wickramaratne

4. ISOLATED SEED GARDEN, AMBAKELLE

4.1 Rainfall: The intensity and distribution of rainfall for 1989 are shown in Table 4 along with the data for the previous year and the 10 year average (1977-1986) for comparison. The total rainfall for the year (850 mm) was lower than previous year (1520 mm) with a fewer number of rainy days (73 vs 90).

Table 4 - The intensity and distribution of rainfall for 1988 and 1989 and 10 year average (1977 - 1986) - Isolated Seed Garden.

Month	1988			1989			10 year average 1977 - 1986		
	A	B	C	A	B	C	A	B	C
January	3.3	1	1	58.4	2	2	24.48	3.3	3.2
February	135.4	6	5	0	0	0	50.91	3.7	3.4
March	77.4	4	4	29.5	4	4	93.43	5.4	4.6
April	233.3	13	13	81.7	5	5	168.24	9.3	7.9
May	71.7	7	7	16.0	8	8	208.26	11.1	8.7
June	129.7	13	13	112.2	12	12	74.08	9.7	8.4
July	91.4	4	4	72.1	5	5	33.67	5.6	4.6
August	60.1	9	9	1.7	1	1	33.62	4.1	3.5
September	272.2	13	13	34.0	6	6	87.22	9.9	8.6
October	61.3	3	3	212.3	12	12	284.61	15.6	15.0
November	319.5	13	13	224.3	16	16	286.71	15.0	13.7
December	64.8	5	5	8.0	2	2	105.03	9.2	8.6
Total	1520.1	91	91	850.2	73	73	1450.26	102.0	90.2

A = rainfall intensity in mm; B = number of rainy days;

C = number of wet days (<1 mm)

4.2 Nut yields: The total yield for 1988 and 1989 are shown in Table 5 with the 10 year average (1977-1986). As a result of the favourable rainfall distribution in 1988, there was a large improvement in yield this year.

Table 5 - *Total nut yield for 1988 and 1989 and the 10-year average (1977-1986), Isolated Seed Garden.*

<i>Pick</i>	<i>1988</i>	<i>1989</i>	<i>10-year average 1977-1986</i>
1	51,873	186,665	91545.9
2	75,591	223,595	134783.5
3	83,969	216,763	150221.1
4	71,507	219,573	138743.9
5	100,380	232,430	124503.5
6	125,761	146,674	92671.7
Total	509,081	1,225,700	732469.6
No. of bearing palms	10,533	11,227	
Average no. of nuts per palm	48	109	

Separate nut yields from the tall and dwarf palms are given in Table 6. There was a 118% increase in the tall palm yields compared to the previous year. In dwarfs, the increase was 264%. While the yield of tall palms achieved a peak in the 4th and 5th pick of the year, such a pattern was not discernible in the dwarfs.

Table 6 - Total number of nuts harvested from tall and dwarf palms in 1988 and 1989, together with 5-year average (1982-1986).

(i) Tall

<i>Pick</i>	1988	1989	5-year average (1982 - 1986)
1	43,525	144,714	75900.0
2	68,078	159,975	118100.8
3	77,118	162,983	145531.4
4	65,155	179,154	153490.2
5	76,220	177,112	126966.4
6	101,713	120,167	81785.6
Total	431,809	944,105	701775.0
No. of palms in bearing	7,315	8,070	
Nuts/palm	59	116	

(ii) Dwarf

<i>Pick</i>	1988	1989	5-year average (1982 - 1986)
1	8,348	41,951	39914.6
2	7,513	63,620	54072.4
3	6,851	53,780	51736.2
4	6,352	40,419	41860.6
5	24,160	55,318	45430.4
6	24,048	26,507	36021.0
Total	77,272	281,595	269035.2
No. of palms in bearing	3,218	3,157	
Nuts/palm	24	89	

The pick-wise cropping pattern for dwarf green and dwarf yellow palms are shown in Table 7. The largest increase in nut yield in both *DG* and *DY* came from the first four crops of the year. The overall increase in nut yield per palm was higher in *DY* than in *DG* (450% vs 207%).

Table 7 - Pickwise cropping patterns for dwarf green and dwarf yellowpalms at ISG in 1988 and 1989.

<i>Pick</i>	<i>Dwarf green</i>		<i>Dwarf yellow</i>	
	1988	1989	1988	1989
1	3,604	28,650	4,744	13,301
2	4,184	41,801	3,329	21,819
3	4,141	32,123	2,710	21,657
4	4,743	23,853	1,609	16,566
5	21,585	25,859	2,575	29,459
6	18,014	17,357	6,034	9,150
Total	56,271	169,643	21,001	111,952
No. of palms in bearing	1,997	1,961	1,221	1,190
Nuts/palm	28	86	17	

4.3 Seednut production: A total of 695,177 *typica* seednuts were produced during the year, comprising 690,876 Ambakelle *tall* and 4,301 Ambakelle special seednuts, with a mean selection percentage of 89.7. Ambakelle special seednuts were set aside exclusively for the replanting and in-filling programmes of the ISG.

4.4 Emasculation of dwarf palms for the production of CRIC 65 hybrid nuts: Details of emasculation are given in Table 8. A total of 3,203 dwarf palms comprising 1988 of the *dwarf green* and 1,215 of the *dwarf yellow* forms were emasculated during the year.

4.5 Controlled pollination: Controlled pollinations were only carried out in field No. 3. A total of 8,322 female flowers were pollinated in 403 inflorescences. At the end of 3 months 1,561 buttons resulted from this exercise (18.7%).

4.6 Crop disposal: Crop disposal figures as at 31 December are given in Table 9.

Table 8 - Emasculation of dwarf palms for the production of nana x typica (CRIC 65) hybrid nuts.

Field no.	Number of palms emasculated		Number of inflorescences emasculated		Number of buttons emasculation	
	DG	DY	DG	DY	DG	DY
05 (I)	116	-	852	-	12,658	-
05 (II)	207	-	1,682	-	35,261	-
09	272	-	2,026	-	21,551	-
10A	95	902	1,020	7,605	10,907	139,842
10B	309	313	2,841	2,507	45,211	39,693
14	989	-	9,164	-	112,631	-
Total	1,988	1,215	17,585	10,112	238,21	179,535

Table 9 - Crop disposal figures as at 31 December.

Method of disposal	Number of nuts from			
	Tall	DG	DY palms	Total
1. Delivered as seednuts	690,878	46,125	29,706	766,709
2. Husked and split nuts	45,100	16,503	24,406	86,000
3. For research purposes				
GPB division	2,000	575	100	2,675
PP unit	137	-	-	137
4. Nut allowances to staff	3,500	-	2,100	5,600
5. Sent to PRS for copra conversion	30,228	28,765	15,468	74,461
6. Cured into copra (excluding item 02)	56,595	30,327	21,599	108,521
7. Rejections (Not suitable for curing)	22,510	15,415	5,900	43,825
8. To be disposed	93,157	31,933	12,673	137,763
Total crop	944,105	169,943	111,9521	1,225,700

PP = Plant Physiology, GPB = Genetics x Plant Breeding

4.7 Field operations and maintenance

4.7.1 Manuring: The application of fertilizer was carried out during the May/June season. The replanted fields 11A, 11B, 12, 13 & 5 were given the recommended Young Palm Mixture (YPM) with 1.5 kg of dolomite. The infillings in field No. 9 were also fertilized with the same mixture. The bearing stand in these said fields was given 3 kg of Adult Palm Mixture (APM) and 1.5 kg of dolomite/palm.

The recommended differential fertilizer mixture, after foliar analysis, was applied to all *T x T* fields except field No. 6 which was maintained under conventional management practices.

The fertilizer programme was carried out during the Oct/Nov season. The application of the second split dose on the young plantation was not done due to the very dry conditions that prevailed towards the latter part of the year. The rate of application of the recommended differential fertilizer mixture is as follows.

Field Nos. 1, 2, 3 and 7 received 6.5 kg APM/palm while field Nos. 4, 8 and 9 received 5.25 kg APM/palm. The remaining adult palms were given 3 kg of APM/palm.

The application of dolomite could not be done due to its non-availability.

4.7.2 Mulching: The mulching programmes were carried out before the onset of the dry season with available fronds, husks and trash in the adult and young palm blocks. The husk mulch appeared sufficient to maintain the moisture level in the replanted fields. In addition to the scheduled mulching, fertilizer application was also followed by a surface mulching on the manure circle.

4.7.3 Weeding: Weeds did not cause much problem during the year due to the prevailing dry weather. Mechanical and chemical control measures were adopted to arrest the growth of weeds, especially illuk (*Imperata cylindrica*). The weather conditions that prevailed were ideal for the control of illuk in the replanted fields. On the recommendation of the Estates Committee, glyphosate was used in Field No. 11B. The results were very satisfactory. Although the recommendation was for a 2% solution, even at the concentration of 1.5% encouraging results on the control of illuk and cooch grass were obtained. A power sprayer was used for spraying the weedicide.

Integration of chemical and mechanical methods proved economical in weed control, as was evident in field 11B. The control of weeds in the tall fields was done by means of mechanical methods such as tractor and cheddy operations (selective

weeding). In field No. 13 repeated rotaslashng proved to be very effective in controlling illuk but the process was slow.

4.7.4 Cover Crops: This programme was not successful due to the poor rainfall experienced during the year. On the recommendation of the Estates Committee, 10,000 poly-bagged *Pueraria* plants were to be established. The goal was not achieved. About 7,000 bagged seedlings were prepared out of which 4,000 were planted in field No. 11B. The early establishment of the seedlings was affected by a species of snail. The pest was controlled by the use of the pesticide "Meta". The poly-bagged seedlings transplanted in field No. 11B were also attacked by a pest.

In addition, *Pueraria* seeds were planted directly in rows, spaced 1 m apart in field No. 11A. A profuse growth was observed during the early stages when the availability of soil water was not limited. The subsequent growth has however retarded, apparently due to insufficient soil water. About 2,000 poly-bagged *Pueraria* plants were awaiting transplantation.

Few vacant patches in field No. 10B were planted with *Crotolaria juncia*. The legume helped to control the growth of Mana (*Pennisetum polystachyon*).

The following quantities of legume seeds were used in the respective fields:

Field No.		Quantity	Method of establishment
11B	<i>Pueraria</i>	6.75 kg	Poly-bags
11A	<i>Pueraria</i>	47.70 kg	In rows 5 ft apart
10B	<i>Sun hemp</i>	39.80 kg	Broadcast

4.7.5 Husk Burying: The burying of husk commenced in field No. 2. Work on a total of 276 pits was completed. Each palm was supplied with a husk pit of 5' x 4' x 2'. Although 251 husk pits were planned for field No. 8, lack of rain compelled the programme to be abandoned half-way. Most of the husk for this operation were procured from the Poththukulama Research Station (PRS).

4.7.6 Drains: Routine maintenance operations were at a minimum as weed growth, silting and breach of bunds were very minor in the absence of heavy rains.

4.7.7 Pests & Diseases: Scheduled routine inspection of palms for pests and diseases was carried out daily. A special vigilance was maintained in the replanted fields where emasculation is being done. With the profuse growth of palms in stem, cracks

began to appear, and the bleeding attracted the red weevil. Frequent inspection and application of coal tar supplemented with pesticides helped overcome this problem.

A black beetle infestation was observed in the recently planted (Maha 88/89) portion of field No. 11A. Frequent inspection and the use of pesticides kept the problem under control. The nettle grub pest was seen in fields 10A, 10B, 9 and in the nursery. Monocrotophos was injected to the adult palms and a foliar spraying was done in the nursery to control this pest.

4.7.8 Replanting and infilling: The replanting of field No. 11A was continued with 130 'Ambakelle super' (A/S) *T x T* seedlings in the single avenue system. Another 552 A/S *T x T* seedlings were planted in the 24' x 24' square system. This programme was carried out during the May/June season.

Details of the number of palms uprooted and the infillings done during the year are shown in Tables 10 and 11 respectively.

Table 10 - Details of palms uprooted during the year.

Field Number	1	2	3	4	5	6	7	8	9	10A	10B	11A	11B	12	13	14
T x T	3a	-	-	20a	4b	-	-	6a	-	1a	-	2c	1b	2b	4b	-
DG	-	-	-	-	14	-	-	-	14d	2d	2d	-	-	-	-	24
DY	-	-	-	-	-	-	-	-	-	33d	5d	-	-	-	-	-
Total	3	-	-	-	18	-	-	6	14	36	7	2	1	2	4	24

a - non-productive b - Red weevil damage c - Lightning damage
d - infills which died due to adverse weather conditions.

Table 11 - Details of the infilling programme carried out during the year

Field		<i>T x T</i>	DG	DY
	9	20	244	-
"	10 A	23	53	570
"	11 A	161	-	-
"	11 B	-	-	-
"	12	-	-	-
"	13	22	-	-
Total		226	297	570

A replanting programme was scheduled in field No. 14 but could not be successfully implemented due to the dry weather which prevailed during most of the year.

4.7.9 Fences: The old fence around the abandoned nursery in field No. 5 was removed. Periodical repair programmes were carried out. Due to the prevailing unrest and civil disturbances in the country, the peripheral fence in the nearby Attangane and Welipelessa villages were frequently damaged.

4.7.10 Roads, Paths & Buildings: Essential repairs to the buildings could not be carried out due to the disturbances in the area. The water tanks in the residential quarters were urgently in need of repair.

Concrete culvert pipes were installed at two points on the estate roads as deemed necessary. The balance culverts are to be renovated shortly. Graveling was done on roads to cover up pot holes. All foot paths within the fields were weeded and maintained satisfactorily.

4.7.11 Electricity & Water supply: The supply of electricity was maintained. The water supply to the residents was not satisfactory due to the leaks in overhead water tanks. This was identified as one of the major items of work for the following year.

4.7.12 Vehicles, Machinery & Tools: The above items were maintained satisfactorily. The transport of officials to and from ISG became a major problem as the only available vehicle (31/5093) was taken over by the security forces during the year.

A new rotaslasher was received during the latter part of the year. A hand tractor, a knapsack sprayer (hand-operated) and a gas cooker were also received.

The tractor, 36/2643 required a major overhaul.

4.7.13 Tanks & Irrigation: The tanks and irrigation lines were maintained. An electric motor was coupled to one of the water pumps in the pump house in field No. 7. An electricity line was installed to this pump house and the necessary switch gear was fixed. Due to the drought, the water level of the tanks remained below the level of foot valves which made the operation of the irrigation system impossible. However, the young palms were irrigated using bowsers.

4.7.14 Jungle Barrier: Incidents of illicit felling of timber were detected and reports made to the Police and to the officials of the Forest Department. In most instances, the timber was recovered.

The barrier vigilance was carried out on six-hour shifts. During day time, two watchers were detailed and an additional watcher was detailed for the night shift. A six-foot path was opened in the teak plantation and a watchers hut was put up for the effective security in the plantation.

General: Most of the field activities were restricted to essential items such as harvesting, manuring etc. as there were restrictions on the release of funds during the latter part of the year.

D M Pathirage

5. SEED PRODUCTION

5.1 Seednut supply: Details of the supply of seednuts for the three seasons of issue namely, Maha 1988/90, Yala 1990 and Maha 1990/91 are shown in Table 12. A total of 2,067,435 seednuts were supplied, which consisted of 1,260,572 plus palm seednuts, 713,438 CRIC 60 (*T x T*) and 93,425 CRIC 65 (*D x T*) seednuts. Approximately 38% of the total supply of seednuts came from the Isolated Seed Garden.

The nurseries of the Coconut Cultivation Board (CCB) were supplied with 1,952,163 seednuts during the year. Of this, approximately 36% were of improved cultivars (632,491 CRIC 60 and 71,300 CRIC 65). The total requirement of the CCB (2.2 m. seednuts) however, could not be met during the year, mainly due to the disturbances in the country.

The public and other state-owned agencies were also supplied which 64,500 seednuts for their replanting programmes. Monrovia State Plantation (Southern Province) was supplied with CRIC 60 and plus palm seednuts for the establishment of a commercial nursery to service that area, since the CCB nursery was inoperative.

5.2 Plus palms: The plus palm pool was increased from 40,907 to 47,181 during the year. Anticipated re-selections of plus palms could not be accomplished except at Keenakelle No. 6 due to the disturbances in the country.

5.3 Seednut selection: Every attempt was made to maintain a high percentage of selection. Several complaints were received consequent to the decision taken in 1988 to dispense with seednut selection. These complaints were dealt with individually. Some re-selection of seednuts had to be done, particularly in instances where the selected seednuts had not been removed from the estates on time.

Table 12 - Supply of seednuts, during the year.

Year & Quarter	Planting Season	CCB Nurseries			Total	CRB Nurseries			Total	Others			Total	Grand Total
		PP	T x T	D x T		PP	T x T	D x T		PP	T x T	D x T		
1988/4	1989/90	-	-	-	-	-	-	-	-	-	-	-	-	
1989/1	1989/90	234,575	185,246	30,735	450,556	-	**137	**350	487	-	500*	5000*	15,300	466,343
											9,800			
1989/2	1989/90	536,347	146,570	12,565	695,482	**200	6,000	**1600	7,800	-	21,000	1,000	22,000	725,282
Total	1989/90	770,922	331,816	43,300	1,146,038	200	6,137	1,950	8,287	-	31,300	6,000	37,300	1,191,625
1989/3	90 Yala	276,020	212,570	16,000	504,590	-	2,000	825	2,825	-	11,700	350	12,050	519,465
1989/4	90 Yala	82,220	55,170	7,000	144,390	-	2,500	-	2,500	-	4,810	-	4,810	151,700
Total	90 Yala	358,240	267,740	23,000	648,980	-	4,500	825	5,325	-	16,510	350	16,860	671,165
1989/4	1990/91	119,210	32,935	5,000	157,145	-	-	-	-	12,000	22,500	3000*	47,500	204,645
Total Supplied in 1989		1,248,372	632,491	71,300	1,952,163	200	10,637	2,775	13,612	12,000	70,310	19,350	101,660	2,067,435

* Export Order
 ** Research

Crop-wise selection of seednuts of tall and hybrids are shown in Table 13 (a) and 13 (b) respectively.

Table13(a) -Crop-wise selection of typica seednutsduring 1989 (excluding nuts from controlled pollinations).

<i>Pick</i>	<i>Heaped</i>	<i>Selected</i>	<i>Percent of heap selected</i>
1	134,842	121,870	90.4
2	151,676	132,531	87.4
3	153,243	135,356	88.3
4	168,906	150,090	88.9
5	167,920	126,440	75.3
6	111,774	66,000	59.0
Total	888,361	732,287	82.43

Table13(b) -Crop-wise selection of hybrid seednuts during 1989.

<i>Pick</i>	<i>DG x T</i>			<i>DY x T</i>		
	<i>Heaped</i>	<i>Selected</i>	<i>Percent selected</i>	<i>Heaped</i>	<i>Selected</i>	<i>Percent selected</i>
1	25,661	22,990	85.5	9,182	8,270	90.0
2	38,526	32,509	84.3	17,294	15,968	92.3
3	28,373	23,478	82.7	16,558	13,623	82.2
4	20,442	17,865	87.3	11,162	10,175	91.1
5	20,210	11,665	57.7	24,565	13,335	54.2
6	14,323	11,445	79.9	6,058	4,570	75.4
Total	147,535	119,952	81.30	84,819	65,941	77.74

The selection percentages fell marginally short of expectation at the 5th and 6th picks, particularly due to the re-selections that had to be carried out. During picks 1 to 4 the selection percentages were mostly over 85%.

5.4 Miscellaneous activities:As a result of the cover crop seed production programme, initiated in 1988, 576 kg of *Pueraria phaseoloides* seed were collected from Rathmalagara, Poththukulama Estates and Makandura Seed Garden. These were issued to state- owned plantations as well as to private estates for their cover crops establishment programmes.

P Kariyawasam

6. POLLEN AND POLLINATION

6.1 Pollen collection and issue: Details of pollen collection and issue are given in Table 14. Pollen of the *typica* variety was collected during the year from 39 inflorescences of 15 selected palms on fields 1 and 2 of the ISG. A total of 609 ampoules of unadulterated pollen were prepared. Pollen from palms on fields 1 and 2 were mixed together, adulterated with lycopodium and re-sealed. A total of 340 such ampoules were produced during the year.

Table 15 shows the number of ampoules of pollen processed from different types of coconut (excluding *typica*) during the year.

A total of 300 ampoules of *typica* pollen were issued to Palugaswewa Estate, Daisy Valley Estate and Pitiyakande Estate for their pollination programmes.

W B S Fernando

Table 14 - Pollen collection and issue.

	ISG palms	typica Variety palms (BE)	No. of ampoules			
			San Ramon (BE)	DG (ISG)	nana DY (ISG)	BGD (BE)
<i>Carried over from 1988</i>						
Pollen from individual palms	216	56	47	-	-	27
<i>Sealed in 1989:</i>						
Pollen from individual palms	609	-	34	246	111	21
Mixed pollen adulterated with lycopodium	340	-	-	-	-	-
<i>Issued to estates (at Rs. 10/- per ampoule):</i>						
Mixed pollen adulterated with lycopodium	300	-	-	-	-	-
<i>Issued for pollination programmes</i>						
Pollen from individual palms						
(1) at ISG	339	-	-	39	-	-
(2) at BE	-	-	7	-	-	7
<i>Other Uses (Viability tests) demonstrations; breakages etc.</i>						
Pollen from individual palms	35	15	7	-	-	7
<i>No Viability/low viability</i>						
Pollen from individual palms	180	41	40	-	-	20
<i>Balance as at 31/12/89</i>						
Pollen from individual palms	145	-	27	207	111	14
Mixed pollen adulterated with lycopodium	40	-	-	-	-	-

DG, green dwarf; BGD, Brazilian green dwarf, DY, yellow dwarf

Table 15 - *The number of ampoules of pollen processed from different types of coconut (excluding typica) during the year. The values in parenthesis are the number of inflorescences harvested in each case.*

Type	Sources	No. of palms	No. of ampoules
Pumilla	Field No. 5 - ISG	14 (11)	246
	Field No. 9	15	
Eburnea	10A	25 (14)	111
San Ramon	Field No. 16 - BE	6 (3)	34
BGD	BE	5 (3)	21

7. RESEARCH NURSERY

7.1 Ambakelle nursery: Seednuts laid at the Ambakelle (ISG) nursery and seedling issues to 31 December are shown in Tables 16 and 17 respectively. The availability of planting material in the nursery as at 31 December is given in Table 18.

Table 16 - *Details of seednuts laid at the ISG research nursery during the year.*

Variety	Source	Number of nuts
(1) From pollination programme		
Ambakelle super	ISG	3,222
Tall (abandoned pollination)	ISG	484
DG selfed	ISG	2,218
DY selfed	ISG	1,644
DY x T	ISG	13
(2) From directed natural pollinations		
Ambakelle special	ISG	4,071
Ambakelle tall	ISG	13,812
DG x T	ISG	2,185
DY x T	ISG	200
Total		27,949

Table 17 - Details of seedlings issued from the ISG research nursery during the year.

Variety	Issued commercially		Issued to		Total
		GPB Division	ISG	BE	
Ambakelle super	-	-	161	-	161
Ambakelle special	-	75	757	645	1,477
DG x T	162	-	-	-	162
DY x T	139	-	-	-	139
DG selfed	-	-	311	-	311
DY selfed	-	-	786	-	786
Total	301	75	2,015	645	3,036

Table 18 - Availability of planting material at ISG nursery as at 31 December

Variety	Seedling over 5 months from laying in beds
(1) From controlled pollinations	
Ambakelle super	2,996
Tall (abandoned pollinations)	425
DG selfed	376
DG x T	10
DY selfed	1,664
DY x T	14
Total	5,485
(2) From directed natural pollinations	
Ambakelle special	2,261
Ambakelle tall	03
DG x T	1,621
DY x T	69
Total	9,439

7.2 Bandirippuwa research nursery: Tables 19, 20 and 21 summarise the data on seednuts laid, seedlings issued and the availability of seedlings as at 31 December. Most seedlings raised for the progeny trials could not be planted during the year due to (a) unfavourable weather and (b) disturbances in the country.

Table 19 - Seednuts laid at Bandirippuwa research nursery during the year.

Variety	Source	No. of seednuts	
		(in beds)	(in polybags)
(i) From pollination programme			
Tall (Hand pollinated)	ISG	1,372	-
Tall (Open pollinated)	ISG	355	-
DG selfed	ISG	63	-
DY selfed	ISG	45	-
DY x T	ISG	3	-
Gon thembili	BE	125	-
Ran thembili	"	43	-
Pora pol	"	28	-
Nawasi	"	47	-
Kamandala	"	36	-
San Ramon	"	293	-
Bodiri	"	82	-
Nawasi thembili	"	66	-
SR x SR	BE field No. 16	361	64
Cameroon red dwarf	BE old nursery site	29	23
Brazilian green dwarf		-	10
(ii) For germplasm collection			
DR	Kundasale	499	-
DG	"	352	-
DY	"	295	-
	Kirimetiya	24	-
	St. Annes	391	-
	Margaret estate	397	-
DG x T	ISG	425	-
DY x T	"	100	-
T x T	"	2,000	-
	Total	7,431	97
	Grand Total	7,528	

Table 20(a) -Availability of planting material at Bandirippuwa research nursery as at 31 December, from Germplasm Conservation Programme.

Variety (or/ accession)	Seedlings over 5 months from laying		Total
	in beds	in polybags	
Pitiyakande	48+90	50	188
Moorock	43	28	61
Goluwapokuna	07	-	07
Dikiri pol	03	-	03
Kasagala	55	14	69
Namalwatta	114	59	173
Debarayaya	61	-	61
K. Jayasekera	01	-	01
Clovis	43	104	147
Palugaswewa	47	-	47
Sausiri	-	88	88
Wellawa	-	03	03
Margerat	-	18	18
Bodiri	-	03	03
Kamandala	-	01	01
Pora pol	-	16	16
DR Kundasale	-	05	05
DY	-	01	01
Kirimetiya	-	02	02
Total	512	392	894

Table 20(b) -Availability of planting material produced by hand pollinations at Bandirippuwa research nursery as at 31 December.

Variety	Seedlings over 5 months from laying		Total
	in beds	in polybags	
DG x T	08+03	-	11
DG selfed	107	-	107
DY x T	06+03	-	09
T x DY	08	-	09
T x T	868	-	868
Tall (OP)	08	-	08
Pora Pol	07	-	07
Gon thembili	02	-	02
Bodiri	04	-	04
SR x SR	12	-	12
SR x SR	34+04 (from 88)	-	41
Cameroon red dwarf	-	-	-
Brazilian green dwarf	-	02(from 88)	02
Total	1,077	02	1,079

Table 21 - Seedling issues from Bandirippuwa research nursery during the year.

Variety/accession	To GPB		Other Divisions		Other purposes	Commer- cial issues	Total
	from beds	in poly bags	from beds	in poly bags			
T x T	304	15	-	02	-	38	359
Ambakelle tall	15	05	-	-	-	-	20
DG x T	08	25	04	35	02	-	74
DY x T	47	09	05	-	05	-	66
T x DG	267	57	-	10	-	45	379
T x DY	238	72	-	07	-	116	433
T x SR	293	81	-	-	-	50	424
Tall (OP)	82	75	-	05	10	125	297
DG	25	-	10	-	-	14	49
DY	10	-	-	-	-	-	10
DR	07	-	-	-	-	-	07
DG x SR	16	02	-	-	-	-	18
DY x SR	41	06	-	-	-	-	47
Plus palm tall	01	-	-	14	-	-	15
DG x DY	11	-	-	-	-	-	11
SR x SR	07	-	-	-	-	-	07
Moorock tall	151	-	-	35	-	-	186
Wellawa	43	05	-	-	-	-	48
Pitiyakande	75	59	-	-	-	-	134
Palugaswewa	166	-	-	-	-	-	166
Debarayaya	63	-	-	-	-	-	63
Clovis	84	02	-	-	-	-	86
Namalwatte	84	-	-	-	-	-	84
Nawasi thembili	05	-	-	-	-	-	05
Pora pol	02	-	-	-	-	-	02
Gon thembili 01	01	-	-	-	-	-	01
Total	2,046	413	19	108	17	388	2,991

8. SYMPOSIA, LECTURES, STUDY TOURS ETC: Dr M R T Wickramaratne attended the 26th COCOTECH meeting held in Bangkok, Thailand from 15 to 19 May 1989 and presented a paper on "Assessment of experience with high yielding coconut varieties".

Mr W G A Ratnasiri, Research Assistant, presented a paper on "Establishment of a coconut germplasm collection" at the seminar held at the SLAAS auditorium on 15 December.

9. REFERENCES:

Wickramaratne, M R T (1988). Annual Report of the division of Genetics & Plant Breeding (in press).

10. ACKNOWLEDGEMENTS: The assistance and co-operation of the staff of the Genetics & Plant Breeding Division in compiling this report are gratefully acknowledged.

REPORT OF THE SOILS AND PLANT NUTRITION DIVISION

Officer-in-Charge - K S Jayasekara, B Sc

1. GENERAL

1.1 Staff Matters

Appointments: Mr K S Jayasekara functioned as the Officer-in- Charge of the Plant Physiology Division for the period 05 November to 19 December.

Mr S M Somaratne and Mrs M T Wimalawathie were appointed as Labourers from 01 November.

Resignations, Retirements, Deaths, etc.: Mr P A D G Appuhamy, Senior Technical Assistant resigned from the service on 21 July.

Mr T Amarasekara, Technical Assistant resigned from the service from 30 September.

Mr A M P Athanayake was considered having vacated his post with effect from 06 December, 1988.

Mr K V W de Silva, Senior Field Assistant retired on 29 October after 32 years service.

Mr E A Remy, Lab & Field Attendant died on 19 October.

Promotions: Mr U S S Perera, Technical Assistant from Technical Grade Class II to Class I with effect from 01 January, 1987.

Mr D S Wijetunga, Lab & Field Assistant from Operative Grade Class I to Special Class with effect from 01 January, 1987.

Overseas Study Leave:

Mr L P Vidana Arachchi, Assistant Soil Scientist left for postgraduate studies at the Universiti Sains Malaysia, Penang, Malaysia on 29 November, under the Malaysian Technical Assistance Programme.

Miss M B M N Dias, Assistant Soil Scientist continued her postgraduate studies at the University of Queensland, Australia.

Mr L L W Somasiri, Assistant Soil Scientist continued his postgraduate studies at the University of Aberdeen, U.K.

Overseas Conferences/Visits/Workshops

Mr M Jeganathan, Project Co-ordinator/Agricultural Research Project participated and presented a poster titled "Studies on potassium-magnesium interaction in coconut (*Cocos nucifera* L.)" at the XI International Plant Nutrition Colloquium held at Wageningen, The Netherlands from 31 July to 04 August.

Mr U S S Perera, Technical Assistant participated in a study tour to Central Plantations Crops Research Institute (CPCRI), Kasragod, India during 04-14 September, organised and sponsored by the FAO Fertilizer Project.

Mr L P Vidana Arachchi, Assistant Soil Scientist attended a "College on Soil Physics" from 02 October to 27 November, sponsored and held at the International Centre for Theoretical Physics (ICTP), Trieste, Italy.

2. LABORATORY AND GLASSHOUSE STUDIES

Studies on leaching of nutrients after application of fertilizer in coconut

Studies were continued with different rates of fertilizer and soil types under varying levels of simulated rainfall. Results show that about 60-80% of the applied K and Mg leached to a level below 1.0 m depth of sandy and gravel soils after 45 cm of rainfall. Similar leaching is observed in sandy soils under field conditions. Trials are in progress.

L P Vidana Arachchi, T Amarasekara and K S Jayasekara

Nutrient balance and water use by weeds in coconut plantations

Several common weeds in coconut plantations were analysed for nutrients. Preliminary results in Table 1 show that most weeds have comparatively high levels of N, P, K, and Mg in their leaf bio-mass and root systems. Aluminium access tubes upto the depth of 1 m were installed in the plots of different weeds/pastures and water extraction was monitored using a Neutron Probe. This study is in progress.

G D George and K S Jayasekara

Table 1 -Nutrient content of some selected weeds.

<i>Weed species</i>		<i>N%</i>	<i>P%</i>	<i>K%</i>	<i>Mg%</i>	<i>Ca%</i>
<i>Urena lobata</i>	Leaf	4.2	0.66	2.5	0.78	0.99
	Stem	0.8	0.40	1.7	0.44	0.59
	Root	0.8	0.30	1.4	0.58	0.70
<i>Chromolaena odorata</i>	Leaf	4.5	0.50	2.4	1.20	1.50
	Stem	0.8	0.28	2.1	0.32	0.30
	Root	1.0	0.17	1.2	0.26	0.28
<i>Mimosa pudica</i>	Leaf	4.6	0.25	0.9	0.43	0.74
	Stem	1.2	0.20	0.4	0.29	0.34
	Root	1.4	0.11	0.3	0.23	0.35
<i>Tephrosia (pila)</i>	Leaf	5.4	0.35	2.0	0.44	0.79
	Stem	1.8	0.17	1.2	0.96	1.47
	Root	2.3	0.24	1.2	0.18	0.27
<i>Cassia tora</i>	Leaf	4.4	0.56	2.5	0.76	1.47
	Stem	0.7	0.14	1.0	0.12	0.37
	Root	0.8	0.68	0.6	0.12	0.20
<i>Crotolaria sp.</i>	Leaf	7.8	0.57	2.4	0.41	0.88
	Stem	2.0	0.35	2.2	0.22	0.28
	Root	1.2	0.18	1.0	0.11	0.10
<i>Stachytarpheta indica</i>	Leaf	3.4	0.18	2.3	0.41	1.33
	Stem	1.0	0.09	1.7	0.12	0.66
	Root	0.8	0.06	1.4	0.10	0.29
<i>Panicum repens</i>	Leaf	2.2	0.13	1.1	0.21	0.46
	Stem	1.1	0.07	0.6	0.07	0.15
	Root	0.8	-	-	-	-

3. RESEARCH PROJECTS

PROJECT 1 - STUDIES ON THE IMPROVEMENT OF SOIL ORGANIC MATTER STATUS AND WATER HOLDING CAPACITY

Experiment 1.5.1 - Effect of coir dust on the physical condition of the soil. Heemmeliyagara Estate, Hiruwalpola (1984).

Yield records were maintained throughout the year and manuring was completed in September. The experiment was terminated at the end of the year and data are being analysed.

K S Jayasekara and L P Vidana Arachchi

Experiment 1.5.2 - Effect of coir dust on the physical condition of the soil. Marichchikattiya Estate, Madurankuliya (1984; Modified 1987)

Yield records were maintained and manuring was completed in August. Soil moisture levels were monitored using the Neutron Probe.

K S Jayasekara and L P Vidana Arachchi

PROJECT 7 - STUDIES ON THE NUTRIENT REQUIREMENTS OF COCONUT

Experiment 7.1 - Effect of NPK fertilizer and organic manure on coconut (CRIC 65). Bandirippuwa Estate, Lunuwila (1984).

Sixth basal dose of 4.5 kg of CU₁ fertilizer mixture/palm and fifth application of 20 kg of goat dung (in addition of CU₁) to half of the treatment palms (ie: 3 palms/plot) in each plot were carried out in May. Magnesium deficiency symptoms were corrected by applying 1 kg of Epsom Salt/palm in May. By the end of the year magnesium deficiency symptoms were almost fully corrected. However 2 kg of dolomite/palm were also applied to all palms in September as a long-term preventive measure for magnesium deficiency.

Inorganic fertilizer with extra goat dung increased the nut and copra yield/palm by 42%, respectively, compared to the inorganic only treatments. The increase was highly significant ($P=0.001$).

N A Tennakoon

Experiment 7.6.1 - Levels of organic manure (goat dung) supplemented with inorganics. Heemmeliyagara Estate, Hiruwalpola (1984).

The fifth differential application of organic manure, supplemented with inorganic fertilizer was completed in May.

Statistical analysis of nuts and copra yields at the end of the fifth year of the

experiment showed no significant difference between treatments. The final leaf and soil samples will be collected when the experiment is due to be terminated in February, 1990. Preliminary analysis of results is in progress.

N A Tennakoon

Experiment 7.6.2 - Levels of organic manure (goat dung) supplemented with inorganics. Saraswathie Estate, Divulapitiya (1985).

The fourth differential application of organic manure supplemented with inorganics was completed in August.

The important yield parameters, namely the number of female flowers, number of nuts and the weight of copra per palm per year showed highly significant difference ($P=0.001$) between treatments in the fourth year (Table 2). The increases of female flowers, nuts and copra over the control were 49%, 61% and 58%, respectively.

All the applied fertilizer/manure treated palms showed significantly increased responses for leaf nutrients N ($P=0.05$), P ($P=0.05$), K ($P=0.001$), Ca ($P=0.001$) and Mg ($P=0.05$) over the control in the 3rd year after manuring (Table 3).

Soil microbiological studies

The dry weight, nutrients (N, P, K) and organic carbon of the goat dung pellets buried in nylon bags were determined monthly. The changes in dry weight, N, P, K and organic carbon content can be separated into three phases during the year; the first phase upto 4 months, the second phase between 4 to 8 months, and the third phase between 8 to 12 months.

The loss in dry weight and release of nutrients (N, P, K) and organic carbon are given in Table 4.

N A Tennakoon

Experiment 7.6.3 - Levels of organic manure (goat dung) supplemented with inorganics. Kiniyama Estate, Weerapokuna (1984).

The fifth differential application of organic manure supplemented with inorganic fertilizer was completed in May.

Statistical analysis of nuts and copra yield at the end of the fifth year of the experiment showed no significant difference between treatments. The final leaf and soil

samples will be collected when the experiment is due to be terminated in February, 1990. Preliminary analysis of results is in progress.

N A Tennakoon

Table 2 - Effect of organic manure and inorganic supplementation on yield (experiment 7.6.2).

<i>Treatment</i>	<i>Female flowers</i>	<i>Nuts</i>	<i>Copra (kg)</i>
T ₁	88	23	4.5
T ₂	120	34	7.0
T ₃	130	37	7.3
T ₄	129	36	6.6
T ₅	132	38	7.0
T ₆	139	40	7.6
T ₇	136	36	7.2
Significance	***	***	***
CV%	1.4	7.0	3.9

T ₁	-	No fertilizer
T ₂	-	3.5 kg CU ₁ + Dolomite (0.5 kg)
T ₃	-	2.5 kg CU ₁ + Dolomite (0.5 kg)
T ₄	-	10 kg Cattle manure
T ₅	-	20 kg Cattle manure
T ₆	-	30 kg Cattle manure
T ₇	-	10 kg Cattle manure, 300 g saphosphosphate, 800 g muriate of potash & 500 g dolomite.

Experiment 7.7 - Nutrient requirement of coconut, based on leaf and soil analysis

a) The Differential Fertilizer Recommendations (DFR) model that was developed based on the leaf/soil nutrient and present/"Potential/target" production level of coconut was further improved to consider economics and resources available in plantations.

Table 3 - Nutrient content in the 14th leaf (%), in the third year after treatments (experiment 7.6.2).

<i>Treatment</i>	<i>N</i>	<i>P</i>	<i>K</i>	<i>Ca</i>	<i>Mg</i>
T ₁	2.17	0.15	1.18	0.44	0.15
T ₂	1.34	0.15	1.36	0.45	0.19
T ₃	2.23	0.15	1.61	0.36	0.17
T ₄	2.23	0.15	1.57	0.34	0.15
T ₅	2.34	0.16	1.54	0.36	0.17
T ₆	2.27	0.16	1.46	0.42	0.19
T ₇	2.41	0.16	1.57	0.34	0.16
Significance	*	*	***	***	*
CV%	4.6	4.8	6.2	6.1	10.0

Treatments as in Table 2.

Table 4 - Dry weight change in goat manure and release of nutrients (experiment 7.6.2).

<i>Parameter</i>	<i>1st phase (Jan - April)</i>	<i>2nd phase (April - August)</i>	<i>3rd phase (August - Dec.)</i>
Dryweight %	36.0	92.0	95.0
N%	8.7	37.8	59.3
P%	11.5	30.4	41.7
K%	91.5	97.7	98.9
OC%	6.7	30.9	39.0

The Division provided the DFR service to 104 large coconut estates (about 50 ac or more in extent) covering an area of about 7250 ac and the nutrient status of the sampled area is given in Fig. 1-4. These estates have used the general fertilizer recommendations provided by the Coconut Research Institute. Analysis of data from foliar analysis show that nearly 85% of the palms in the estate sector have adequate or excess levels of leaf nitrogen and leaf phosphorus. However, about 65% of the palms

in these estates are deficient in both potassium and magnesium while about 35% of the palms have adequate or excess levels of K and Mg. It is interesting to note the two peaks in the frequency bar chart for K (Fig. 3) at 0.9 and 1.3% of leaf K indicative of the level of fertilizer management.

Further work on the DFR computer model is in progress with a view to improve its capability.

K S Jayasekara

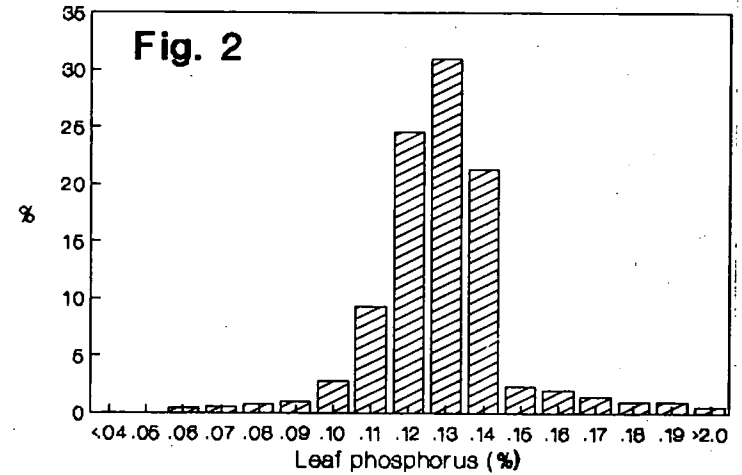
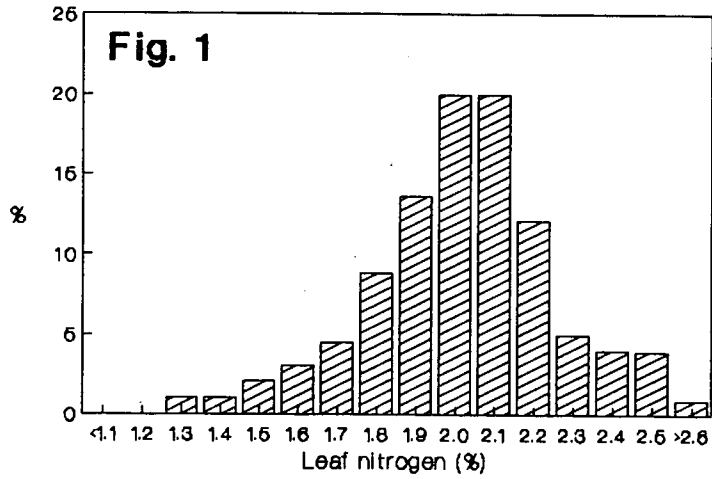
b) FAO Fertilizer Project

The project was reviewed in June by a Review Mission consisting of representatives of the donors and the FAO, which took note of the analytical and yield data of the 71 demonstration plots which were selected for detail monitoring as recommended in the report titled "A field evaluation of fertilizer demonstrations on coconut" (De Silva, 1988). Leaf (14th) nutritional data of palms in the all 212 demonstration plots at the beginning of the project (ie: 1981-1983) were collated and given in the Figs 5-8. Since the selected plots have not been fertilized at least during the previous 3-5 years, the leaf nutrient levels were considered as an indicator of the general soil fertility levels of the coconut lands in Sri Lanka.

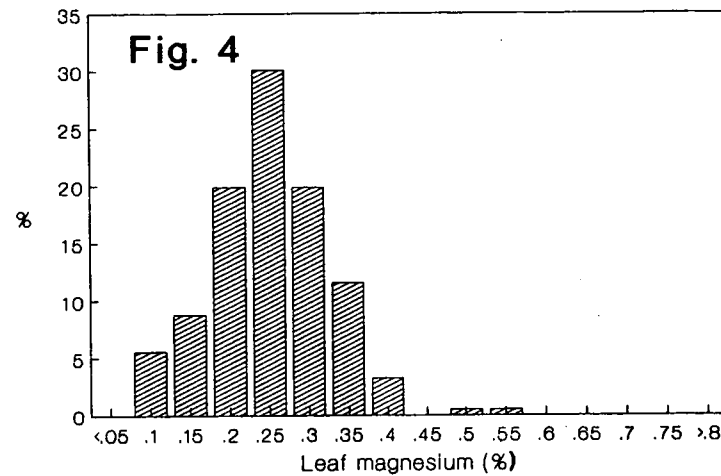
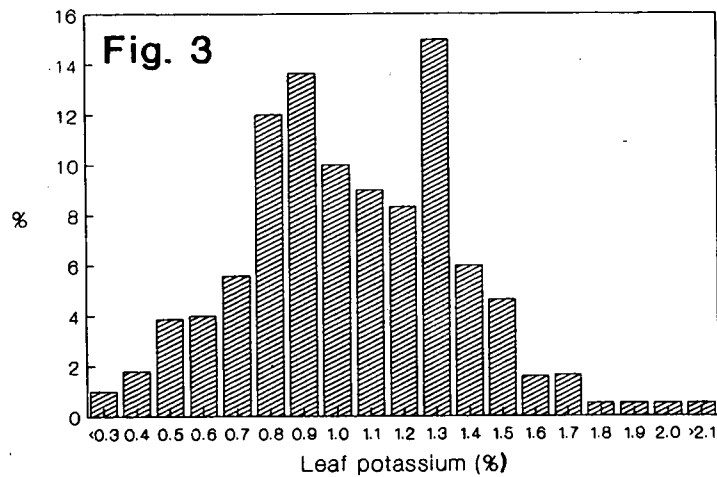
Results show that only 30% of the blocks are deficient in nitrogen with leaf N levels of less than 1.9% (ie: Sufficiency ranges for nutrient in the 14th leaf of coconut are N 1.9-2.1%; P 0.11-0.13%; K 1.2-1.5; Mg 0.25-0.35%). Results in Fig. 6 show that less than 10% of coconut lands are deficient in phosphorous. However, data presented in Fig. 7 show that nearly 60% of the palms show severe K deficiency indicating it to be the main yield-limiting nutrient in Sri Lanka. Similarly, about 40% of the palms had Mg deficiency. These results show that the current order of importance of nutrients in coconut in Sri Lanka to be $K > Mg >> N > P$. These data were extensively used in the formulation of the new "Adult Coconut" (0-6-32-5) fertilizer mixture (See Section 5.1).

Preliminary analysis of yield and cost data show a yield increase of 59% (range 23-194%) with a Value Cost Ratio (VCR) of 2.1-5.9. Further analysis is in progress for different soil types, districts, agro-climates etc..

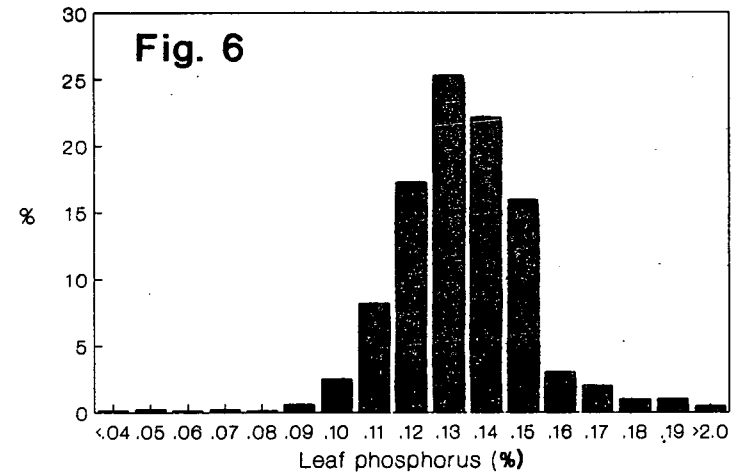
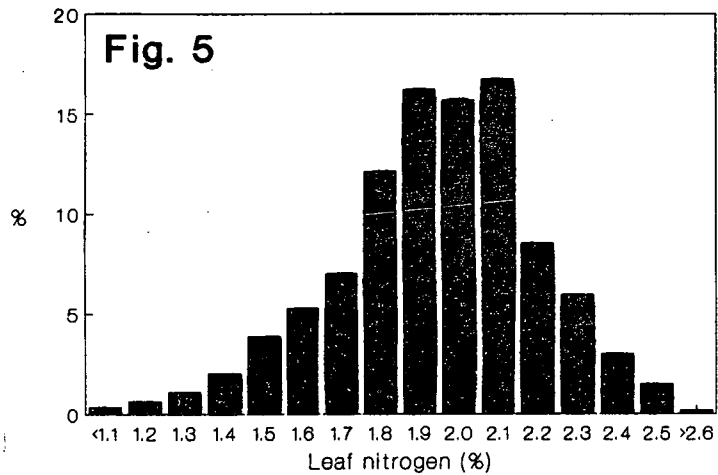
Several meetings with the relevant Coconut Development Officers were held in Gampaha and Kurunegala districts followed by field visits to demonstration plots.



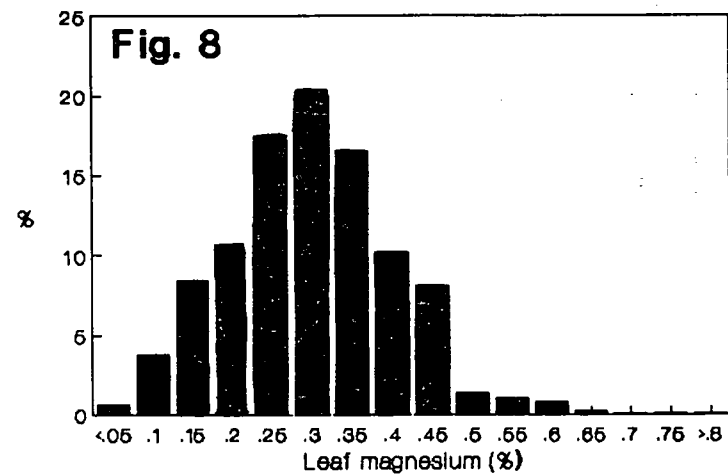
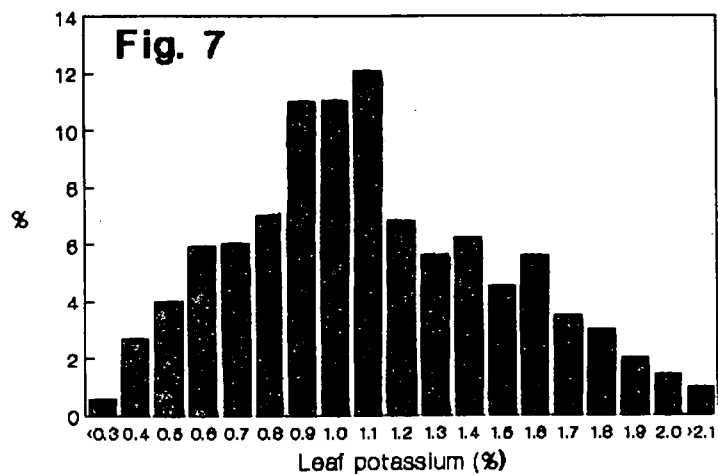
Figs. 1 & 2 - Status of nitrogen (N) and phosphorus (P) in the 14th leaf, expressed as % occurrence (data from 216 samples from estates).



Figs. 3 & 4 - Status of potassium (K) and magnesium (Mg) in the 14th leaf, expressed as % occurrence (data from 216 samples from estates).



Figs. 5 & 6 - Status of nitrogen (N) and phosphorus (P) in the 14th leaf, expressed as % occurrence (data from 1776 samples from small-holdings in the FAO Fertilizer Project).



Figs. 7 & 8 - Status of potassium (K) and magnesium (Mg) in the 14th leaf, expressed as % occurrence (data from 1776 samples from small-holdings in the FAO Fertilizer Project).

A tri-partite (FAO-CCB-CRI) meeting was held on 30 November to review and monitor the progress of the project, budget, and the implementation schedule for 1990.

K S Jayasekara

Experiment 7.8 - Effect of chloride and sulphate of potassium, magnesium, and sodium on the yield of coconut. Heemmeliyagara Estate, Hiruwalpola (1984).

Yield records were maintained and the differential fertilizer treatments were given in May. Detailed analysis of data are in progress.

L L W Somasiri

Experiment 7.9.1 - Studies on K-Mg interaction in coconut. Heemmeliyagara Estate, Hiruwalpola (1984). [Funded by CIDA].

Statistical analysis of yield data for 1989, in terms of nuts and copra showed neither a significant response to the main treatments K and Mg nor significant interaction between them.

Nut water analysis: Nut water samples from the different treatment combinations were collected in March and November and analysed for Na, K, Ca, Mg and Cl. The data are presented in Tables 5 and 6. The increased rates of K caused significant changes in Na, K and Mg.

Sodium: Increased rates of K caused a significant ($P=0.05$) quadratic decline in the Na status. There was a depressive effect on Na uptake with increased rates of applied K.

Potassium: Increased rates of applied K caused a highly significant ($P=0.001$) linear increase of K.

Chloride: Increased rates of applied K caused linear increase ($P=0.05$ and 0.01) of chloride in nut water.

M Jeganathan

Experiment 7.9.2 - Studies on K-Mg interaction in coconut. Sirikandura Estate, Dodanduwa (1984). [Funded by CIDA]

Yield: Statistical analysis of yield data for the period April 1988 to February 1989 showed significant differences for both nuts and copra ($P=0.01$) for increased K (Table 7). This is the third consecutive year that significant differences have been observed for applied K.

Table 5 - Nutrient concentration (ppm) in nut water due to differential application of K & Mg (experiment 7.9.1).

Treatment	Na	K	Ca	Mg	Cl
K ₁	135	1799	204	125	1877
K ₂	77	2002	227	120	1936
K ₃	58	2003	226	122	1949
K ₄	50	2117	229	122	1993
Mg ₁	89	1903	226	116	1946
Mg ₂	77	2030	226	122	1941
Mg ₃	73	2002	225	125	1954
Mg ₄	81	1988	209	127	1914
K ₁ Mg ₁	162	1653	213	121	1917
K ₁ Mg ₂	140	1791	214	125	1839
K ₁ Mg ₃	86	1923	206	126	1885
K ₁ Mg ₄	150	1831	185	128	1869
K ₂ Mg ₁	93	1941	243	119	1960
K ₂ Mg ₂	59	2139	239	120	1989
K ₂ Mg ₃	92	1868	229	121	1899
K ₂ Mg ₄	63	2059	198	121	1897
K ₃ Mg ₁	60	1899	222	114	1914
K ₃ Mg ₂	55	2117	220	115	1951
K ₃ Mg ₃	56	2100	226	125	2018
K ₃ Mg ₄	61	1897	237	135	1912
K ₄ Mg ₁	43	2117	226	108	1992
K ₄ Mg ₂	53	2071	232	128	1987
K ₄ Mg ₃	57	2118	239	126	2014
K ₄ Mg ₄	49	2162	218	123	1980
Sig. Level K	1	***	***	*	*
	q	*	-	-	-
	l	-	-	-	-
Sig. Level Mg	q	-	-	-	-
CV %	44.12	9.52	12.15	12.10	5.77

* P = 0.05; ** P = 0.01; *** P = 0.001

l = linear response; q = quadratic response

Table 6 - Nutrient concentration (ppm) in nut water due to differential application of K and Mg (experiment 7.9.1).

Treatment	Na	K	Ca	Mg	Cl	
K ₁	158	2293	199	128	1887	
K ₂	82	2534	183	117	1958	
K ₃	64	2527	199	119	2045	
K ₄	56	2619	197	123	2014	
Mg ₁	102	2421	215	122	1990	
Mg ₂	85	2534	193	119	1940	
Mg ₃	88	2494	184	119	1968	
Mg ₄	84	2524	185	127	1999	
K ₁ Mg ₁	196	2104	227	134	1879	
K ₁ Mg ₂	155	2430	198	129	1843	
K ₁ Mg ₃	128	2307	175	116	1875	
K ₁ Mg ₄	153	2331	195	133	1953	
K ₂ Mg ₁	98	2420	229	127	2019	
K ₂ Mg ₂	68	2589	185	110	1891	
K ₂ Mg ₃	93	2470	163	111	1894	
K ₂ Mg ₄	69	2659	154	123	2027	
K ₃ Mg ₁	64	2502	196	114	2097	
K ₃ Mg ₂	64	2536	180	114	1964	
K ₃ Mg ₃	67	2619	207	127	2075	
K ₃ Mg ₄	61	2450	214	123	2043	
K ₄ Mg ₁	51	2657	209	113	1965	
K ₄ Mg ₂	54	2582	210	125	2086	
K ₄ Mg ₃	66	2583	192	124	2029	
K ₄ Mg ₄	53	2656	177	131	1975	
Sig. Level K	l	***	***	-	-	**
	q	*	-	-	*	-
	l	-	-	-	-	-
Sig. Level Mg	q	-	-	*	-	-
CV %		56.66	7.29	16.62	9.75	6.27

* P = 0.05; ** P = 0.01; *** P = 0.001

l = linear response; q = quadratic response

Table 7 - *Coconut and copra yield from April, 1988 to February, 1989 under different rates of potassium application (experiment 7.9.2 - 158 palms/ha).*

<i>Treatment</i>	<i>Nuts/ha</i>	<i>%</i>	<i>Difference</i>
K ₁	5728	100	-----
K ₂	7290	127	1562
K ₃	7773	136	2045

<i>Treatment</i>	<i>Copra (kg)/ha</i>	<i>%</i>	<i>Difference Copra/ha</i>
K ₁	1127	100	-----
K ₂	1559	138	432
K ₃	1696	150	569

Leaf analysis: Analysis of samples from the 6th leaf, collected in May, 1988, showed a quadratic response for N, which was not shown with respect to the 14th leaf. However, P remained unaffected in both leaves (Table 8). Application of K showed significant quadratic responses in leaf Na, K, Ca and Mg with Na, Ca and Mg showing decreases and K an increase.

Increasing the rates of Mg showed a significant linear increase in leaf Mg, similar to that observed with leaf 14. This response was seen for the year 1988, the fourth year of the experiment. Unlike in leaf 14, there was a significant ($P=0.01$) interacting effect K x Mg.

Nut water analysis: Analysis of nut water collected in May and October, 1989, (Tables 9 and 10) showed significant responses to application of K, resulting in Na, K and Cl showing both linear and quadratic responses, with a decrease in Na and increase in K and Cl. Calcium increased linearly, but Mg showed a quadratic response with an increasing-decreasing pattern.

Application of Mg showed a significant linear increase in Mg and the observations were on similar in respect of leaf 6 and 14, sampled in May, 1988.

M Jeganathan

Table 8 - Nutrient concentration (%) in the sixth leaf due to differential application of K & Mg (experiment 7.9.2) - April, 1988.

Treatment	N	P	Na	K	Ca	Mg
K ₁	2.19	0.154	0.399	0.77	0.284	0.206
K ₂	2.10	0.147	0.231	1.57	0.209	0.122
K ₃	2.24	0.149	0.171	1.94	0.185	0.106
Mg ₁	2.12	0.149	0.264	1.53	0.229	0.115
Mg ₂	2.16	0.152	0.283	1.37	0.235	0.151
Mg ₃	2.24	0.149	0.253	1.38	0.212	0.168
K ₁ Mg ₁	2.04	0.147	0.413	0.82	0.281	0.145
K ₁ Mg ₂	2.21	0.161	0.395	0.82	0.287	0.226
K ₁ Mg ₃	2.33	0.154	0.390	0.69	0.285	0.249
K ₂ Mg ₁	2.08	0.147	0.202	1.81	0.205	0.098
K ₂ Mg ₂	2.14	0.149	0.271	1.40	0.214	0.126
K ₂ Mg ₃	2.08	0.146	0.219	1.51	0.201	0.144
K ₃ Mg ₁	2.26	0.153	0.177	1.98	0.202	0.104
K ₃ Mg ₂	2.13	0.146	0.185	1.89	0.205	0.102
K ₃ Mg ₃	2.32	0.149	0.151	1.95	0.150	0.111
1	-	-	***	***	***	***
K						
q	*	-	**	**	*	***
1	-	-	-	-	-	***
Mg						
q	-	-	-	-	-	-
K x Mg	-	-	-	-	-	**
CV %	5.79	4.25	15.78	12.09	12.02	13.52

* P = 0.05; ** P = 0.01; *** P = 0.001
 l = linear response; q = quadratic response

Table 9 - Nutrient concentration (ppm) in nut water due to differential application of K & Mg (experiment 7.9.2 - March, 1989).

Treatment	Na	K	Ca	Mg	Cl
K ₁	371	1473	220	111	1949
K ₂	152	2469	198	113	2160
K ₃	97	2695	187	108	2110
Mg ₁	221	2184	210	102	2135
Mg ₂	201	2254	194	108	2082
Mg ₃	197	2198	202	121	2001
K ₁ Mg ₁	416	1445	228	102	2075
K ₁ Mg ₂	330	1528	202	105	1936
K ₁ Mg ₃	307	1446	231	125	1835
K ₂ Mg ₁	148	2379	220	105	2175
K ₂ Mg ₂	167	2539	179	108	2219
K ₂ Mg ₃	141	2489	196	125	2086
K ₃ Mg ₁	99	2729	181	98	2155
K ₃ Mg ₂	106	2697	200	111	2093
K ₃ Mg ₃	85	2661	179	114	2083
Sig. Level K					
l	***	***	*	-	**
q	***	***	-	-	**
Sig. Level Mg					
l	-	-	-	***	*
q	-	-	-	-	-
CV %	18.42	6.92	12.24	9.02	4.99

* P = 0.05; ** P = 0.01; *** P = 0.001

l = linear response; q = quadratic response

Experiment 7.10 - The occurrence of Vesicular-Arbuscular Mycorrhizae (VAM) in coconut (1987).

Laboratory studies on the culture/multiplication of several important VAM species were continued.

M G F S Jayasundara

Table 10 - Nutrient concentration (ppm) in nut water due to differential application of K & Mg (experiment 7.9.2 - October, 1989).

Treatment	Na	K	Ca	Mg	Cl
K ₁	319	1246	214	98	1769
K ₂	146	2108	225	110	2043
K ₃	83	2410	234	103	2077
Mg ₁	185	1956	225	96	2015
Mg ₂	185	1934	224	100	1928
Mg ₃	175	1875	223	115	1946
K ₁ Mg ₁	329	1283	219	90	1835
K ₁ Mg ₂	317	1325	206	95	1736
K ₁ Mg ₃	312	1130	218	111	1737
K ₂ Mg ₁	139	2125	225	101	2106
K ₂ Mg ₂	160	2071	225	107	2032
K ₂ Mg ₃	140	2128	223	122	1992
K ₃ Mg ₁	89	2459	231	98	2106
K ₃ Mg ₂	86	2406	241	101	2015
K ₃ Mg ₃	74	2367	230	112	2109
Sig. Level K					
1	***	***	*	-	***
q	**	**	-	*	**
Sig. Level Mg					
1	-	-	-	**	-
q	-	-	-	-	-
CV %	20.68	6.91	7.64	9.65	4.79

* P = 0.05; ** P = 0.01; *** P = 0.001

1 = linear response; q = quadratic response

Experiment 7.11 - Effect of Vesicular-Arbuscular Mycorrhizae (VAM) on growth of coconut and uptake of phosphorus from Eppawala Rock Phosphate (ERP) (1987).

The cover crop, *Centrosema pubescens*, infected with VAM fungi *Glomus fasciculatum* and *Gigaspora gigantea* was introduced to the respective treatments. All

the pots were fertilized with a mixture containing Urea (83 g) and muriate of potash (83 g). In addition, dolomite was applied at the rate of 192 g/pot. All pots were watered regularly. Growth parameters viz: plant height, girth at collar, number of leaves and leaf area were taken at bimonthly intervals. One year after the commencement of the experiment, coconut seedlings were removed for the determination of leaf dry weight, root dry weight, and leaf nutrient content.

One gram of fresh roots from the root systems of each coconut seedling was taken for the determination of infection intensity.

Statistical analysis of the data indicated that there were significant differences in leaf and root dry weights among the treatments. Root and leaf dry matter of coconut seedlings were significantly higher in saphos phosphate-applied pots when compared with those of Eppawala Rock Phosphate applied pots. Mycorrhizal inoculation significantly improved the root and leaf dry matter in Eppawala Rock Phosphate applied pots and also the leaf and root dry matter were higher in unselected mycorrhizal infected pots than that of selected mycorrhizal pots (Table 11).

M G F S. Jayasundara

PROJECT 24 - STUDIES ON IRRIGATION OF COCONUT

Experiment 24.1 - The effect of frequency and rate of drip irrigation on the soil-plant water relations and the productivity of coconut. Marandawila NLDB Farm, Marandawila (1987).

Yield records were maintained. Irrigation treatments were not imposed regularly as scheduled, due to lack of water. However, water was transported in bowsers during the dry periods in order to continue the irrigation treatments as much as possible.

Neutron probe measurements were taken during the May-August dry period after the monsoonal rains.

L P Vidana Arachchi and K S Jayasekara

Experiment 24.2 - Effect of size of the irrigation zone on the growth and water relations of coconut seedlings and its nutrient balance. Bandirippuwa Estate, Lunuwila (1987).

Average water holding capacity of the soil was found to be 4.9% as determined by the pressure plate apparatus. Differential irrigation treatments (See Annual Report,

Table 11- *Effect of Vesicular Arbuscular Mycorrhizae (VAM) and Eppawala Rock Phosphate (ERP) on dry matter content and leaf nutrient composition of coconut seedlings.*

Treatment	Dry Matter (g)		Leaf Nutrient Composition (%)				
	Leaf	Root	N	P	K	Ca	Mg
1. Control	90.5	78.0	1.4	0.09	1.6	0.4	0.2
2. A	116.5	84.7	1.8	0.09	1.5	0.5	0.3
3. B	106.7	99.2	1.5	0.09	1.2	0.5	0.3
4. A + ERP	124.7	119.7	1.5	0.07	1.3	0.5	0.3
5. B + ERP	104.5	88.5	1.5	0.10	1.2	0.5	0.3
6. Saphosphosphate	156.2	160.0	1.7	0.06	1.2	0.5	0.3
7. ERP	97.7	82.2	1.5	0.07	1.0	0.6	0.3
8. A + B	101.2	72.7	1.5	0.08	1.4	0.5	0.3
9. A + B + ERP	131.5	104.5	1.9	0.10	1.4	0.4	0.3
10. Unidentified Mycorrhizae	145.0	107.0	1.6	0.07	1.1	0.5	0.3
LSD	35.30	45.64					

A - *Glomus fasciculatum*

B - *Gigaspora gigantea*

1987) were imposed from March. Soil water content/potential was regularly monitored using the neutron probe. Plants were fertilized with YPM (13-12-17) fertilizer mixture at the rate of 800 g/seedling in May and 1 kg of dolomite per seedling in September. Plant growth parameters (leaf number, leaf area) and leaf nutrient levels were monitored regularly.

K S Jayasekara

4. MISCELLANEOUS STUDIES

Rainfall interception in coconut plantations

Rainfall interception by coconut canopy during 59 rainy periods was monitored using mini rain gauges (see Annual Report, 1988). The total amount of intercepted rain water was determined and the nutrient content was determined. Water from the stem flow was also collected using a galvanised ring collar fixed to the trunks of four coconut palms. Preliminary results show a high degree of stem flow and canopy droppings were during rains, indicating interception by the coconut canopy. The canopy droppings were found to have high levels of N and K. The trial is in progress.

E M A T Banda and K S Jayasekara

Studies on dolomite and NPK fertilization in coconut

Laboratory studies posed some practical difficulties in the capture of evolved ammonia gas in transparent perspex boxes. Continuous air flow system prevented the condensation of the evaporated soil water on the sides of the perspex box. About 85% recovery of ammonia gas was achieved by the system. The trial is in progress.

T W Fernando and K S Jayasekara

Sea Water in irrigation of coconut

Following six differential sea water irrigation treatments were imposed on thirty five TxT seedlings planted in May 1988 (Annual Report, 1988).

T0	-	Control (No irrigation - rained)							
T1	-	Weekly* irrigation of sea water upto field capacity							
T2	-	Two* weekly	"	"	"	"	"	"	"
T3	-	Three*	"	"	"	"	"	"	"
T4	-	Four*	"	"	"	"	"	"	"
T5	-	Six*	"	"	"	"	"	"	"

* Time schedule was adjusted after the each rainfall regime of more than 5 mm/day.

Coconut seedlings were fertilized with 500 g of YPM (13-12-17) fertilizer mixture in May and October during the monsoons. Plant growth parameters (leaf number, leaf area) were measured bi-monthly. Leaf nutrient levels were monitored before and after each irrigation treatment. The response of plants is satisfactory and the trial is in progress.

D P Panditharatne and K S Jayasekara

Nutrient culture (hydroponics) technique in coconut

Twenty four coconut seedlings were grown in the aerated (1 min aeration/10 min) nutrient culture solution (See Annual Report, 1988). Studies on leaf analysis and nutrient levels in the aerated solution after one week showed a complete depletion of nitrogen in the solution. Hence the reported nutrient solution may be adequate for 3 - 4 days (specially nitrogen) and the solution needs to be changed at least weekly for optimum growth of the coconut seedlings.

Extensive formation of pneumatophores in the root system was observed, and studies are in progress to study the effect of degree of aeration on the formation of pneumatophores and related root adaptations.

D P Panditharatne and K S Jayasekara

Ground water nutrient study

A study was initiated in August to monitor the nutrient levels in ground water at various locations at Bandirippuwa Estate, Lunuwila. The objective is to monitor/study the nutrients accumulated to the ground water table in a coconut plantation and its relation to the fertilizer practices.

Nineteen locations (17 wells, 1 pond, 1 stream) at Bandirippuwa Estate were selected for the study. Preliminary results show a high level of N, K, and Mg in the ground water in certain locations. Regular monitoring is in progress to collect more data.

U S S Perera and K S Jayasekara

Coir dust in manure circle of coconut (Bandirippuwa Estate)

The trial was commenced in May to study the effect of application of coir dust in the manure circle area of coconut on its yield. This method has several advantages

over the method under investigation (expt. 1.5.1) where coir dust is applied in the entire field Tall x dwarf hybrid farms were randomly selected for this experiment. Each treatment had three replicates palms and at least one guard row palm. Following four rates of coir dust were applied to the manure circle area.

Treatment Air dry coir dust rate/palm in the manure circle area

	kg	Layer thickness (cm)
T0	0	0
T1	14	0.5
T2	28	1.0
T3	56	2.0

Coir dust was broadcast evenly around the palm within the 1.75 m radius (ie: manure circle area) and the soil was turned with a mamoty.

Several soil physical measurements (bulk density, infiltration, available soil water) were taken. Yield records are being maintained. Studies on leaf and soil nutrient dynamics are in progress.

K S Jayasekara

5. NEW RECOMMENDATIONS

5.1 New "adult coconut" fertilizer mixture

The "Adult Palm Mixture" (APM : 12-6-32) was introduced in March 1986 for adult coconut palms. Application of dolomite at the rate of 1.5-2.0 kg/palm, once in three years was also recommended to supply the Mg requirements.

However during the last two years studies conducted by the division have revealed the following:

1. Most coconut soils have adequate levels of phosphorus (studies from FAO fertilizer project; Fig. 6).

The phosphate component in the coconut fertilizer mixtures could be partly (50%) substituted with locally-produced Eppawala Rock Phosphate (Apatite), thereby saving foreign exchange.

2. The current practice of applying dolomite once in three years often makes the growers to postpone application, resulting in widespread magnesium deficiency (ie: Figs. 4 and 8). Imported, and therefore more expensive, kieserite is required and is being extensively used to correct the magnesium deficiency in coconut.
3. Growers especially small-holders, when using organic manures as the source of nitrogen have difficulties of using the supplementary straight fertilizers since only the mixtures containing N-P-K are generally available.
4. Coconut growers are often faced with lack of labour during the rainy season to apply fertilizer.
5. Uncertainty of rain has caused many growers to postpone/suspend the application of fertilizers containing nitrogen (ie: APM YPM) during the dry weather.
6. Since urea absorbs moisture readily, urea-based fertilizer mixtures tend to get caked-up on storing, and therefore needs special packing. Growers often find difficulties with storage and handling of such mixtures.

In order to overcome these problems, a new fertilizer mixture for adult coconut palms known as "Adult Coconut" containing phosphorus, potassium and magnesium was introduced in November. The new "Adult Coconut" fertilizer mixture could be prepared as follows:

Eppawala Rock Phosphate (30% P ₂ O ₅)	- 3 parts by weight
Saphos Phosphate (27.5% P ₂ O ₅)	- 3 parts by weight
Muriate of Potash (60% K ₂ O)	- 16 parts by weight
Dolomite (20% MgO)	- 8 parts by weight

(App. Composition 0-6-32-5)

This mixture can be applied any time of the year. Since the mixture does not contain a nitrogen source, it is necessary to apply urea separately when the soil is moist. The following rates of application may be used as a guide to determine the appropriate amount for coconut yielding 3,000 nuts/acre/year.

Upto 1 1/2 times of these rates should be applied to improved cultivars, high yielding fields or fields with a potential for high yield.

<i>Climatic Zone</i>	<i>Soil Type</i>	<i>Dosage (kg/palm/year)</i>	
		<i>"Adult Coconut"</i> (0-6-32-5)	<i>Urea</i> (46% N)
Wet	Gravel, Cabook, Sand	3	0.8
Intermediate	Loam, Clay	2	0.5
Intermediate	Gravel, Sand	3	0.8
	Loam, Clay	2	0.5
Dry	Gravel	3	0.8
	Loam, Clay	2	0.5
	Sand	2.5	0.7

Instead of urea, organic manures/green manures could be used as indicated below, to obtain the nitrogen requirement of the coconut palms.

<i>Urea</i> (kg)	<i>Equivalent rate of organic manure (kg)</i>			
	<i>Cow dung</i>	<i>Goat dung</i>	<i>Poultry droppings</i>	<i>Glyricidia fresh leaves</i>
0.5	25	10	20	20
0.7	30	12	25	25
0.8	35	15	30	30

5.2 Advisory Circulars

The division assisted in the preparation of the following new Advisory Circulars.

1. Advisory Circular A6 (1989). Soil Moisture Conservation in Coconut Lands - General Considerations.

2. Advisory Circular A7 (1989). Soil Moisture Conservation in Coconut Lands - Use of Husk and Coir Dust.
3. Advisory Circular A9 (1989). Soil Moisture Conservation in Coconut Lands - Contour Drains, Bunds, and Terracing.

6. CHEMICAL, PHYSICAL, AND MICROBIOLOGICAL ANALYSIS

6.1 Quality Control

The Division continued to participate in the Leaf Sample Exchange Programme (LSEP) under the International Plant Analytical Exchange (IPE) organised by the University of Wageningen, The Netherlands. Thirty leaf samples were analysed for N, P, K, Ca, Mg, S, Cl, Na, Fe, Mn, Cu, Zn, and B at two monthly intervals during the year.

Annual review of the LSEP-IPE showed that 346 entries of analysis were comparable with that of other international laboratories throughout the world, out of a total of 390 analyses conducted by the division.

The Division also participated in the Soil Sample Exchange Programme (SSEP) under the International Soil-Analytical Exchange (ISE) organised by the University of Wageningen, The Netherlands. Eight soil samples were analysed for total (K, Mg, Mn, N, Na, P, Zn, Cu, Fe), pH-H₂O (1:5), pH-CaCl₂ (1:10), Extractable with CaCl₂ 0.01 M 1:10 w/v (Cu, Fe, K, Mg, Mn, Na, Zn), Extractable with 1 M NH₄OAC (Ca, K, Mg, Na).

Annual review of the SSEP-ISE showed that 153 entries of analysis were comparable with other international laboratories, out of a total of 180 analyses.

6.2 Leaf, Soil, Fertilizer, Water Analysis

Analytical methods were checked and collated to be published.

Altogether 2037 leaf samples were analysed N, P, K, Ca, and Mg. About 75% of these samples were analysed for Cl, S, E, Fe, Mn, Cu, Zn and Mo as well. A total of 2221 soil samples were analysed for pH and conductivity. About half of these samples were analysed for Total N, Exch. K, Exch. Mg, Avail. p (Bray/Olsen), and Total Exchangeable Bases (TEB).

Thirty eight fertilizer (chemical and organic) and coir dust samples were analysed for N, P, K, Mg, and Org. C. Fourty five samples of toddy and 324 water (ground and rain water) samples were also analysed for N, P, K, Mg, Ca, Cl, S, B, Fe, Mn, Cu, Zn and Mo.

Nine hundred and twenty soil samples were analysed for several soil physical parameters such as bulk density (156 samples), practice size analysis (50), particle density (42), available water (670 samples at 1/10, 1/3, 15 bar using pressure plate) and gravimetric moisture (250).

Fifty soil samples were subjected to microbial analysis for total fungal/bacterial colonies, total microbial biomass, CO₂ evolution and rate of N mineralization/nitrification. Soil (80) and root (160) samples were also tested for mycorrhizae. Four coir dust samples were examined for nematodes using Baerman's method.

7. SERVICES AND EXTENSION ACTIVITIES

7.1 Participation of divisional staff in Committees.

Mr K S Jayasekara - Member, Fertilizer Co-Ordinating Committee of the National Fertilizer Secretariat (NFS).

Mr K S Jayasekara - Member, Committee appointed by the Secretary/Ministry of Agriculture, Food and Co-operatives to report on the "Use of organic fertilizer in the context of removal of subsidy on chemical fertilizers".

Mr M Jeganathan - Member, Drafting Committee on Fertilizers, Sri Lanka Standards Institution.

7.2 Electronic Workshop

Several minor repairs and maintenance work of equipment in various research divisions were carried out.

7.3 Seminars/Field Days and Training Programmes

Research staff of the division participated in the Research Seminar on 07 July and briefed the staff about the Differential Fertilizer Recommendation, new "Adult Coconut" fertilizer mixture, and the research programme of the division.

Staff of the division participated in training programme for the Superintendents and Field Officers of the CRI estates on the Differential Fertilizer Recommendation, new "Adult Coconut" mixture, and soil/moisture conservation practices in coconut.

Mr K S Jayasekara functioned as a resource person in four training programmes conducted at the Coconut Development Training Centre, Lunuwila.

Four student trainees from the National Apprentice Board of Sri Lanka were given a general training on fertilizer and cultural practices in coconut.

7.4 Advisory/Extension Work

One hundred and four coconut estates covering about 7250 ac were inspected and the Differential Fertilizer Recommendations (DFR) and cultural practices were given. The DFR was based on the leaf/soil nutrient and present/"Potential/target" productivity of the coconut plantation. Transport facilities for sample collection were provided by land owners.

Two demonstrations (Magnesium deficient coconut palm and Fertilizer/Irrigation/Cultural practices) were maintained satisfactorily and were used in the field training programmes.

Promotional stickers on fertilizer use in coconut were prepared with the financial assistance from the National Fertilizer Secretariat (NFS).

A poster campaign to promote fertilizer use in coconut was arranged with the help of the Information Services Division.

8. PUBLICATIONS AND COMMUNICATIONS

8.1 Publications and Communications

Jayasekara, K S (1989). Boron Deficiency in Coconut. *Coconut Bulletin* 6 (2) : 19 - 20.

Jayasekara, K S (1989). Efficient Use of Dolomite in Coconut Cultivation. *Coconut Bulletin* 6 (2) : 9.

Jayasekara, K S, Periathamby, S, and Jayalath, N S (1989). Measure Your Fertilizer Easily. *Coconut Bulletin* 6 (2) : 7-8.

Jayasekara, K S (1989). Efficient Use of Fertilizers in Coconut. "Symposium on Fertilizer and their Efficient Fertilizer Utilization" organized by the Institute of Chemistry, Ceylon. University of Peradeniya, Kandy. 11 March.

Jayasekara, K S (1989). Use of Eppawala Rock Phosphate in Coconut. "National Symposium on the Eppawala Phosphate Deposit- Recent Advances in Knowledge" organized and sponsored by the Institute of Fundamental Studies, Kandy. 16- 17 December.

Jayasundara, M G F S (1989). Mycorrhizae in coconut. Paper presented at the "Research Seminar for Young Scientists" organised by the Institute of Biology, Colombo. 15 December.

Jeganathan, M (1989). Hazards in Perennial Crop Nutrition. Presidential Address to Section B. Annual Sessions of the Sri Lanka Association for the Advancement of Science (SLAAS), Colombo. 07 December.

Tennakoon, N A, and Mathes, D T (1989). Decomposition of goat dung and the availability of nutrients to the coconut palm. Paper presented at the 45th Annual Sessions of SLAAS, Colombo. 05 December.

9. REFERENCES

Annual Report (1988). Annual Report of the Soils and Plant Nutrition Division. Report for 1988 - Coconut Research Institute of Sri Lanka.

De Silva, M A T (1988). A Field Evaluation of Fertilizer Demonstration on coconut. Field Document No. 2, FAO Fertilizer Project GCPF/SRL/047/NET.

10. ACKNOWLEDGEMENTS

Encouragement and co-operation rendered by the Chairman, Coconut Research Board and the Director, Coconut Research Institute are gratefully acknowledged. Thanks are due to Mr D T Mathes, Head and Mr T S G Peiris, Biometrician of the Biometry Division for biometrical assistance, data recording/analysis, and computer programming. Assistance given by the Heads and staff of other research and services divisions of the Coconut Research Institute is sincerely appreciated. Co-operation from Janatha Estates Development Board (JEDB), National Livestock Development Board (NLDB) and Sri Lanka State Plantations Corporation (SLPC), in the conduct of field experiments in their plantations and the encouraging response from the coconut growers are also acknowledged.

Contributions by former members of the division is duly recognised.

All staff members in the division worked hard with dedication throughout the year to implement the research programme with the limited staff and inspite of the disturbed conditions in the country.

REPORT OF THE CROP PROTECTION DIVISION

Head - P A C R Perera Ph.D

1. GENERAL

1.1 Staff Matters

Appointments: Dr P A C R Perera, Acting Head, Crop Protection Division was appointed Head, Crop Protection Division with effect from 10 August.

Mr W M Edward Gamini Fernando was appointed Labourer with effect from 01 November.

Promotions: Mr K F G Perera, Technical Assistant, from Technical Grade Class II to Class I with effect from 01 January, 1987.

Mrs A de Zoysa, Clerk, from Clerical Grade Class II to Class I with effect from 01 January, 1987.

Transfers: Messrs. M Nadarajah (Lab & Field Attendant), V Sithambarapillai and K Velupillai (Labourers) were transferred from the Parasite Breeding Station, Mylambavely to Passekudah Farm on 04 February, 1989, to the divisional laboratories on 24 July, 1989 and back to Passekudah Farm on 07 November, 1989.

Study Leave and Training: Mrs L C P Fernando, Asst. Crop Protection Officer continued her postgraduate studies at the University of Queensland, Australia.

Mrs C N K Rajapakse, Asst. Crop Protection Officer was awarded a Research Assistantship by the Texas A & M University, Texas, U S A to carry out postgraduate studies and left for the U S A on 14 March, 1989.

The following received training in Coconut Pest Control Work with lectures and demonstrations in the laboratory and field.

1. A group of 8 field officers of the Janatha Estates Development Board, Chilaw Region - 23 and 24 February.

2. A group of Coconut Development Officers from Kurunegala Region - 29 August.

3. A group of Field Officers from the CRI - 15 and 16 November.

4. The following NAB trainees were attached to the CPD and received a two-month training.

Mr G N Yagamuni, Miss K W P B S de Silva, Miss M Chandrasekara, Mr M Iqbal and Mr M Nihas.

Overseas leave: Dr P Kanagaratnam, Senior Research Officer and Mr A H Norman, Technical Assistant continued to be on leave during the year. Mr D M Jayakody, Field Assistant was granted no-pay leave from 20 October.

2. RESEARCH PROJECTS

PROJECT 8 - POPULATION DYNAMICS OF THE PEST/PARASITOID COMPLEX OF THE COCONUT CATERPILLAR

Experiment 8.2.1 - The effect of nutrient status of plant on susceptibility to *Opisina arenosella* attack (1984).

Leaf analysis for N and K content was done on samples collected from both the laboratory-grown seedlings and the palms in the field experiment. The required deficiency levels were not obtainable in both experiments and the differential fertiliser treatments are being continued prior to bioassay.

P A C R Perera, K F G Perera and K A S Chandrasiri

PROJECT 9 - EVALUATION OF SYSTEMIC INSECTICIDES FOR THE CONTROL OF FOLIAR PESTS OF COCONUT

Experiment 9.1.12 - Integrated chemical and biological control for the management of *Opisina arenosella*, the coconut caterpillar; Ethalai (1988).

In this experiment, alternate palms in a coconut caterpillar infested area were treated with Monocrotophos 60% at 8 ml per palm using the trunk injection technique. Population counts of *Opisina arenosella* and its parasitoids were recorded on treated and untreated palms before treatment and at weekly intervals after treatment for two months continuously. These studies were carried out at two sites within the same estate, but with distinctly separated areas of infestation.

Analysis of the pre-experimental *Opisina* population data showed a significant ($P < 0.005$) difference in the mean numbers of pest between the two sites, and a significant ($P < 0.05$) difference in the direction-wise orientation of the pest within each site. The analysis of the data for treatment effect was done with due corrections for distribution variations.

Pre-treatment population counts showed no difference in the mean pest numbers per palm between untreated and treated palms giving means of 10.9 and 11.2 per sample of 20 leaflets. Two weeks after treatment a significant ($P < 0.05$) difference was observed between untreated and treated palms with means of 9.1 and 5.6 respectively. Four weeks after treatment, while significant ($P < 0.001$) differences were again observed, the population in both the untreated and treated palms declined appreciably, giving means of 1.40 and 0.6 per 20 leaflets. At six weeks, the populations declined still further to 0.16 and 0.07 for untreated and treated palms respectively, and at eight weeks after treatment the populations of both untreated and treated reduced to zero. These results indicate that the method is effective, but further experimentation is necessary to determine the minimum number of trees that should be treated for effective control.

Although parasitoid populations in the treated area showed a very rapid decline parallel with the decrease in pest numbers, no significant correlation was observed.

C N K Rajapakse and P Kanagaratnam

MISCELLANEOUS INVESTIGATIONS

1. Evaluation of the minimum effective dose of Monocrotophos 60% EC as trunk injection against the coconut caterpillar *Opisina arenosella*.

The experiment was carried out on a moderate to heavy coconut caterpillar infestation at Wellawa, and consisted of four treatments of 8 ml of Monocrotophos as 15, 30, 45 and 60% (undiluted) solution applied as a trunk injection with 10 replicates per treatment. Mortality was recorded on a sample of 20 leaflets at 5, 10, 20 and 40 days from treatment. At 40 hours the mean mortality of larvae increased with increase in concentration and mean of 93.3 was recorded for the 30% application.

P A C R Perera, K F G Perera and D M Jayakody

2. Investigations on Leaf blight control.

These studies were carried out at an estate at Vanathavillu, consisted of eight treatments including an untreated control and was replicated six times. The palms were approximately 10 years old.

Treatments

1. Soil application of KCl (250 g/palm)
2. Soil application of K₂SO₄ (300 g/palm)
3. Soil application of NaCl (200 g/palm)
4. Foliar application of KCl (1% 15 l/palm)
5. Foliar application of copper oxide (0.25% 15 l/palm)
6. Foliar application of Bitertamol (0.15% 15 l/palm)
7. Petiolar well application of Benomyl (5% 10 ml/palm)
8. Control

Since application of minerals was carried out during dry weather, all the experimental palms were watered with approx 30 litres/palm immediately after treatment and at weekly intervals for one month. Leaflets were sampled for infection rate and each sample was a composite of the 15th, 45th and 75th leaflets (from the petiolar end) from the 3rd leaf, considering the last fully opened leaf as the 1st leaf. Sampling was done at two-months intervals for six months.

No significant difference between treatments was observed but the infection rate decreased very rapidly and no new infections were detected after six months. The control also responded equally as the treatments perhaps indicating that Potassium reserves already in the soil were made available to the palms through the watering. The data collected is being examined further for possible interactions.

R Mahindapala, P A C R Perera, K F G Perera, T Mudalige and D M Jayakody

3. NEW RECORDS

3.1 New records of insects from coconut

Insect collections from the base of Leaf Scorch affected palms were identified as *Diocalandra frumenti* Fabricius. (Curculionidae) and *Microcerotermes* sp. (Termitidae).

3.2 New records of parasitoids

A larval parasitoid of *Parasa lepida* was identified as *Exorista* sp. (Tachinidae).

3.3 New records of diseases of coconut

Laboratory cultures of a fungus associated with leaf blight of coconut collected from an estate at Mangalaeliya was identified as *Pestalotiopsis versicolor*.

4. COLLABORATIVE RESEARCH PROJECT

A collaborative research project entitled "Pesticides from Sri Lankan plants for the control of coconut pests" between Munster University (West Germany), Peradeniya University and the Coconut Research Institute was initiated in September. A temporary Research Assistant was recruited for the project and was stationed at the CRI to work under the guidance and supervision of the Head, Crop Protection Division. The initial screening of extracts from six plant species for feeding inhibition in the coconut caterpillar was carried out.

5. PEST INCIDENCE

As in the previous year, the largest number of pest infestations reported and recorded was of the coconut caterpillar. Severe infestations necessitating immediate insecticidal treatment were recorded from the North Western Province (Table 1). Of the 46 coconut caterpillar infestations recorded from the North Western Province 37 were estates over 8 ha.

Table 1 - Record of reported pest infestations.

Pest	Province			Total
	W.P.	N.W.P.	N.C.P.	
1. Coconut caterpillar <i>Opisina arenosella</i>	2	46	-	48
2. Black beetle <i>Oryctes rhinoceros</i>	-	5	-	5
3. Red Weevil <i>Rhynchophorus ferrugineus</i>	1	9	-	10
4. Coconut Scale <i>Aspidiotus destructor</i>	-	3	-	3
5. Nettle grub <i>Parasa lepida</i>	-	2	-	2

6. CROP PROTECTION SERVICE

6.1 Biological control

The laboratory mass breeding of parasitoids of the coconut caterpillar was re-activated because of the outbreaks in the North Western Province and limited numbers of laboratory bred parasitoids were released in the insecticide-treated areas two months after treatment (Table 2).

For the control of the weed *Chromolaena odorata* (*Eupatorium odoratum*) the defoliator insect *Paraeuchaetes pseudoinsulata* was reared in the laboratory and larvae (22,600) and moths (300) were released in the North Western and Western Provinces.

Laboratory cultures of *Metarhizium anisopliae* and *Baculovirus oryctes* were maintained.

6.2 Chemical control

A total of 61,445 coconut palms severely attacked by the coconut caterpillar, covering approximately 400 ha in the North Western and Western Provinces, were treated with the systemic insecticide Monocrotophos 60% and the infestations were quickly brought under control. The insecticide which was supplied by the land-owners was applied as a trunk injection using an electric drill powered by a generator. This service was provided free of charge to the growers.

7. LECTURES WORKSHOPS ETC.

Dr P A C R Perera attended the FES/CLF workshop on law and practice governing pesticides in Sri Lanka sponsored by Friedrich Ebert Stiftung and held at the Sri Lanka Foundation Institute on 28 April.

Dr P A C R Perera served as a member of the Sri Lanka Pesticides Formulary Committee and attended its bimonthly meetings.

8. PUBLICATIONS

Perera, P A C R., Mahindapala, R., and Pethiyagoda, U. A Technique for the application of systemic insecticides through petiolar wells in coconut. *Cocos* 5: 30-35

Table 2 - Parasitoid releases for coconut caterpillar control.

<i>Province</i>	<i>Parasitoid numbers</i>					<i>Total</i>
	<i>Bracon hebetor</i>	<i>Goniozus nephantidis</i>	<i>Eriborus trochanteratus</i>	<i>Trichospilus pupivora</i>	<i>Brachymeria nephantidis</i>	
1. Western	19,200	19,500	1,300	169,500	300	209,800
2. North Western	5,000	6,500	800	94,800	1,700	108,800
3. Southern	2,000	2,000	1,000	-	400	5,400
Total	26,200	28,000	3,100	264,300	2,400	324,000

Perera, P A C R., Hassell, M P. and Godfray, H C J. Population dynamics of the coconut caterpillar, *Opisina arenosella* Walker (Lepidoptera: Xylorictidae), in Sri Lanka. *Cocos* 5: 37 - 42 (Reprinted from *Bull.ent.Res.* 78: 479 - 492)

Way, M J., Cammell, M E., Bolton, B and Kanagaratnam, P (1989) Ants (Hymenoptera: Formicidae) as egg predators of coconut pests, especially in relation to biological control of the coconut caterpillar, *Opisina arenosella* Walker (Lepidoptera Xylorictidae), in Sri Lanka. *Bull.ent.Res.* 79: 219 - 233.

9. ACKNOWLEDGEMENTS

We sincerely thank the Soils and Plant Nutrition Division for analyses of leaf samples, the Biometry Unit for statistical analyses of experimental data, the CAB International Institute of Entomology, London for insect identifications and the CAB International Institute of Mycology for identification of fungi.

REPORT OF THE BIOMETRY UNIT

Officer-in-Charge - D T Mathes B.Sc

1. GENERAL

1.1 Staff Matters

Mr H P De Zoysa, Technical Assistant completed a one-year training course on Diploma in Computer Systems Design, conducted by the National Institute of Business Management. This training was sponsored by the Agricultural Research Project.

Overseas Visits: Mr T S G Peiris, Biometrician attended a Conference on Statistics for Repeated Measurements, held in Italy from 7-9 September.

Mr T S G Peiris served as the Secretary of Section B (Agriculture & Forestry) of the Sri Lanka Association for the Advancement of Science. He also served as the Chairman of the Waste Elimination Committee at the CRI.

Computerization: The computer facilities were expanded by the addition of a third computer with hard-disc capacity 40 MB and RAM 1.2 MB, supplied under the Agricultural Research Project. Other additions include an X-Y plotter (MP3200) and SAS/graph (6.03) module.

2. BIOMETRICAL ASSISTANCE

Assistance to the research staff was provided by way of statistical designs, selection of land, layout of experimental plots, analysis and interpretation of results. Nearly 900 analyses of data were carried out during the year.

Special assistance was provided to Mr Ananda Tennakoon in his M.Phil project.

3. RESEARCH PROJECTS

PROJECT 19 - APPLICATION OF BIOMETRY IN COCONUT RESEARCH

Experiment 19.3 - Calibration trial at Walpita Estate (Wet Zone) - 1984.

The biometry recordings of vegetative and yield characters were carried out without interruption. Variation of yield parameters between the six picks of 1988 and

1989 is given in Table 1 and 2. The total number of bunches for the year showed an increase of 12.9% over 1988. All the six picks recorded an increased number of nuts per palm compared to that of 1988. The overall increase over 1988 was 70.5%. The number of nuts per hectare too showed a similar pattern to nuts per palm. An all time record of 18,329 nuts per hectare was recorded during the year. This shows the yield potential that could be achieved under good environmental conditions. Except for the 3rd and 6th picks, the rest of the picks recorded an increased weight per husked nut over 1988. The year has thus shown an increased number of nuts per hectare along with increased husked nut weight. The copra yield was 3,741.2 kg/ha, which represents 81.5% increase.

Table - 1 Average yield components in 1989 (experiment 19.3).

	1st Pick		2nd Pick		3rd Pick		4th Pick		5th Pick		6th Pick		Total	
	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	1988
No. of bunches/palm	2.2	2.6	2.0	2.4	2.3	1.9	2.1	1.7	2.5	1.6	2.0	1.4	13.1	11.6
No. of nuts/palm	16.7	2.7	22.5	11.4	30.8	19.9	21.8	15.9	15.3	10.4	8.7	7.6	115.8	67.9
No. of nuts/ha.	2642	424	3558	1797	4879	3144	3452	2515	2423	1641	1375	1208	18329	10730
No. of nuts/bunch	7.5	1.0	11.5	4.7	13.6	10.3	10.5	9.2	6.1	6.3	4.3	5.7		

Table - 2 Average weight of husked nut and copra yield in 1989 (experiment 19.3).

Pick	Weight of husked nut (g)		Copra ** (kg/ha)	
	1989	1988	1989	1988
1	756	673	639.15	87.86
2	664	664	756.00	362.13
3	604	645	943.01	619.72
4	629	618	694.82	456.99
5	582	562	451.26	280.13
6	584	705	256.96	254.81
Total / Ave.	638	637	3741.20	2061.64

** Copra Yield = husked nut weight x 0.32

Sequence of shedding button nuts

A detailed analysis was carried out during the year using four years data, to obtain information on the shedding of buttons from the opening of an inflorescence to maturity. The results on the pattern of shedding of buttons from bunches, arising from the inflorescences which opened during the year are shown in Table 3.

Table 3 - Shedding of female flowers over the period.

Pick	Month	1 - 2 months		3 - 4 months		5 - 6 months		% loss 1 to 4 month period
		No.	%	No.	%	No.	%	
1	Jan.	3796	59.5	1084	17.0	104	1.6	76.5
2	March	4421	61.8	998	14.0	153	2.1	75.8
3	May	5328	51.5	904	8.7	326	3.1	60.2
4	July	4273	41.1	1601	15.4	168	1.6	56.5
5	Sept.	5540	49.6	1657	14.8	378	3.4	64.4
6	Nov.	3495	50.3	1270	18.3	393	5.7	68.6
	Total	26853	51.2	7514	14.3	1522	22.9	65.5

On the whole 26,853 and 7,514 female flowers were shed during the 1st two and 2nd two months period. This amounts to 51.2 and 14.3% nutfall. The total loss during the 1st four months period was 65.5%.

The pattern of button shedding during the year from the inflorescences which opened during different periods shows varying degrees. The highest shedding was 76.5 and 75.8% for the inflorescences which opened during January and March periods. These periods are generally dry months. This was followed by the pattern in December which is again a dry month. Much lower button shedding was recorded for months of May and July. This period is generally wet. Generally these results show the degree of influence of weather on the shedding of female flowers.

Impact on the final production

Table 4 shows the total female flower production at the opening of the inflorescence and the final yield.

Table 4 - *Number of female flowers produced and the final harvest.*

<i>Pick</i>	<i>Month</i>	<i>No. of FF</i>	<i>Final harvest</i>	<i>% Harvested</i>
1	Jan.	6378	1277	20.0
2	March	7148	1541	21.5
3	May	10342	3722	36.0
4	July	10404	4224	40.6
5	Sept.	11174	3406	30.5
6	Nov.	6951	1675	24.1
	Total	52397	15845	30.2

It was observed that out of 52397 female flowers per hectare produced during the year, 36552 buttons shed, leaving only 15845 mature nuts. This final harvest amounts to only 30.2% of a potential crop.

The female flower production during the year shows lower values for the inflorescences that open during January, March and November periods and relatively larger production for months May to September. The percentage harvested for July amounted to 40.6% as against 20% for that harvested in January and 30% the general average. This information shows the varying nature of production of female flowers and the final yield over the year. The extent of button shedding and its impact on the final yield suggest the necessity for improved soil moisture conditions for increased female flower production, reduced button shedding and finally increased yields.

D T Mathes

4. COMPUTER FACILITY

4.1 The computer programme for the Differential Fertilizer Recommendation (DFR) was further modified in collaboration with the Soils and Plant Nutrition Division.

T S G Peiris

4.2 A data entry programme was developed for the use of Tissue Culture Unit to facilitate data entry.

H P De Zoysa

4.3 An interactive programme for retrieval and analyses of summary data from field experiments is being developed.

H P De Zoysa and D T Mathes

4.4 An interactive programme for analysing climatological variables is being developed.

T S G Peiris, J D J S Kularatne and D T Mathes

4.5 Assistance was provided to computerize information of the Medical Aid Scheme operated by the CRI, and monthly data sheets were provided.

T S G Peiris and J D J S Kularatne

4.6 Assistance was provided to the Administration Division to process applications received for various posts at the CRI.

W E R C Fernando, J D J S Kularatne and T S G Peiris

4.7 Special computer course was conducted in D-base III for the staff of the Tissue Culture Unit.

T S G Peiris

5. YIELD RECORDING

The recording of yield data of 17 experiments conducted by the Research Divisions at the following estates was continued satisfactorily. In all 250,581 nuts were recorded.

- | | |
|--------------------|------------------|
| i Bandirippuwa | vii Puwakwatte |
| ii Ratmalagara | viii Sirikandura |
| iii Heemmeliyagara | ix Poththukulama |
| iv Kinyama | x Saddhatissa |
| v Jasintha | xi Walpita |
| vi Muthugala | |

6. PUBLICATIONS AND COMMUNICATIONS

Peiris, T S G and R D Stern (1988), Use of Statistical Package SAS: A Case study from Coconut Research Institute. *Cocos* 6, 38- 52.

Peiris, T S G (1989). Forecasting the crop yield of a coconut estate. *Cord* (2), 67-76.

Liyanage, L V K, H P S Jayasundara, D T Mathes and D N S Fernando (1989). Integration of pasture, fodder and cattle in Coconut small holdings. *Cord* 5(2), 53-66.

Peiris, T S G (1989) An alternative approach for analysing repeated measurements data in perennial crops. Presented at the Conference on 'Statistics on Repeated Measurements Data' held in Brassanane, Italy. September, 1989.

Tennakoon, N A and D T Mathes (1989). Decomposition of goat dung and the availability of nutrients to the coconut palm. Presented at the Sri Lanka Association for the Advancement of Science, December, 1989.

Jayasundara, H P S, D T Mathes and M de S Liyanage (1989). Impact of an Integrated Farming Model on the productivity of coconut land. Presented at Sri Lanka Association for the Advancement of Science, December, 1989.

Peiris, T S G, and E K Seneviratna (1989). The use of daily rainfall in analysing repeated measurements data in perennial crops. Presented at Sri Lanka Association for the Advancement of Science, December, 1989.

7. AGRI-METEOROLOGY

The three meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained satisfactorily. The daily recordings taken throughout the year were rainfall, temperature, evaporation, humidity and soil temperature. The data from these stations were provided to the Dept. of Meteorology monthly and to a number of other Institutions on request.

7.1 Bandirippuwa Estate

a) Rainfall (Table 5)

Table 5 - Rainfall (mm) for the last 10 years and in 1989 (Bandirippuwa Estate).

<i>Month</i>	<i>1979</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>	<i>1984</i>	<i>1985</i>	<i>1986</i>	<i>1987</i>	<i>1988</i>	<i>79-88 Ave.</i>	<i>1989</i>
January	0.5	0.0	50.8	0.0	0.0	197.9	13.0	61.7	31.2	0.0	35.5	25.4
February	146.8	0.0	66.0	0.0	0.0	106.9	189.0	35.0	0.0	111.4	65.5	0.0
March	17.5	68.8	16.5	144.3	0.0	145.5	228.9	62.0	118.3	87.4	88.9	65.7
April	70.9	206.0	100.6	125.2	219.7	425.2	103.9	60.2	237.6	283.0	183.2	234.9
May	174.5	52.2	333.5	232.9	322.1	297.7	275.3	284.7	187.2	109.9	227.2	52.3
June	231.4	308.1	107.4	328.4	138.4	115.1	291.3	44.7	61.6	255.8	188.2	153.4
July	22.4	21.8	38.6	152.1	79.7	111.0	14.5	33.5	6.4	151.8	63.2	99.0
August	20.1	78.2	41.4	188.9	120.6	0.5	139.9	77.2	156.5	105.2	92.9	20.4
September	194.8	182.3	124.2	185.2	242.1	129.3	168.4	94.7	410.7	303.4	203.5	222.1
October	203.2	364.4	298.4	235.7	50.0	121.9	195.6	224.3	579.3	88.8	236.2	395.9
November	364.5	184.9	297.2	244.6	159.0	239.8	306.3	149.4	194.7	370.7	251.1	379.4
December	162.3	102.3	12.9	57.7	141.0	83.0	63.7	63.5	79.9	19.1	78.5	50.3
Total	1608.9	1571.0	1487.5	1895.0	1472.6	1973.8	1989.8	1190.9	2053.4	1886.5	1713.9	1698.8

All the months except February experienced a fairly well distributed rainfall during the year. However the 2nd half of the year showed over twice as much rain as the 1st half of the year. The total rainfall of 1699 mm was less than that in 1988. Comparatively reduced yields in the first half and increased yields in the second half could be expected during the year 1990.

b) Temperature (Table 6)

The monthly temperature ranged from 28.0 to 32.6 °C as against 30.0 to 32.9 °C in 1988. The monthly minimum temperature ranged from 19.5 to 25.2 °C. On the whole, the temperature during the year was slightly lower compared to 1988.

c. Sunshine (Table 6)

Longer sunshine hours were observed during the early and latter part of the year, while a shorter duration was recorded during the mid-year. The average for the year was 6.8 h.

d. Soil Temperature (Table 7)

The average temperature recorded at depths 5, 10, 20, 30, 60 and 120 mm for the morning were 27.9, 28.1, 28.7, 29.4, 29.5 and 29.6 °C while for the afternoon were 32.2, 31.0, 30.1, 30.0, 29.5 and 29.6 °C respectively.

7.2 Ratmalagara Estate (Table 8)

The total rainfall recorded for the year was 1437.6 mm compared to 1528.0 mm in 1988. Except for the month of February, rest of the months recorded a fairly well-distributed rainfall. The rainfall during the second half of the year was 857.6 mm compared to 580.0 mm in the first half of the year. In 1990, reduced crops during the early period of the year and increased crops during the latter part of the year could be expected.

7.3 Isolated Seed Garden (Table 9)

The total rainfall for the year was 850.2 mm compared to 1519.7 mm recorded in 1988. This is an all-time low rainfall recorded during the last 10 years. In 1990, except for the early crops in the year, rest of the year will show low crops.

Table 6 - Summary of meteorological observations in 1989 (Bandirippuwa Estate).

	Temperature C°		Evaporation (mm) per day	Relative Humidity %		Sunshine
	max	min		a.m.	p.m.	
January	31.4	21.4	4.1	80	62	6.8
February	32.6	19.5	4.9	73	55	8.5
March	31.9	21.1	*	75	64	8.9
April	32.3	23.8	*	78	70	7.2
May	30.7	25.2	*	81	77	5.8
June	28.0	24.2	*	85	80	3.4
July	29.3	23.9	*	84	80	5.1
August	29.6	24.8	*	81	77	7.6
September	29.6	24.2	4.0	84	74	5.9
October	30.0	23.1	3.9	85	77	7.0
November	30.9	22.6	3.5	83	71	7.2
December	31.1	22.0	5.4	80	63	8.3
Average	30.6	23.0	4.3	81	71	6.8

* Not available

Table 7 - Soil temperature ($^{\circ}\text{C}$) at different depths (Bandirippuwa Estate).

Month	Morning						Afternoon					
	5 cm	10 cm	20 cm	30 cm	60 cm	120 cm	5 cm	10 cm	20 cm	30 cm	60 cm	120 cm
January	25.5	25.8	26.4	27.0	27.3	27.4	28.9	28.0	27.6	27.5	27.3	27.4
February	25.8	26.3	27.1	27.7	27.9	27.9	32.4	30.0	29.0	28.5	27.9	27.9
March	28.2	28.4	29.1	29.9	30.0	30.0	25.1	32.4	31.1	30.7	29.9	30.0
April	29.7	29.9	30.4	31.3	31.2	30.9	35.0	33.0	31.9	31.8	31.2	31.2
May	29.3	29.2	29.4	30.1	30.3	30.3	31.7	30.5	30.3	30.5	30.2	30.3
June	28.1	28.1	28.7	29.3	29.4	29.5	31.5	30.7	30.2	30.0	29.4	29.5
July	28.2	28.2	28.5	29.2	29.2	29.3	30.9	30.1	29.7	29.7	29.2	29.3
August	28.6	28.6	29.0	29.6	29.5	29.7	32.1	30.9	30.0	30.0	29.5	29.6
September	28.2	28.5	29.2	30.1	30.3	30.4	33.2	32.2	31.0	30.9	30.3	30.4
October	28.4	28.7	29.5	30.2	30.4	30.5	32.6	32.0	31.0	30.9	30.3	30.4
November	27.5	27.9	28.5	29.2	29.3	29.4	31.8	31.2	30.0	29.7	29.3	29.4
December	27.4	27.9	28.6	29.3	29.5	29.5	30.9	30.9	29.9	29.7	29.5	29.5
Average	27.9	28.1	28.7	29.4	29.5	29.6	32.2	31.0	30.1	30.0	29.5	29.6

Table 8 - Rainfall (mm) for the last 10 years and in 1989 (Raimalagara Estate).

<i>Month</i>	<i>1979</i>	<i>1980</i>	<i>1981</i>	<i>1982</i>	<i>1983</i>	<i>1984</i>	<i>1985</i>	<i>1986</i>	<i>1987</i>	<i>1988</i>	<i>79-88 Ave.</i>	<i>1989</i>
January	0.0	0.0	78.7	0.0	0.0	132.9	16.6	64.8	13.6	0.0	30.7	77.7
February	167.3	0.0	11.3	0.0	0.0	166.2	122.1	54.3	0.0	101.3	62.2	0.0
March	16.9	16.7	38.4	118.8	0.0	168.6	158.3	74.7	72.0	53.3	71.8	117.4
April	70.6	208.2	52.5	112.2	109.2	703.6	208.3	143.4	120.4	231.4	196.0	204.2
May	46.9	74.0	290.8	196.8	145.3	282.4	82.3	246.1	141.5	68.0	157.4	54.2
June	46.1	246.1	87.4	190.8	80.9	39.1	126.0	50.9	65.1	221.9	115.4	126.5
July	28.8	14.3	55.1	35.6	55.6	88.6	39.1	22.6	16.9	57.9	41.4	124.2
August	46.1	31.2	80.4	155.2	74.9	2.0	13.3	85.9	139.5	158.1	78.7	10.0
September	125.6	149.0	121.6	36.6	109.9	132.8	84.2	26.4	190.0	259.7	123.6	161.4
October	316.3	239.6	168.9	272.8	79.5	109.3	209.9	153.0	502.8	58.0	211.0	238.9
November	377.3	273.2	304.0	200.8	163.6	472.8	319.0	228.4	195.9	230.1	276.5	298.7
December	272.6	126.4	24.2	118.7	216.3	95.9	104.4	95.9	53.2	88.8	119.6	24.4
Total	1514.5	1378.7	1313.3	1438.3	1035.2	2394.2	1483.5	1246.4	1510.9	1528.5	1484.3	1437.6

Table 9 - Rainfall (mm) for the last 10 years and in 1989 (Isolated Seed Garden).

Month	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	79-88 Ave.	1989
January	13.1	0.5	36.9	0.0	0.0	96.9	38.3	59.1	5.9	3.3	25.4	58.4
February	60.0	0.0	11.5	0.0	2.1	228.9	113.4	65.8	0.0	135.0	61.7	0.0
March	17.6	23.7	93.5	176.3	1.6	279.7	94.6	55.3	21.7	77.4	84.1	29.5
April	59.8	164.5	48.4	61.7	52.8	821.4	100.0	104.9	141.1	233.3	178.8	81.7
May	11.4	87.8	147.8	281.8	248.8	155.5	171.4	121.9	100.2	71.7	139.8	16.0
June	34.8	147.9	148.9	110.7	73.4	29.7	88.8	74.5	49.8	129.7	88.8	112.2
July	19.4	5.8	72.5	32.1	26.4	117.0	17.9	4.2	4.5	91.4	39.1	72.1
August	10.6	10.0	54.3	91.6	78.0	3.8	10.7	47.4	48.1	60.1	41.5	1.7
September	197.8	106.9	68.4	35.6	89.4	164.7	107.4	37.4	270.8	272.2	135.1	34.0
October	160.6	272.1	280.3	199.9	105.7	227.3	108.7	199.9	467.6	61.3	208.3	221.9
November	356.6	251.0	295.9	152.7	199.3	210.6	334.8	236.1	143.2	319.5	250.0	214.7
December	172.1	82.7	54.3	93.4	331.4	53.6	118.6	7.6	49.5	64.8	102.8	8.0
Total	1113.8	1152.9	1312.7	1235.8	1208.9	2389.1	1304.6	1014.1	1302.4	1519.7	1355.4	850.2

REPORT OF THE TISSUE CULTURE UNIT

Officer-in-Charge - S M Karunaratne, M.Sc

1. GENERAL

1.1 Staff Matters

Ms L K Periyapperuma, Research Assistant left the country in August for a two-year postgraduate training on Molecular Techniques in Plant Tissue Culture and Allied Fields at the Illinois State University, USA. This training is sponsored by the Agricultural Research Project.

Mrs S M Karunaratne continued to work as a Visiting Research Associate at the Institute of Fundamental Studies.

2. RESEARCH PROJECTS

PROJECT 18 - STUDIES ON THE VEGETATIVE PROPAGATION OF COCONUT

Experiment 18.1 - In vitro culture of zygotic embryos of local varieties of coconut (1983).

Investigations were continued to enhance somatic embryogenesis from immature zygotic embryos and to improve further development of the resultant somatic embryos. By carefully maintaining an auxin/cytokinin balance in the medium, it was possible to increase the number of somatic embryos per callus mass and shoot induction from the somatic embryos. Each embryogenic callus mass produced upto about 10-20 shoots and the process was consistent. The shoots however, exhibited limited growth.

Attempts were also made to enhance continuous growth of the developing shoots by culturing them in a pre-conditioned medium. The sprouting somatic embryos were isolated from the callus mass and cultured separately in the conditioned medium. The leaves slowly began to unfurl and the plantlets reached a height of about 1-3 cm.

This experiment is in progress.

L K Periyapperuma, C K Gamage and S M Karunaratne

Experiment 18.2 - Investigations on development of vegetative propagules in coconut inflorescences in vitro (1983).

The auxin/cytokinin combinations tested on experimental palms had no effect on the development of inflorescences nor on setting of female flowers after pollination.

Since the palms were too tall for hormone applications, a young plantation at Bandirippuwa Estate was selected for further work. The palms in this field have just come into flower and it is expected to select suitable palms and commence hormone application in early 1990. The treatments will consist of different concentrations of 2, 4-Dichlorophenoxy Acetic Acid, (2, 4-D) and 2, 4-D in various combinations with N6-Benzyl Amino Purine, (BAP).

S M Karunaratne and N Jayatissa

Experiment 18.3 - Culture of leaf explants of coconut in vitro (1983).

Somatic embryos and neoformations derived from leaf explants produced callus which could be sub-cultured. This callus occasionally produced roots but somatic embryogenesis did not occur.

This project was partly funded by USAID and the final report of the project entitled "Culture of leaf explants of coconut: Developments towards somatic embryogenesis" has been submitted.

S M Karunaratne and C K Gamage

Experiment 18.4 - Culture of coconut floral meristem explants (1986).

Callus tissues originated from flower meristems were successfully subcultured. The experiment had to be suspended as Ms L K Periyapperuma, the Research Assistant left the country in August to pursue higher studies.

Experiment 18.5 - Application of embryo culture technology to select drought tolerant coconuts (1986).

The *in vitro* technique developed for drought screening coconut germplasm using drought simulating chemicals in the culture medium, was tested on embryos derived from four cultivars of coconut namely, putative drought tolerant Ambakelle Special, drought tolerant *San Ramon* and drought susceptible dwarf x tall hybrid and dwarf green

(*nana*). All the embryos derived from putative drought tolerant cultivars and having the potential to germinate in the common culture medium (as judged by the control), survived the mild stress conditions imposed by salt. Under moderate conditions of stress in the culture medium, the percent survival dropped to about 80%. It continued to decline with further increase in water deficit conditions in culture and only 16-19% of the germinating seedlings survived the severe stress. Of the drought susceptible cultivars, CRIC-65 lost 30% of the potential plants under mild water deficit conditions and not a single survived the moderate stress. The investigation using the dwarf green cultivar is being continued.

Further investigations are in progress to understand the mechanism of stress tolerance in vitro and to recover the survivals of stress and establish them in soil.

S M Karunaratne, S Santha and A Kovoov

3. LECTURES, SYMPOSIA, VISITS

Mrs S M Karunaratne attended a workshop on Biotechnology and Allied Sciences held in Pune, India in January. The tour was sponsored by the Commonwealth Science Council.

Mrs S M Karunaratne presented a paper entitled "Current state of the art of the use of tissue culture techniques in vegetative propagation of coconut in Sri Lanka" at the 26th COCOTECH meeting held in Bangkok in May. Financial support for this visit was provided by the Asia and Pacific Coconut Community. She also participated in a workshop on Chromatography held in the University of Peradeniya in October.

4. PUBLICATIONS/COMMUNICATIONS

Karunaratne, S M (1989) Current state of the art of the use of tissue culture techniques in vegetative propagation of coconut in Sri Lanka, in : Coconut Production and Productivity. Proc. 26th COCOTECH meeting held in Bangkok. Sumith de Silva (ed). Asian and Pacific Coconut Community.

Karunaratne, S M (1989) Report of the PSTC grant 4:345. Culture of leaf explants of coconut : Development towards somatic embryogenesis. Tissue Culture Unit, Coconut Research Institute, Lunuwila Sri Lanka.

Seetha Karunaratne and Kaushalya Periyapperuma (1989). Culture of immature embryos of coconut *Cocos nucifera* L : Callus proliferation and somatic embryogenesis. *Pl Sci.* 62:247-253.

5. MISCELLANEOUS

About 200 zygotic embryos of coconut (cv. *typica*) were sent to the Australian Centre for International Agricultural Research (ACIAR), Australia under aseptic culture conditions.

Mrs S M Karunaratne served on the following committees.

1. Member, Committee for the organization of a M.Sc course in Biotechnology, School of Graduate Studies, University of Peradeniya.
2. Member, Sub-committee on Biotechnology, University Grants Commission.

REPORT OF THE PLANT PHYSIOLOGY UNIT

Officer-in-Charge - C Jayasekara, Ph.D

1. GENERAL

1.1 Staff Matters

Appointments: Miss R S Mudalige was appointed as a Temporary Research Assistant by the Natural Resources, Energy & Science Authority (NARESA) to work on a Canadian International Development Agency (CIDA) - funded project and assumed duties on 11 October.

Miss C S Ranasinghe was appointed Research Assistant with effect from 08 December.

Study Leave: Miss S P Suriyapperuma, continued her postgraduate training at the Department of Botany, University of Rhode Island, Kingston, USA.

Transfers: Mr K S N M Fernando, Laboratory and Field Attendant at Kirimetiyan Estate was transferred on 09 November.

Promotions: Mr R D N Premasiri, Technical Assistant, from Technical Grade Class II to Class I with effect from 01 January, 1987.

Mr S Samaratunga from Minor Grade Class II to Class I with effect from 01 January, 1987.

Acting Arrangements: Mr K S Jayasekara, Officer-in-Charge of the Soils and Plant Nutrition Division overlooked the Plant Physiology Unit for the period 05 November to 09 December when Dr Jayasekara was on overseas leave.

2. RESEARCH PROJECTS

PROJECT 16 - STUDIES ON THE PHYSIOLOGY OF COCONUT PALM

Experiment 16.6 - Studies on the effect of N, K, Cl and abscisic acid on drought tolerant characteristics of different varieties of coconut (1988).

Application of nutrients and water was continued as reported in the previous annual report. Water relations studies revealed that transpiration was increased and stomatal diffusive resistance was decreased in the seedlings which received more potassium (Table 1). No such relationship was observed between potassium treatments and leaf water potential measurements of the seedlings. Significant correlation was noted between the amount of nitrogen applied in the treatments and the total chlorophyll content. The total chlorophyll content increased with increasing nitrogen levels in treatments. However, Chl A/Chl.B ratio was similar with the different treatment combinations of nitrogen, potassium and chloride

Table 1 - *Response of K on transpiration, stomatal diffusive resistance and leaf water potential of coconut seedlings.*

<i>Treatment Potassium (mM)</i>	<i>Leaf water potential (bars) Ψ_L</i>	<i>Transpiration $\mu\text{g H}_2\text{O/cm}^2/\text{S}$</i>	<i>Stomatal diffusive resistance S cm^{-1}</i>
0	-8.42	1.207	18.994
5	-6.52	1.520	14.197
10	-5.93	1.621	13.896
Significance	P = 0.001	P = 0.001	P = 0.001

The total sugar concentration in leaves increased with increasing nitrogen supply.

Except on a few occasions, increasing potassium levels decreased the leaf starch content. However, the leaf total soluble and reducing sugar concentrations were found to be similar with different potassium treatments. Under field capacity conditions, different treatment combinations have not shown any relationship with the leaf proline concentration. Proline concentration in K₁ and K₂ treatments was generally higher than that of K₀ treatment. However, this was not statistically significant.

C Jayasekara and R G Mudalige

Experiment 16.3 - Identification of physiological and biochemical characters of putative drought tolerant tall (Ambakelle special) palms, Isolated Seed Garden, Ambakelle (1986).

Physiological parameters such as rate of transpiration, stomatal diffusive resistance and leaf water potential of individual palms were measured at monthly intervals as reported in previous annual reports (1987, 1988). Analysis of data for individual palms showed that out of 10 putative drought resistant palms, a steady transpiration rate and leaf water potential were maintained by few palms, both wet and dry months.

In order to study the genotypic environmental interaction, linear regression of individual palms to leaf water potential and transpiration flux was computed as reported by Finlay and Wilkinson (1963). The genotypes which have sensitivity coefficients (b values) for transpiration and Leaf water potential equal to 1 or less than 1 indicated an average of above-average stability, respectively. Analysis of data showed that 40% of the palms having average or high stability to fluctuating environmental conditions maintained a steady transpiration rate and high leaf water potential whilst giving high yields throughout the year.

High leaf sugar and low proline concentrations than that of drought sensitive palms were recorded by these palms as given in Tables 2 and 3. Soil moisture extraction studies of individual palms with the neutron probe also revealed that palms with high environmental stability extracted average quantities of moisture during a given period of time, whilst drought sensitive palms extracted more water when soil moisture was adequately available. Based on these results it has been decided to screen the remaining putative drought resistant palms in the field Nos. 1 and 2 at the Isolated Seed Garden by studying their physiological and biochemical parameters.

C S.Ranasinghe, R D N Premasiri, L & S Silva and C Jayasekara

Experiment 16.4 - Comparative study of physiological and biochemical determinants of drought tolerance in Ambakelle Special and tall x tall seedlings (1987).

Seedlings from putative drought resistant palms and low yielding palms (*typica*), which were planted at Bandirippuwa Estate (hedge plantation) were affected by drought early in the year. With the onset of rains and application of fertilizer, growth of seedlings improved.

Each seedling was given 500g of YPM mixture/application on four occasions during the year. Vegetative growth parameters such as the number of new leaves produced, girth of collar, were recorded at three months intervals. Seedlings are now ready for measurements of rate of photosynthesis, transpiration, water uptake pattern, and root distribution.

Table 2 - Mean total soluble sugar concentration in the ninth leaf (mg/g dry wt of leaves) of high yielding putative drought resistant and low yielding drought susceptible palms during a wet and dry season.

<i>Cultivar</i>	<i>Wet Season</i>	<i>Dry Season</i>
Putative drought resistant palms	17.50	17.56
Drought susceptible palms	10.50	2.95
t value	2.27**	1.71
SE $(\bar{x}_1 - \bar{x}_2)$	3.08	2.95

** P = 0.01

Table 3 - Mean leaf proline concentration in the ninth leaf (mg/g dry wt of leaves) of high yielding drought resistant and low yielding drought susceptible palms during a wet and dry season.

<i>Cultivar</i>	<i>Wet Season</i>	<i>Dry Season</i>
Putative drought resistant palms	50.08	48.90
Drought susceptible palms	95.40	77.15
t value	4.34***	3.74**
SE $(\bar{x}_1 - \bar{x}_2)$	10.44	7.56

*** P = 0.001

** P = 0.01

Another glass house pot experiment was established with self-pollinated putative drought tolerant and low yielding drought sensitive seedlings to compare the genotypic environmental interaction and heritability of drought resistant character from parental palms to the offsprings.

C Jayasekara and R D N Premasiri

Experiment 16.5 - Identification of physiological and biochemical determinants of drought tolerance in selected high yielding and low yielding dwarf palms, Isolated Seed Garden, Ambakelle (1987).

Data collection from this experiment was irregular, due to the disturbances in the country. This experiment will have to be continued with a new set of palms as the dwarf plantation will be replaced with Ambakelle special seedlings, next year.

C S Ranasinghe and C Jayasekara

Experiment 16.10 - Study of physiological and biochemical characters of different varieties and forms of coconut (1989).

Some varieties of coconut are found to be high yielding and drought resistant under a wide range of environmental conditions. The objective of this study is to evaluate suitable physiological and biochemical parameters which determine the high yielding and drought resistant characters of different varieties of coconut.

The rate of transpiration, Leaf water potential, Leaf Chlorophyll A & B concentration, Leaf total sugar and starch concentration, Leaf soluble protein and proline concentration were measured in three local varieties of coconut, improved cultivars and hybrid crosses. Although the rate of photosynthesis and dark respiration in different varieties of coconut are important, these parameters were not measured due to the problems with the instrument.

Among the cultivars studied, *typica*, *bodiri*, three colour forms of the variety *nana*, improved cultivars namely CRIC 60, *Moorock tall*, two colour forms of *San Ramon* and three hybrid crosses, *tall x San Ramon*, *dwarf green x tall* and *dwarf yellow x tall* recorded the highest concentration of chlorophyll. Sugar concentration in leaf tissues fluctuated during the year and was higher during the wet season than during the dry season. Cultivar *bodiri*, *San Ramon* and the hybrid cross between *tall x San Ramon* recorded the highest soluble sugar and starch concentrations in leaves.

Accumulation of proline in leaf tissues gives some indication about the drought tolerant characteristics of plant species. *Cultivars typica, pora pol, kamandala, bodiri* and *dikiri pol* were found to have high leaf proline concentration during dry months. Amongst the improved cultivars and hybrids, *Moorock tall*, two colour forms of *San Ramon* and the cross between *tall x San Ramon* recorded high leaf proline content. Concentration of proline in CRIC 65 hybrid was low, compared with the other hybrid crosses. Generally it was known that CRIC 65 hybrid is susceptible to drought.

C S Ranasinghe, P S A Saram and C Jayasekara

PROJECT 17 - PREMATURE DECLINE OF COCONUT PALM

Experiment 17.1 - Studies on the water relations of Leaf Scorch Decline (LSD) palms (1989).

Objectives of the experiment are;

1. to study the leaf water status of palms with increasing severity of symptoms, and
2. to determine the transpiration rate and leaf stomatal diffusive resistance under soil moisture saturated and stress conditions, in order to find out any physical blockage to water flow in LSD palms.

Eight LSD-affected palms (two palms from each category of severity) were chosen for this study from T x D hybrids of uniform age located at Bandirippuwa estate. Leaflets from the mid-section from the 9th leaf were used to measure leaf water potential and transpiration at hourly intervals during dry weather and soon after monsoonal rains. The measured leaf water potentials of the selected palms between 11.30 am to 12.00 noon at the peak moisture deficit period are given in Table 4.

Table 4 - Leaf water potential (bar) of healthy and Leaf Scorch (LSD) - affected palms at around mid-day (experiment 17.1).

Time	Soil Status	Leaf Water Potential			
		Healthy	Mild	Moderate	Severe
11.30 to 12 noon	Dry condition	12.0	18.0	40.0	33.5
11.30 to 12 noon	Soil moisture saturated condition	11.0	16.0	19.5	12.5

It was observed that the rate of transpiration decreased with concomitant increase in stomatal diffusive resistance with increasing severity symptoms. The same trend was maintained even under soil moisture saturated conditions.

These results indicate that LSD-affected palms have an internal water deficit in leaves under soil moisture saturated conditions. Failure to absorb water by the root system of LSD-affected palms to reach the demand developed in the crown or failure to translocate water within xylem tissues in roots and the stem due to physical blockage could be some possible reasons for this. Further experiments are in progress to determine the possible cause(s) for this high internal water deficit in LSD-affected palms.

C S Jayasekara, C S Ranasinghe, L R S Silva and R D N Premasiri

Experiment 17.3 - Studies on Net assimilation rate, productivity, inorganic and organic nutrient levels in LSD palms (1987).

Five palms from each category of LSD and five healthy palms were selected from Pothukulama Research Station (PRS) and Walpita Estate for inorganic nutrient analysis. The last fully open leaf was taken as the first leaf. Leaf samples were collected from 1st, 6th 14th and LSD-affected mature leaf in the crown. From healthy palms, similar aged mature leaf was sampled for comparison of nutrients in healthy mature and LSD leaves. Samples were analysed for macro-and micro-nutrients (Tables 5 and 6). Analysis of S, B and Cl are yet to be completed.

Analysis of leaf nutrient data from palms at PRS gave reproducible results as observed in the previous year. However, when overall nutrient status of healthy and LSD-affected palms was considered, significant decrease in N, P, K levels and significant increase in Ca and Mn levels were observed with increasing severity of symptoms. As reported in the previous year, statistically significant decrease in nutrient status, excluding Zn, was observed with the ageing of leaves. Analysis of organic nutrients in leaves revealed that a decrease in leaf total and reducing sugars as well as starch with increasing severity of LSD high leaf proline content was recorded with increasing symptoms (Table 7).

These results further confirm the existence of a physiological stress in LSD-affected palms.

C Jayasekara, C S Ranasinghe, R D N Premasiri and P A D Saram

Table 5 - Mean Nutrient Status of Healthy and Leaf Scorch Decline Palms at P.R.S. (experiment 17.3).

Status of the Palm		% N	% P	% K	% Ca	% Mg	Fe ppm	Mn ppm	Cu ppm	Zn ppm
Healthy		1.80	0.13	1.64	0.35	0.24	16	128	5	24
Mild		1.82	0.12	1.47	0.47	0.25	15	142	4	25
Moderate		1.60	0.12	1.36	0.58	0.30	14	148	4	23
Severe		1.71	0.13	1.37	0.67	0.31	18	176	3	27
(Average of the leaves)										
Between Status of Palm		***	**	*	***	N.S	N.S	N.S	***	N.S
Leaf with Status										
Healthy	1st leaf	1.40	0.14	2.64	0.19	0.18	8	42	6	21
	6th leaf	1.99	0.15	1.76	0.28	0.22	16	80	5	23
	14th leaf	2.18	0.14	1.27	0.40	0.25	18	154	6	24
Mature leaf		1.63	0.10	0.88	0.55	0.29	23	236	3	28
Mild	1st leaf	1.64	0.15	2.58	0.22	0.17	10	42	6	27
	6th leaf	2.18	0.14	1.91	0.33	0.21	14	80	5	28
	14th leaf	2.16	0.14	1.48	0.47	0.26	14	139	5	23
Affected green		1.55	0.10	0.83	0.75	0.35	17	255	3	22
Affected withered		1.58	0.09	0.54	0.60	0.25	23	192	3	25
Moderate	1st leaf	1.39	0.13	2.53	0.22	0.18	9	43	6	25
	6th leaf	1.78	0.14	1.95	0.35	0.24	10	77	4	23
	14th leaf	2.04	0.13	1.17	0.65	0.35	14	162	4	23
Affected green		1.43	0.10	0.69	0.94	0.43	16	252	3	23
Affected withered		1.38	0.09	0.46	0.76	0.34	22	209	4	24
Severe	1st leaf	1.53	0.16	2.42	0.32	0.21	10	60	5	29
	6th leaf	2.04	0.15	1.88	0.46	0.28	14	106	4	32
	14th leaf	1.97	0.14	1.36	0.67	0.33	18	169	3	28
Affected green		1.43	0.10	0.71	0.99	0.39	19	293	2	21
Affected withered		1.56	0.09	0.45	0.91	0.34	28	253	2	25
Between Status of Leaves		**	**	**	**	**	**	***	***	N.S
L.S.D.		0.24	0.01	0.45	0.18	0.08	57	99	1	7

Table 6 - Mean Nutrient Status of Healthy and Leaf Scorch Decline Palms at Walpita Estate (experiment 17.3).

Status of the Palm	% N	% P	% K	% Ca	% Mg	Fe ppm	Mn ppm	Cu ppm	Zn ppm
Healthy	2.24	0.14	1.64	0.21	0.24	14	135	6	33
Mild	1.95	0.14	1.35	0.30	0.22	14	217	5	31
Moderate	2.09	0.14	1.47	0.34	0.24	15	285	5	38
Severe	1.81	0.12	1.22	0.36	0.20	13	191	7	24
(Average of the leaves)									
Between Status of the Palm	***	**	*	***	N.S	N.S	***	N.S	***
Leaf with Status									
Healthy									
1st leaf	1.77	0.15	2.47	0.12	0.21	8	57	7	30
6th leaf	2.41	0.16	1.77	0.15	0.24	11	88	6	31
14th leaf	2.59	0.15	1.24	0.26	0.23	15	153	5	34
Mature leaf	2.18	0.12	0.96	0.38	0.27	22	267	5	37
Mild									
1st leaf	1.71	0.16	2.45	0.12	0.18	10	65	7	32
6th leaf	2.27	0.18	1.69	0.19	0.20	12	116		30
14th leaf	2.29	0.15	1.14	0.30	0.25	12	226	6	32
Affected green	1.81	0.11	0.83	0.49	0.29	13	412	4	33
Affected withered	1.66	0.99	0.61	0.40	0.22	21	265	5	30
Moderate									
1st leaf	1.65	0.15	2.72	0.15	0.19	10	87	8	33
6th leaf	2.38	0.17	1.85	0.21	0.20	12	161	6	34
14th leaf	2.42	0.15	1.29	0.34	0.27	14	305	4	41
Affected green	2.02	0.12	0.78	0.49	0.31	17	470	4	49
Affected withered	1.97	0.11	0.57	0.51	0.24	21	437	4	36
Severe									
1st leaf	1.50	0.14	2.35	0.20	0.17	9	69	13	29
6th leaf	2.11	0.15	1.75	0.26	0.18	12	126	6	22
14th leaf	2.12	0.14	1.09	0.38	0.22	12	222	5	21
Affected green	1.72	0.10	0.64	0.51	0.23	12	299	4	23
Affected withered	1.59	0.08	0.32	0.43	0.21	19	239	4	22
Between Status of Leaves	***	***	***	**	***	**	***	***	N.S
L.S.D.	0.24	0.02	0.28	0.10	0.06	35	116.7	3.02	8.69

Table 7 - Proline Concentration ($\mu\text{g/g}$ dry wt) in leaves of healthy and LSD-affected coconut palms (experiment 17.3).

Status of palms	Leaf number			Mature leaf	
	leaf 1	leaf 6	leaf 14	green	withered
Healthy	162	139	171	144	
Mild	139	141	149	192	536
Moderate	124	480	453	334	323
Severe	262	254	235	363	383

PROJECT 18 - STUDIES ON THE VEGETATIVE PROPAGATION OF COCONUT

Experiment 18.4 - Studies on the field performance of the Embryo- Cultured seedlings, Bandirippuwa Estate (1989).

The objective of this study are (1) to determine the vegetative growth pattern of embryo-cultured seedlings under field conditions, and (2) to determine the flowering pattern and nut production of embryo-cultured coconut palms.

Vegetative growth measurements and fertilizer applications were continued as reported in the previous year. Fourteen new embryo-cultured seedlings (open pollinated) received from the Tissue Culture Unit were planted in the same block in May. These seedlings received 500g of YPM mixture application, on two occasions during the year.

Table 8 shows the vegetative growth parameters of three colour forms of dwarfs and open-pollinated tall seedlings at six-monthly intervals, at 16 months after planting. The data show that the remaining dwarf green palm performed exceptionally well, compared with the other two colour forms of dwarfs. No significant difference in general vegetative growth pattern of dwarfs and open-pollinated tall seedlings was observed.

C Jayasekara and R D N Premasiri

Table 8 - Vegetative growth of Embryo - cultured seedlings 18 months after planting (experiment 18.4).

Cultivar	After 6 Months			After 12 Months		
	Height (cm)	Girth (cm)	No. of leaves	Height (cm)	Girth (cm)	No. of leaves
Dwarf green	401.00	56.50	10.00	504.00	120.00	13.00
Dwarf yellow	231.00 ±104.65	36.60 ±18.40	8.00 ±1.40	324.00 ±117.37	58.50 ±27.57	9.00
Dwarf red	171.46 ±56.57	30.50 ±9.90	7.50 ±3.10	274.00 ±71.14	56.66 ±11.60	9.83 ±1.72
Open pollinated tall	246.83 ±40.88	33.41 ±10.25	8.16 ±1.32	343.30 ±59.58	66.50 ±19.02	8.30 ±1.21

PROJECT 25 - STUDIES ON THE ESTABLISHMENT AND FURTHER GROWTH OF AMPUTATED SEEDLINGS IN POLYBAGS.

Experiment 25.2 - Effect of growth hormones on vegetative growth of the amputated seedlings in polybags.

The objective of this study is to determine suitable growth hormones and their concentrations to induce better root and shoot growth in amputated polybagged seedlings. Indole acetic acid, Gibberallin and cytokinin were used at the concentrations of 100, 150 and 200 ppm.

Three months after application of hormones, girth and height of the seedlings were measured. Compared with the control plants, significant increase in height and girth were observed with all the treatments (Table 9). However, there was no significant difference between hormone treatments. Hence, application of 100 ppm of IAA, Kinetin or Gibberallin (GA₃) will be sufficient to improve the vegetative growth of amputated seedlings.

C Jayasekara and L R S Silva

Table 9 - Effect of growth hormones on height and girth of the amputated polybagged seedlings (experiment 25.2).

<i>Treatment</i>	<i>Mean Girth (cm)</i>	<i>Mean Height (cm)</i>
Kinetin	7.93 ± 1.19	55.02 ± 14.4
Gibberelic acid	8.02 ± 1.48	52.89 ± 12.20
Indole Acetic acid	8.23 ± 1.41	53.96 ± 11.08
Control	7.26 ± 1.37	46.94 ± 9.06
C.V	17.164	23.009
Significance	n.s.	n.s.

3. MISCELLANEOUS STUDIES

1. Morphology and anatomy of juvenile coconut seedlings and chemical composition of the cotyledon, endosperm and kernel during germination of coconut.

Unhusked and husked seednuts were laid in a nursery bed and five seednuts from each category were uprooted, after sprouting, at monthly intervals. Length of the shoot, number of leaves and primary and secondary roots, their radii and the number of pneumatophores per seedling were recorded for all the seedlings. Sugars and amino acid composition in the cotyledon, kernel and nut water at different stages of germination were also determined.

At the initial stage of sprouting, juvenile seedlings have three to four primary roots and the roots were longer than the shoot. The primary roots in husked coconuts were longer than those in unhusked seednuts and they produced less pneumatophores and more secondary roots. Size and length of the shoot were similar in both types even though root growth was better in husked seednuts.

Sucrose was the predominant sugar in the kernel and liquid endosperm. High performance liquid chromatographic analysis of extracts from individual components revealed that glucose, fructose, sorbitol, galactose and sucrose content was higher in developing cotyledons than in kernel and in the liquid endosperm.

C Jayasekara and W P K K Fernando

2. Sugars and water soluble vitamins in young coconut endosperm at different stages of maturity.

Hybrid and king coconut water at different stages of maturity were analysed by High performance Liquid Chromatography for sugars and water soluble vitamins. At very young stage, glucose and fructose were the predominant monosaccharides in liquid endosperm. With increasing maturity of the seednuts, monosaccharide concentration increased rapidly. From seven months onwards, sucrose concentration increased with a concomitant decrease in monosaccharides. With increasing maturity, galactose and sorbitol also appeared in nut water. King coconut had slightly higher concentration of monosaccharides than hybrid coconuts. Sweetness of king coconut water could be attributed to this high concentration of monosaccharides.

Liquid endosperm of both varieties was rich in ascorbic acid or vitamin C. King coconut water had more ascorbic acid than hybrid coconut water. Ascorbic acid concentration increased with increasing maturity. Vitamin B group components namely nicotinamide, pyridoxine, thiamine and riboflavin were also detected in traceable quantities. Vitamin B group components also increased with maturity, as in the case with Vitamin C.

C Jayasekara and W P K K Fernando

4. PUBLICATIONS AND COMMUNICATIONS

Jayasekara, C. and W P K K Fernando (1989): Studies on sugars and vitamins in coconut water by High Performance Liquid Chromatography (HPLC). Annual Sessions, Sri Lanka Association for the Advancement of Science, December, 1989.

Ranasinghe, C S (1989). Physiological and biochemical characters of different varieties and cultivars of coconut. Research seminar for young scientists, Institute of Biology. December, 1989.

5. VISITS, LECTURES AND SYMPOSIA

Dr C Jayasekara, Miss C S Ranasinghe and Mrs W P K K Fernando participated in a workshop on Mass spectroscopy and Gas chromatography held at the Institute of Fundamental Studies, Kandy on 29 April.

Miss C S Ranasinghe and Mrs W P K K Fernando participated in a workshop on Emission and Absorption spectroscopy held at the Institute of Fundamental Studies on 12 May.

Mrs W P K K Fernando attended a workshop on the use, maintenance and Repair of Analytical Instruments held at CISIR, Colombo from 11 - 28 August.

Miss C S Ranasinghe attended the workshop on Techniques and applications of Gas Chromatography/Mass spectroscopy held at CISIR, Colombo from 2 - 6 October.

Dr C Jayasekara participated in a FAO/IAEA Regional Training Course on the Use of Isotopes and Radiation Techniques in Studies on Soil/Plant Relationships with Special Emphasis on Trees, held in Bangi, Kuala-Lumpur, Malaysia from 06 November to 08 December.

6. REFERENCES

Finlay, K W and Wilkinson, C N (1963). The analysis of adaptation in a Plant Breeding Programme. *Aust. J. Agric. Res.* 14, 742 - 754.

7. ACKNOWLEDGEMENTS

We express our sincere thanks to the Canadian International Development Agency for their financial support and for providing a Research Assistant to work on the project.

Thanks are due to Mr D T Mathes, Head, Biometry Unit and the staff for analysis of data and Mr K S Jayasekara, Officer-in- Charge, Soils and Plant Nutrition Division and staff for analysis of the leaf samples.

The assistance given by the staff of the Plant Physiology Unit in conducting the experiments and in preparation of this report is gratefully acknowledged.

REPORT OF THE INFORMATION SERVICES DIVISION

Assistant Information Officer: P A Henry Nimal B Sc

1. GENERAL

1.1 Staff Matters

Resignations: Mr T R W Weralupitiya, Technical Assistant (Photography) resigned the services on 31 December.

2. PUBLICATIONS

2.1 Technical Publications

Volume 6 of COCOS and the Annual Report of the Institute for 1987 were published.

2.2 Extension Publications

The following publications were issued during the year under review.

Pol Pawath Volume 11 No. 2

Pol Pawath Volume 12 No. 1

Coconut Bulletin Volume 5 No. 2

Coconut Bulletin Volume 6 No. 1

Due to heavy demand, the following issues were reprinted.

Coconut Bulletin Volume 2 No. 1

Coconut Bulletin Volume 3 No. 1

Pol Pawath Volume 9 No. 2

2.3 Advisory Circulars

An advisory circular (No. A6) in the new series on Soil and Moisture Conservation in coconut lands was published.

3. ADVISORY ACTIVITIES

In keeping with the responsibilities of providing free technical advisory assistance to coconut estates of 50 ac and above, a number of estates was inspected and necessary advisory assistance was provided. These activities had to be curtailed due to the disturbances in the country.

4. TRAINING PROGRAMMES AND STUDY TOURS

4.1 Training Programmes

The following training programmes were conducted during the year.

- Attachment training for three batches of students from the National Apprenticeship Board from 16 January to 31 December.
- A training programme was organized for the Estate Supervisors of CRI from 13 to 23 November.

4.2 Study Tours

The following study tours were organized for the persons indicated.

- Mr Fredi Wapner and Edith Peintner, students from Austria on 29 March.
- A group of scientists from the Philippines on Coconut Processing on 10 May.
- Dr John B Flynn, Chief and USAID team on 10 May.
- District land use planners, staff members of the Ministry of Lands Irrigation and Mahaweli Development on 20 June.

5. SEMINARS/LECTURES/FIELD DAYS

- 5.1 A series of lectures was delivered on coconut cultivation and coconut products at Nattandiya, Arachchikattuwa, Wanathawilluwa and Puttalam, during the year, in connection with the Janasaviya Programme.

- 5.2 A half day seminar was conducted on coconut cultivation, intercropping in coconut lands and coconut products at Chilaw on 20 October, in connection with the Agromart Seminar Series, organized by the Women's Chamber of Industry and Commerce.
- 5.3 A series of informal discussions amongst research divisions on new recommendations and research highlights was organized.
- 5.4 Mr P A H N Appuhamy, Assistant Information Officer, participated in the workshop on Status Review Report held on 13 and 14 December, at the BMICH, Colombo, organized by the Sri Lanka Council for Agricultural Research Policy.
- 5.5 The Institute participated in activities of the mobile ministry held at the Red Cross Society Hall, Kurunegala on 15 December, arranged by State Ministry of Coconut Industries.

6. VISITORS

The important visitors included the following:

The Hon. Sarachchandra Rajakaruna, Minister of State for Coconut Industries.

Dr Mrs M J Lawrence, University of Birmingham.

Dr A L T Perera, University of Peradeniya.

Mr J Alwis, Secretary, Ministry of Coconut Industries.

Mr Paul Osborne, SATIS Network Project.

Mr Ivar Serejski and Mr P V Ramakrishna, World Bank.

Messrs John Flynn, Gary Alex, Nelson Vithanage & S H Charles, USAID, Colombo.

Mr Onofre Cruz, Ms M A Rodriguez, Ms C G Maocadgsakay and M G Marges, Philippines.

Mr B Prunieres, French Embassy, Colombo.

Mr J Neeteson, The Netherlands.

Mr S Lampe and Dr M Rezania, FAO.

Prof. and Mrs G Kemmler, FRG.

Mr P Dres, UK.

Prof. M M U Sultan Bawa, Chairman, CISIR.

Mr M A T de Silva, Ms M. Amarasuriya and a team from NARESA.

Ms C L Nethsinghe, CISIR.

A large number of coconut growers seeking advice on coconut cultivation visited the Institute. Also groups of school children from various schools also visited the Institute.

7. PHOTOGRAPHY

Transparencies and photographs required for technical divisions were prepared.

8. MUSEUM

The Museum was maintained satisfactorily.

REPORT OF THE LIBRARY

Librarian : M J C Perera, ALA

1. GENERAL

The library continued its routine activities satisfactorily during the year under review. Requests received from within the institute and from other outside institutions were satisfactorily met with by using resources available within and from outside as well as from abroad. Participation in local network activities continued satisfactorily.

1.1 Staff

Staff position as at 31 December, 1989 remained as Librarian (1), Machine Operator (1) and supporting staff (3). Services of one Library Assistant from the Coconut Information Centre were also provided. A position of a Library Assistant remained vacant.

2. ACQUISITIONS

The library stock recorded 4616 books as at the end of the year. The number of new items accessed during the year was 112. A collection of 49 books/pamphlets on coconut received from the Library of Congress was also added to the collection. The library received 125 journals during the year including 13 Annual Reports 71 journals (received on exchange) and 41 on subscription.

About 50 books were requisitioned from the World Bank-funded Agricultural Research Project. The Third World Academy of Science has also expressed its willingness to donate 50 books for the library and a list of requirements has been forwarded.

A gift of 25 books on Genetics and Plant Breeding has been offered by Dr M A P P Manthiraratne a former Botanist of the Institute.

3. SERVICES

In addition to normal acquisition and processing of library material, user requirements have been fulfilled from in-house as well as from outside resources. Eighteen requests have been made on inter-library loan on behalf of the research staff

of which 10 have been serviced. Of the 67 requests received from other libraries, 52 have been serviced. There had been 27 requests for material not available within the country. Such requests were referred to the British Library Document Supply Division and 14 have been successfully met with. A 'Literature Alert Service' and a 'New Books Announcement Service' were provided to the research staff in order to keep them in touch with the latest available information.

The library continued to participate in the activities of the Sri Lanka Scientific & Technical Information Centre (SLSTIC) and the Agricultural Information Network (AGRINET). Contents pages from 36 journals have been supplied to other libraries and contents pages from 30 journals have been received under Selective Dissemination of Contents Page Service (SDCP) for the institute staff. As a contributing library for the Union Catalogue of Scientific and Technical Books (UNICAST) II, of the SLSTIC, the library commenced cataloguing of new arrivals commencing from 1989 into the computer database and 74 books have been entered according to the common format as agreed by the member libraries participating in this scheme.

3.1 Library Automation

Lending Information was continuously recorded in the computer. Arrangements have also been made to record all information regarding book acquisition and payments in the computer, and to build up a computer-based catalogue by incorporating the entries created for the SLSTIC Union Catalogue.

4. VISITORS

A group of member librarians from the Sri Lanka Library Association visited the library on 27 October on a study tour. A full day programme was arranged for them. University lecturers, students and research workers from other institutes continued to use the library regularly.

REPORT OF THE ESTATES MANAGEMENT DIVISION

Manager (Estates) - P S Liyanagama B Sc (Agric)

1. GENERAL

1.1 Staff Matters

Appointments: Mr M F H G Ivan Appuhamy (Technical Assistant) as the Officer-in-Charge, Bandirippuwa Estate on 02 January.

Mr W L D Fernando (Tractor Operator), re-instated at Bandirippuwa Estate on 02 June, effective from 27 December, 1978.

Transfers: Mr M J A Miranda (Tractor Operator) Maduruoya Seed Garden to ISG Ambakelle on 16 January.

Mr M R L A Perera (Superintendent) from Ratmalagara Estate to Makandura Seed Garden on 11 February.

Mr J I Jayalath (Supervisor) from Makandura Seed Garden to Walpita Estate as the Officer-in-Charge, on 11 February.

Mr M Sisira Perera (Supervisor) from Walpita Estate to Minneriya Farm as the Officer-in-Charge, on 13 February.

Mr M P W Fernando (Supervisor) from Minneriya Farm to Bandirippuwa Estate, on 15 January.

Mr A Jayasinghe (Watcher) from Kirimetiya Estate to Bandirippuwa Estate, on 30 May.

Mr D W Piyasena (Watcher) from Kirimetiya Estate to Bandirippuwa Estate, on 30 May.

Mr J I Jayalath (Supervisor) from Walpita Estate to Estates Management Office on 09 June.

Mr N Gamage (Field Officer) from Poththukulama Research Station to Walpita Estate as the Officer-in-Charge on 09 June.

Mr A Thavaratnarajah (Asst. Manager/Farms) from Passekudah Farm to Estates Management Office on 21 July.

Mr K Parisathan (Driver) from Passekudah Farm to Head Office, on 21 July.

Mr M Nadarajah (Lab/Field Attendant) Passekudah Farm to Crop Protection Division, on 21 July.

Mr V Sithambarapillai (Labourer) from Passekudah Farm to Crop Protection Division, on 21 July.

Mr K Velupillai (Labourer) from Passekudah Farm to Crop Protection Division, on 21 July.

Mr K Parisathan (Driver) from Head Office to Minneriya Farm, on 11 August.

Mr C Neil Luxman (Tractor Operator) from Minneriya Farm to Bandirippuwa Estate, on 11 August.

Mr K P C Fernando (Supervisor) from Kirimetiya Estate to Bandirippuwa Estate, on 11 August.

Mr K S N M Fernando (Lab/Field Attendant) from Kirimetiya Estate to Estates Management Office, on 11 August.

Mr K L L Appuhamy (Watcher) from Agronomy Division to Bandirippuwa Estate, on 22 September.

Mr M Nadarajah (Lab/Field Attendant) from Crop Protection Division to Passekudah Farm on 02 October.

Mr V Sithambarapillai (Labourer) from Crop Protection Division to Passekudah Farm on 02 October.

Mr K Velupillai (Labourer) from Crop Protection Division to Passekudah Farm on 22 October.

Mr A Thavaratnarajah (Asst. Manager/Farms) from Estates Management Office to Passekudah Farm as Officer-in-Charge on 07 November.

Mr K S N M Fernando (Lab/Field Attendant) from Estates Management Office to Plant Physiology Unit on 07 November.

No-Pay leave abroad: Mr B M Subasinghe (Tractor Operator) returned from no-pay leave abroad on 24 July.

Deaths: Mr B A L Mendis (Field Assistant) on 13 June.

Mr J M S N Appuhamy (Lab/Field Assistant) on 30 June.

2. ACTIVITIES

The following estates, Seed Gardens and other Sub-stations were administered by the Division (The report on the Isolated Seed Garden appears under the Genetics & Plant Breeding Division).

1. Bandirippuwa Estate, Lunuwila.
2. Ratmalagara Estate, Madampe.
3. Poththukulama Research Station, Pallama.
4. Walpita Estate, Walpita.
5. Kirimetiya Estate, Lunuwila.
6. Makandura Seed Garden, Gonawila.
7. Maduru-Oya Seed Garden, Bogaswewa, Kashyapapura.
8. Minneriya Research & Demonstration Farm, Minneriya.
9. Passekudah Research & Demonstration Farm, Passekudah.

General maintenance of these properties was satisfactory. Improved agricultural standards and enhanced profitability of these properties, achieved under the guidance of the Estates Committee were sustained without a decline. Usage of herbicides in cultural practices, especially in the maintenance of manure circles and roadways, became increasingly popular resulting in a considerable saving in cost.

The Differential Fertilizer Recommendations based on foliar analysis and provided by the Soils & Plant Nutrition Division were introduced during the later part of the year.

There was an overall increase of nut yield by about 90% on the average which could be attributed mainly to the weather conditions prevailed and the improved cultural practices.

The rainfall and its distribution during the year were somewhat poorer than the previous year's and this could affect the yields in the coming year.

The area statement, census of palms and crop disposal patterns in relation to all estates and seed gardens under the management of the division are given in Table 1. The rainfall and distribution recorded at these stations are given in Table 2.

2.1 Bandirippuwa Estate, Lunuwila

(Officer-in-Charge: Mr M H F G Ivan Appuhamy)

District	:	Puttalam
Electorate	:	Wennappuwa
Agro-Climatic zone	:	Semi-wet Intermediate Zone

A large area (72 ha) of the estate is under young plantations of various ages ranging from 3 to 5 years and only 53 ha of the planted area are in production.

Rainfall: The total rainfall during the year had been about 10% less than the previous year with reduced number of wet days. However, excepting for a short dry spell at the beginning of the year, the distribution of rainfall was satisfactory.

Analysis of yield data: The total nut yield for the year (512 595) was 142% more than the 1988 yield which could be attributed to the favourable climatic conditions prevailed in 1988 and to the effective security systems implemented by the estate. There was a very significant improvement in collection of fallen nuts that came about due to better security system and the incentive paid for collection of fallen nuts. An analysis of yield data for the last five years is given in Table 3.

Field Operations:

1. **Manuring:** Instead of the Differential Fertilizer Recommendations, equivalent quantities of the Adult Palm Mixture, which was already available in stock was used. Both kieserite and dolomite were applied as per the same recommendations. Young palms (6400) were manured with YPM at recommended dosages in two split applications half-yearly. The second dose was applied at the very end of the rainy season due to delays in obtaining fertilizer.

2. **Weed Control:** Weeds were kept under control with the use of rotaslasher. However certain sections were not in satisfactory conditions due to tall weeds. Towards the latter part of the year they were brought under control.

Table 1 - Area Statement, Census of palms and Crop Disposal relating to estates and seed gardens

	BE	RE	PRS	WE	KE	MSG	MOSG	MIN	PAS
1. Area Statement (ha)									
Coconut	123.9	98.4	66.0	16.2	16.2	53.8	38.9	13.4	32.3
Nursery	1.6	-	-	-	-	-	-	-	-
Roads & Buildings	9.3	2.0	2.0	1.6	1.0	2.0	4.0	-	3.7
Vacant land	13.2	10.0	16.6	-	21.2	-	21.9	37.1	8.0
Other	-	-	1.6	-	-	2.4	20.2	-	3.4
Total	148.0	110.4	86.2	17.8	38.4	58.2	85.0	50.5	47.4
2. Census of palms					N/A				
Bearing palms	9500	7652	6745	2158		-	-	-	955
Young palms	6400	7054	456	351		2589	-	1922	2409
Seedlings	850	-	3100	-		7578	8050	-	-
Palms	380	56	97	55		-	-	-	-
Vacancies	232	647	641	35		-	338	42	1694
Total	17362	15409	11039	2599		10167	8388	1964	5058
3. Crop Disposal					N/A				N/A
Sold	368,791	423,754	626,647	154,264		85*	-	-	-
Converted to Copra	11,021	99,695	43,276	13,153		-	-	3 380	-
Research	7,890	-	-	-		-	-	-	-
Staff issues	57,295	10,605	18,970	2,772		-	-	810	-
Rejections	26,587	23,046	25,304	4,633		12	-	145	-
Awaiting Sale	41,011	77,829	86,024	17,652		123	-	-	-
Total	512,595	634,929	800,221	192,474		220	-	4 335	-

(BE - Bandirippuwa Estate; RE - Ratmalagara Estate; PRS - Poththukulama Research Station; WE - Walpita Estate; KE - Kirimetiyan Estate; MSG - Makandura Seed Garden; MOSG - Maduru Oya Seed Garden; MIN - Research & Demonstration Farm, Minneriya; PAS - Research & Demonstration Farm Passekudah, Kalkudah).

Table 2 - Rainfall (A) (mm) and number of Wet days (B) in 1989
 (corresponding figures for 1988 are given in parenthesis)

	Bandirippuwa Estate				Ratmalagara Estate				Poththukulama Estate			
	A		B		A		B		A		B	
January	25.4	(0)	5	(0)	77.7	(0)	5	(0)	53.9	(0)	2	(0)
February	0	(111.4)	0	(6)	0	(101.3)	0	(5)	0	(165.1)	0	(6)
March	65.7	(87.4)	4	(7)	117.4	(53.3)	6	(6)	2.5	(68.1)	1	(4)
April	234.9	(283.0)	14	(18)	204.2	(231.4)	8	(14)	146.1	(232.9)	5	(12)
May	52.3	(109.9)	15	(14)	54.2	(69.0)	13	(11)	8.9	(85.6)	1	(3)
June	153.4	(255.8)	19	(25)	131.5	(221.9)	16	(20)	93.7	(188.7)	8	(13)
July	99.0	(151.8)	10	(8)	124.2	(57.9)	14	(6)	62.5	(28.2)	4	(2)
August	20.4	(105.2)	7	(20)	10.0	(167.3)	7	(16)	0	(58.9)	0	(7)
September	222.1	(303.4)	14	(21)	161.4	(259.7)	12	(17)	34.0	(183.1)	2	(10)
October	395.9	(88.8)	16	(7)	238.9	(58.0)	16	(7)	142.8	(80.3)	11	(2)
November	379.4	(370.7)	18	(5)	278.7	(230.1)	18	(15)	301.2	(352.1)	14	(12)
December	50.3	(19.1)	2	(12)	24.4	(88.8)	3	(8)	14.2	(65.0)	2	(4)
TOTAL	1698.8	(1886.5)	124	(143)	1422.6	(1538.7)	118	(125)	859.8	(1508.0)	50	(75)

Table 2 Contd

	Walpita Estate				Makandura Seed Garden				Maduruoya Seed Garden			
	A		B		A		B		A		B	
January	1.9	(0)	2	(0)	21.4	(0)	2	(0)	218.7	(31.0)	7	(2)
February	0	(253.9)	0	(7)	0	(84.8)	0	(6)	0	(77.2)	0	(3)
March	93.3	(86.9)	4	(8)	139.1	(55.3)	3	(8)	50.0	(65.5)	5	(4)
April	230.0	(386.2)	8	(17)	207.1	(356.1)	9	(15)	35.6	(134.6)	4	(6)
May	185.7	(87.8)	14	(11)	84.8	(132.8)	11	(13)	59.2	(40.1)	5	(2)
June	431.8	(263.4)	15	(17)	224.2	(240.7)	17	(19)	29.5	(0)	2	(0)
July	288.0	(131.9)	7	(8)	150.3	(112.7)	11	(9)	151.4	(61.5)	8	(4)
August	35.2	(209.1)	4	(15)	23.1	(165.5)	5	(16)	115.1	(162.1)	2	(7)
September	173.8	(414.5)	13	(19)	165.6	(356.5)	15	(20)	88.9	(71.9)	5	(4)
October	209.2	(176.2)	14	(5)	224.3	(88.4)	14	(3)	209.3	(129.3)	8	(7)
November	315.7	(239.9)	10	(11)	272.6	(304.2)	10	(13)	254.5	(346.5)	15	(11)
December	82.2	(6.6)	2	(3)	69.6	(46.0)	2	(6)	159.5	(213.9)	13	(10)
Total	2046.8	(2256.4)	93	(121)	1582.1	(1943.0)	99	(128)	1371.7	(1333.6)	74	(60)

Table 2 Contd

Minneriya R & D Farm

Passekuda R & D Farm

	A		B		A		B	
	January	147.3	(38.1)	3	(1)	87.5	(10.4)	5
February	2.3	(34.3)	1	(1)	1.0	(38.0)	1	(3)
March	68.6	(72.4)	3	(7)	112.7	(195.0)	6	(7)
April	172.5	(200.7)	6	(13)	112.7	(42.4)	3	(8)
May	120.4	(35.6)	5	(1)	78.8	(35.2)	3	(5)
June	33.3	(0)	2	(0)	0	(0)	0	(0)
July	179.3	(177.8)	5	(4)	45.0	(306.7)	2	(5)
August	0	(49.3)	0	(2)	89.2	(84.1)	2	(6)
September	89.9	(189.2)	4	(5)	106.4	(37.0)	8	(7)
October	133.9	(250.4)	4	(5)	190.7	(317.0)	9	(10)
November	322.3	(200.2)	16	(10)	297.0	(160.8)	21	(13)
December	58.7	(230.6)	2	(14)	160.5	(113.5)	9	(14)
Total	1328.5	(1478.6)	51	(63)	1281.5	(1340.1)	69	(82)

Table 3 - Analysis of Yield Data, 1984 to 1989 - Bandirippuwa Estate

Pick	1984	1985	1986	1987	1988	Five years' average	Per cent	1989
1	31 107	81 496	86 180	39 942	24 867	52 718	13.3	52 656
2	57 418	105 327	112 322	63 033	36 112	74 242	18.8	85 714
3	96 823	122 662	82 023	76 837	52 772	86 223	21.8	129 704
4	112 174	114 394	90 490	69 247	45 161	86 293	21.8	114 458
5	62 678	93 811	56 088	39 699	28 130	56 081	14.2	82 255
6	37 766	76 116	37 534	18 996	29 505	39 983	10.1	47 808
Total	397 966	593 806	464 637	307 754	216 547	395 152	100.0	512 595
Bearing palms	13 289	13 289	11 834	9 940	9 940	11 658	-	9 500
Yield/palm	30.0	44.7	39.3	31.0	21.3	33.3	-	54.0
Yield/ac	1 917	2 860	2 513	1 984	1 176	2 090	-	3 417
Yield/ha	4 735	7 064	6 207	4 900	2 905	5 162	-	8 440

3. **Soil and moisture conservation:** Very little work had been newly done in this respect except for the maintenance of routine cultural practices.

4. **Fences:** Boundary fence was repaired in full and was maintained in good order. Two hundred and fifty fathoms of the perimeter fence in field No. 7 was replaced with fence of concrete posts. Wilful damages to the perimeter were effectively controlled and the stray animals on the property became a rare sight.

5. **Roads and paths:** Main estate roads and field roads were maintained in a satisfactory condition.

6. **Replanting:** No new plantings had been done during the year. Established young plantations were maintained in good order. Over 600 vacancies were supplied.

7. **Buildings, Machinery etc:** Machinery and equipment were satisfactorily maintained.

2.2 Ratmalagara Estate, Madampe.

(Superintendent: Mr G Vithanage)

District	:	Puttalam
Electorate	:	Chilaw
Agro-climatic Zone	:	Semi-dry Intermediate Zone

Excepting for a jungle block of about 3.3 ha, the rest of the plantable land in the estate is planted to coconut. The bearing area is 54 ha.

Rainfall: The total rainfall for the year was about 6% less than that of the previous year with more or less a similar pattern of distribution. Hence the yield in 1990 is not expected to be affected adversely.

Analysis of yield data: The yield in 1989 is 39% more than that of the previous year (Table 4).

Field Operations:

1. **Manuring:** The mature plantations were manured with N, P, K and Mg as per the Differential Fertilizer Recommendation. All the young palms were manured with YPM at 1 1/2 times the normal dosage as recommended. In addition to these inorganic fertilizers, 2050 young palms in field No. 4, 420 young palms in field No. 8 and 645 mature palms in field No. 8 were given cattle manure at 30 kg each.

Table 4 - Analysis of Yield Data 1984 to 1989 - Ratmalagara Estate

Pick	1984	1985	1986	1987	1988	Five years' average	Per cent	1989
1	43 324	109 226	133 637	74 024	44 186	80 880	11.7	83 747
2	80 520	109 455	157 982	114 359	61 368	104 734	15.1	94 867
3	138 395	159 840	203 283	119 910	122 224	148 710	21.4	127 673
4	119 035	137 083	160 857	174 100	108 062	149 827	21.6	128 100
5	121 802	220 007	127 404	94 998	58 159	124 474	18.0	118 477
6	72 418	133 945	91 978	61 590	63 298	84 586	12.2	82 069
Total	575 393	919 556	874 843	638 781	457 279	693 214	100.0	634 929
Bearing palms	11 409	11 398	11 398	11 424	7 657	10 657	-	7 652
Nuts/palm	50.4	80.7	76.8	56.0	59.7	65.0	-	83.0
Nuts/acre	3 226	5 158	4 787	3 590	3 413	4 035	-	4 738
Nuts/ha	7 972	12 749	11 832	8 854	8 430	9 966	-	11 704

2. **Weed control:** Weeds were kept well under control throughout the year and the ground conditions were quite satisfactory. Depending on the weed growth each field was weeded three or four rounds during the year. In addition, selective weeding and cheddy weeding were done as required. Herbicides were effectively used in controlling weeds in manure circles. The cover crop in about 50% of the area in the estate had established well and kept the weeds well under control resulting in reduced cost of weeding.

3. **Soil and moisture conservation:** The husk burying programme was completed as programmed. The Cover crop Pueraria was planted in field Nos. 7, 8 and 9. Contour drains in the same fields were desilted and renovated. The drainage drains too in the lower reaches were re-conditioned. Semi-circular husk trenches 3'x 2'x 2' were provided to 1002 seedlings in field No. 4 as a special treatment since the growth of this plantation was not upto the required standard. The manure circles were mulched three rounds during the year using fallen fronds, weed trash etc.

4. **Fences:** The perimeter fence was maintained in good order. Gliricidia stakes were planted along the fence to establish a live fence. Fences were kept free of weeds with the use of herbicides which proved to be economical and beneficial over manual clearing.

5. **Roads:** Estate roads and road drains were well maintained. Reconditioning of roads was done where necessary. The use of herbicides kept down the cost of weed control in roads and paths.

6. **Young plantations:** One hundred and nine acres of young plantations in field Nos. 1, 2, 3, 4, 5 and 8 were maintained in good order. No new plantings were done during the year. No serious incidents of pests and diseases were reported.

7. **Buildings, Machinery, etc.:** Vehicles (jeep, motor cycle, tractors, trailers, bowsers etc.) and agricultural implements were well maintained. One of the four-wheeled tractors was sent to the State Trading Corporation for a complete over-haul. A tractor-driven grass cutter (Rotaslasher), a tractor and a knapsack power sprayer (Arimitsu) were received. Major repair jobs in buildings were not carried out due to lack of funds.

8. **Costing:** The cost of production was Rs. 1466.15 while the net sales average was Rs. 2 055.57 per 1000 nuts.

2.3 Poththukulama Research Station, Pallama

(Superintendent: S M Wijeratnebanda)

District : Puttalam
Electorate : Anamaduwa
Agro-climatic Zone : Semi-dry Intermediate Zone

The remaining uncleared jungle area (approx. 26 ha) of the estate was cleared and kept reserved for planting trials. The planted extent is now increased to 66 ha of which 55 ha are in production. Young plantations cover 10.5 ha.

Rainfall: The total rainfall in 1989 indicates a decrease of 43% over that of 1988 and a 34% drop over the last three years' average.

Analysis of yield data: The total crop in 1989 indicated a 79% increase over that of 1988 and a 55% increase over the previous five years' average (Table 5). This could be attributed to the favourable weather conditions and the agricultural practices continued over the years.

Field operations and maintenance:

1. **Manuring:** The entire mature stand (6 745 palms) was fertilized with the equivalent dosage of APM and dolomite as per the Differential Fertilizer Recommendation. Of these, about 300 palms that showed acute magnesium deficiency were treated with an extra dose of 500 g kieserite/palm. Cattle manure too was applied at the rate of 20 kg per palm.

Young palms over one year (2 573) were manured half-yearly at varying dose of 1,200 to 1,800 g of YPM according to the age. Dolomite was applied at the rate of 500 g/seedling, together with the first half-yearly application of YPM. Cattle manure at 10 kg per seedling was applied once.

2. **Weed Control:** Weeds were effectively kept under control. Each field was weeded using Rotaslasher two or three rounds as required. Cheddy weeding was done where necessary. Herbicides were used in controlling weeds in manure circles of young palms. Leguminous creeping covers, mainly Pueraria, made their contribution by smothering weeds, especially 'Illuk' in certain fields.

Table 5 - Analysis of Yield Data 1984 to 1989 - Poththukulama Research Station

Pick	1984	1985	1986	1987	1988	Five years' average	Per cent	1989
1	22 959	92 480	79 934	78 887	64 625	67 777	13.2	102 372
2	23 519	128 213	75 245	97 815	52 576	75 473	14.7	141 944
3	40 842	211 778	100 534	142 204	90 009	117 073	22.7	200 080
4	61 673	135 320	81 132	87 893	87 978	90 799	17.6	140 051
5	56 197	147 100	71 424	81 701	77 212	86 726	16.8	128 718
6	61 156	91 702	74 762	76 842	84 528	77 798	15.0	88 336
Total	266 346	806 593	483 031	565 342	446 928	515 646	100.0	801 501
Bearing								
palms	7 009	7 071	6 982	6 851	6 699	6 922	-	6 745
Nuts/palm	38	111	69	83	67	75	-	119
Nuts/ac	1 875	5 888	3 401	3 681	3 788	4 297	-	5 850
Nuts/ha	4 607	14 549	8 355	9 779	8 628	10 614	-	14 450

3. Soil and moisture conservation: All available husks were buried in 1221 pits of 5'x 3'x 3' in field Nos. 8, 11-A and 12. Manure circles were mulched with fallen fronds etc. in two complete cycles and another round partially as per the availability of mulching material. Coir dust was used in mulching seedlings in field Nos. 6 and 13. The cover crop *Fueraria* was established in another 30 acres, bringing about half the estate under covers. Drains (733 fathoms) were renovated in field No. 6 and in the paddy field area.

4. Fences: Perimeter fence of the estate was maintained in good order. Herbicides were used in keeping the fences free of weeds. About 20,000 stakes of gliricidia were planted with 80% success along the perimeter to form a live fence. One thousand seven hundred fathoms of new fencing with concrete posts was done on the perimeter of the newly-cleared jungle area. Repairs were effected in 375 fathoms of fence.

5. Roads: All roads and paths were kept in good order. A new field road of about 100 fathoms was opened in field No. 13 (K/C block). The road over the tank bund joining field No. 8 and 10 was improved after installing a culvert. A 20' wide new main road of the estate was opened through the newly-cleared jungle block. Construction of this road was completed upto about 600 fathoms leaving about another 150 fathoms to be completed in the following year.

6. Young plantations: New clearings were well maintained. There were about 50 casualties in field Nos. 6 and 13 due to dry weather conditions and they were supplied with poly-bagged T x T seedlings received from Ratmalagara Estate. Young plantation along the perimeter performed well and 7.7 ha of them were transferred into the bearing stand. Fifty three seedlings of the young plantation in field No. 9 came into flower.

A nursery was maintained successfully to raise poly-bagged seedlings for the estate planting programme. By the end of the year, there were 667 seedlings (CRIC 60) in polybags.

The newly-cleared jungle was allocated for field experiments to the Agronomy Division (15 ac) and Genetics & Plant Breeding Division (40 ac) (Field Nos. 15 and 14 respectively). Of these, 15 acres were established as trials by both divisions.

The balance vacant land was given on lease to estate staff for cultivation of short-term legume crops.

7. **Subsidiary crops:** Banana intercropped in field No. 11-B young plantation was removed as the palms reached five years of age and the intercrop became a hindrance to the growth of seedlings. A new banana plantation was established with variety "Kolikuttu" in the double avenue plantation of field No. 6.

The bund of the reservoir breached during heavy rains and the paddy fields was not cultivated in Yala for lack of water. However, it was cultivated successfully in Maha season after repairing the tank bund.

8. **Buildings, machinery etc.:** Minor repairs and colour- washing of the buildings were effected. However, no action was taken on the two living quarters that need major repairs.

Machinery and equipment on the estate were maintained in good order.

The estate received one filing cabinet and a power sprayer. Two solar-power units with average capacity for domestic purposes were installed.

9. **Costing:** The cost of production was Rs. 854.32 per 1000 nuts produced. The net sales average was Rs. 2,304.33 per 1000 nuts.

10. **Others:** The damage to tender nuts by monkeys had increased with the clearing of jungle. This damage, which is estimated at over 150,000 nuts per year, continues unabated as the fire-arms of the estate were not available.

2.4 Walpita Estate

(Officer-in-Charge: Mr Newton Gamage)

District	:	Gampaha
Electorate	:	Divulapitiya
Agro-climatic Zone	:	Semi-wet Intermediate Zone

This is a small property of 17.8 ha in extent established in 1948 as a Progeny Trial. The area under coconut is 16.2 ha. A several intercropping trials and demonstrations are conducted here.

Census of palms: According to the census 83% of this plantation is in bearing.

Rainfall: The total rainfall for the year was 9.2% less than that of 1988 with a similar distribution pattern. Crop is not expected to be improved during 1990.

Analysis of data: The crop in 1989 was more than double (211%) the yield in 1988 (Table 6).

Disposal of Crop: The crop was disposed mainly as fresh nuts through brokers and only the buyers' rejections were converted into copra.

Field Operations:

1. **Manuring:** The bearing palms (2128) were manured with equivalent dosage of APM and dolomite as per the Differential Fertilizer Recommendation. Seedlings (infills) were manured half-yearly with YPM at 1 1/2 times the normal dosage as recommended.

2. **Weed control:** Ground conditions remained satisfactory with the weeds well under control. Only a few rounds of selective cheddy weeding were required. Manure circles were maintained by the use of herbicides.

3. **Soil and moisture conservation:** Husks were buried in 300 pits of 5'x 3'x 3' in block A. Regular mulching with fallen fronds was continued. The cover crop *Pueraria* established rapidly smothering weeds and arresting soil erosion.

4. **Fences:** The boundary fence of the estate was maintained in good order. However, certain sections of the fence need early reconstruction.

5. **Roads:** Field roads were maintained in satisfactory condition.

6. **Intercrops:** The intercrops cocoa, coffee, pepper and cinnamon, established and maintained by the Agronomy Division for about 10 years, were taken over by the estate in July. Since then the sale of intercrop produce was done through produce brokers, resulting a revenue of Rs. 35,000/= by end of the year. Initial work had been done to plant another 1 ha of pepper.

7. **Buildings, machinery etc.:** All the buildings were maintained in good order. The well, which was the main source of water for the estate, collapsed and was repaired but smaller in diameter. The capacity of the well appears to be reduced.

Vehicles and machinery were kept in good condition. A new motor cycle (HONDA CG 125) was received for the estate.

Table 6 - Analysis of Yield Data 1984 to 1989 - Walpita Estate

Pick	1984	1985	1986	1987	1988	Five years' average	Per cent	1989
1	5 408	17 926	20 843	16 958	4 937	13 214	8.5	19 472
2	11 032	24 116	24 741	47 925	8 904	23 344	15.0	32 012
3	24 040	58 925	43 911	44 643	15 312	37 366	24.1	47 632
4	33 704	43 722	48 049	33 634	25 944	37 011	23.9	39 391
5	25 854	40 291	33 114	22 092	23 311	28 932	18.7	35 895
6	8 623	28 943	18 337	7 074	12 634	15 122	9.8	18 072
Total	108 661	213 923	188 995	172 326	91 042	154 989	100.0	192 474
Bearing palms	2 157	2 157	2 157	2 099	2 094	2 133	-	2128
Nuts/palm	50.4	99.2	87.6	82.1	43.5	72.7	-	90.4
Nuts/acre	2 717	5 348	4 725	4 308	2 276	3 875	-	4 812
Nuts/ha	6 710	13 210	11 670	10 641	5 622	9 571	-	11 885

8. **Costing:** Cost of production during the year was Rs. 1,111.43 per 1000 nuts produced and net sales average was Rs. 2,198.04. Intercrops derived a revenue of Rs. 35,000.

2.5 Kirimetiya Estate

(Officer-in-Charge: Mr K P C Fernando)

District : Puttalam
Electorate : Wennappuwa
Agro-climatic Zone : Semi-wet Intermediate Zone

This is a property owned by the Land Reforms Commission (LRC) and managed by the CRI on a lease basis. No development work had been done due to the uncertainty of the ownership. Consequently the land was handed back to the LRC at end of the year retaining about 1 ha along with five living quarters with the CRI.

Census of palms: No proper census of palm was taken due to the uncertain conditions prevailed.

Rainfall: Similar to that of Bandirippuwa Estate.

Others: Part of the estate, about 8 ha was alienated by the LRC in January resulting in total disarray of administration. Work on the estate was at a standstill. External interferences were beyond control. Later on, the staff were transferred to Bandirippuwa Estate leaving behind only two casual watchers to look after the interests of the CRI. Eventually by the end of the year the property was handed over to the LRC.

The CRI retained two blocks of land with two of grade III quarters and three of grade II quarters constructed by the institute. One of the grade II quarters situated elsewhere in the land was handed over to the LRC.

2.6 Makandura Seed Garden

(Superintendent: Mr M R L A Perera)

District : Kurunegala
Electorate : Katugampola
Agro-climatic Zone : Semi-wet Intermediate Zone

The Seed Garden is planted to CRIC 60 and Ambakelle Special. Out of the 54 ha planted, the seed garden proper consists of 33.5 ha and the balance 20.5 ha constitute the barrier.

By the end 1988, a total of 2589 seedlings had flowered and harvesting commenced in June with the initial harvest of 17 nuts. By the end of the year the total crop was 220 nuts, which were laid in the nursery to raise seedlings in polybags.

Last harvest of 123 nuts was in stock undisposed awaiting laying in nursery.

Rainfall: Total rainfall for 1989 indicates a 19% decrease over that of 1988. Dry spell commenced towards the end 1988 continued till May 1989. Seedlings were irrigated during the first quarter.

Field Operations:

1. Manuring: From the inception the seed garden was manured with YPM at 1 1/2 the normal dosage. From the second half of this year it was revised as per the Differential Fertilizer Recommendation.

The entire plantation was fertilized with goat manure at the rate of 15 kg per palm.

2. Weed control: Weeds were kept effectively under control as a result of the well established cover crops in about 75% of the plantation. Rest of the area was kept weed free with the use of rotaslasher. Cheddy weeding was done where necessary.

3. Soil & moisture conservation: Manure circles were mulched with weed trash in three rounds for the year. Contour drains (1333 fathoms) were reconditioned.

4. Fences: Boundary fence was cleaned and maintained in good order. Live fencing with gliricidia stakes was attempted with little success, due to adverse weather conditions.

5. Roads: Field roads and paths were maintained well using herbicides.

6. Others: One hundred and eighty five vacancies were filled with poly-bagged seedlings (CRIC-60) [Fields 15 - 54, 25 - 16, 45 - 17, 1B - 12; 2B - 86].

Another 1000 seednuts (CRIC 60) were laid in a pre-nursery of which 870 were poly-bagged for future infilling programme.

Produce of the seed garden too were primarily laid in nursery.

Seedlings were irrigated during the dry period at the beginning of the year.

An incidence of red weevil damage observed at the early part of the year was controlled using chemicals. However, six seedlings succumbed to the pest attack. A minor incidence of the coconut caterpillar pest was observed for the second time during the year, and the infestation was controlled using parasitoids.

7. Buildings, machinery, etc.: All the buildings were maintained in good order. Two tractors and their trailers, bowsers and other attachments were serviced and maintained well. The motor cycle was kept in good running order.

One water bowser was received during the year.

Four numbers of grade II quarters constructed in 1987 have still not been handed over by the contractor.

2.7 Maduru Oya Seed Garden

(Superintendent: Mr A N Ekneligoda)

District	:	Polonnaruwa
Electorate	:	Polonnaruwa
Agro-climatic Zone	:	Dry Zone

Coconut occupies only 39 ha. Expansion of the seed garden area could not be undertaken as planned due to disturbances in the area.

Rainfall: The seed garden received rainfall typical of the dry zone.

Field Operations

1. Manuring: YPM was applied recommended in two split doses at 1 1/2 times the normal recommendation.

2. Weed control: Weeds were kept satisfactorily under control. However, the last two months of the year weed control was restricted due to financial difficulties.

3. **Soil & moisture conservation:** Cover crops were established in a further 15 acres in field Nos. 1, 4 and 5. Seedlings were mulched twice with salvinia. Watering was done during the dry months.

4. **Fences:** Boundary fence was maintained in good order in spite of frequent damage by wild elephants.

5. **Roads:** All the roads and paths in the seed garden were maintained satisfactorily. Use of herbicides reduced the cost of maintenance.

6. **Pests and diseases:** Recommended preventive measures were taken. No incidents of pests and diseases were reported.

7. **Nursery:** Four thousand seednuts (CRIC 60) were laid in a pre-nursery for future planting.

8. **New planting:** Although new planting was programmed for 14 ha, only 2 ha were planted with CRIC 60 seedlings raised at the seed garden. This was attributed to the unsettled conditions prevailed in the area and finally to the restriction in the release of funds.

9. **Elephant damage:** Visitation of wild elephants continued resulting in a loss of 20 young palms. The Department of Wildlife assisted in chasing away the elephants but it was not a permanent solution.

10. **Others:** Ten seedlings came into flowering during the year.

11. **Buildings, machinery, etc.:** The only two quarters (Grade II) were maintained in good order. Rest of the buildings programme could not be completed yet on account of the difficulties faced with the contractors.

All vehicles, machinery and equipment were well maintained.

2.8 Minneriya Research & Demonstration Farm

(Officer-in-Charge: Mr M S Perera)

District	:	Polonnaruwa
Electorate	:	Polonnaruwa
Agro-climatic Zone	:	Dry Zone

The farm was established in 1982 under the East Coast Rehabilitation Project.

Rainfall: The farm received an average rainfall typical of the region.

Harvesting: First harvest of the farm commenced on 06 June.

Field Operations

1. **Manuring:** Bearing palms were manured with APM at 3 kg/palm. Seedlings were manured with YPM. Dolomite was applied at 500 g per palm on a flat rate. Palms were also applied with cattle manure at the rate of 15 kg/palm.

2. **Weed control:** Planted area was weeded three rounds using rotaslasker. Weeds were generally kept under control.

3. **Soil & moisture conservation:** Cover crop was established in 5 ha. Manure circles were mulched with weed trash.

4. **Irrigation:** Bowser irrigation was done during the dry period in February, March and August.

5. **Fences:** In spite of the frequent damage by wild elephants the perimeter fence was repaired and kept in tact. The southern boundary fence was repaired using new fence posts.

6. **Roads:** About 1500 fathoms of field roads were maintained in good order using herbicides in three rounds. The main access road to the farm too was repaired where necessary by re-surfacing with gravel.

7. **Pests and diseases:** Recommended preventive measures were taken. No incidents of pests and diseases were recorded.

8. **Elephant damage:** Wild elephants continued to visit and damage the palms.

9. **Buildings, machinery, etc.:** Buildings and machinery were maintained in good order. A new motor cycle (HONDA CG 125) was received. The jeep (No. 28 Sri 3622) was temporarily transferred to the Head Office.

2.9 Passekudah Demonstration Farm

(Officer-in-Charge: Mr A Thavaratnarajah, Asst. Manager/Farms)

District : Batticaloa
Electorate : Kalkudah
Agro-climatic Zone : Dry Zone

Activities: The situation in the area did not improve for the officers from the Head Office to visit the farm and review the progress physically. The field operations were kept to a minimum.

In June, the farm was forcibly occupied by the Indian Peace Keeping Force who conducted a training camp at the farm for local youth. Activities of the farm were suspended and the resident staff, including the OIC, were removed by force.

In October, the IPKF vacated and the OIC who took charge of the farm immediately afterwards made an assessment of damage caused to the property.

All incidents were reported at the local police station and detailed reports were submitted to the Ministry of Coconut Industries. Farm activities has not come back to normal since then.

REPORT OF THE CRI COMPONENT OF THE AGRICULTURAL RESEARCH PROJECT

Project Co-ordinator: M Jeganathan M.Phil

1. APPOINTMENTS

Mr M T N Fernando was appointed Research Assistant (Agricultural Economics) with effect from 19 June, as provided under the Incremental Staff for the CRI.

2. ACTIVITIES

2.1 Manpower Development Programme

The following officers continued with their postgraduate studies.

Mr H A J Gunathilake, reading for Ph. D in Crop Ecology at the University of North Wales, UK.

Mr L L W Somasiri, reading for Ph.D in Plant Nutrition at the University of Aberdeen, UK.

Mr R A J A Perera, reading for MS in Agricultural Economics at the University of North Carolina, USA.

Two officers left the country for overseas postgraduate studies during the year.

Ms W M U Fernando, on 01 June, to read for Ph.D in Population Genetics at the University of Birmingham, UK.

Ms L K Weerakoon, on 17 August, to read for MS in Tissue Culture at the Illinois State University, USA.

2.2 Agricultural Research Project - Special Programmes

The Project Co-ordinator attended the second part of the training course in Management Information Systems (MIS) in Agricultural Research and Programme Budgeting Systems (PBS) at the Council for Agricultural Research Policy (CARP) office in Colombo from 29 May to 03 June.

2.3 Strengthening of research station facilities

- (a) The following vehicles and equipment were received.

Motor Cycle 'Honda' model CG 125; Computer and graphic plotter; Fluid Bed Drier; Voltage Stabilizer; Spares for Technicon Autoanalyser.

- (b) Civil Works

Restrictions were placed on all new ARP expenditure for the period October - December causing delay in the implementation on Civil Works programme.

2.4 Inter-Institutional Research Programme (IIRP)

The second, third and fourth meetings of the IIRP was held on 03 February, 02 March and 30 June, respectively, to finalise the research programme.

A comprehensive research proposal was submitted to the CARP on 01 July, and the agreement was signed between CARP and CRI (on behalf of the programme) on 08 September, bringing into operation the programme.

The fifth meeting of the IIRP was held on 12 October to finalize the modalities of implementing the research programme, which has since commenced.

2.5 Review

Mr Iver Serejski and Mr R V Ramakrishna of the World Bank visited the Institute on 28 April, to review the progress of the CRI component of the ARP, under the Fifth Supervision Mission.

REPORT OF THE ADMINISTRATION DIVISION

Deputy Director (A & F) - D N B Perera (B.Sc)

1. GENERAL

The division continued to assist the research divisions in routine administrative and financial matters and related affairs, including maintenance work.

Cadre

The staff position of the Coconut Research Institute at the end of December was as follows:

Grade	Unclassified	Sp. Cl.	Cl. I	Cl. II	Cl. III	Cl. IV	Total
Executive	02	-	07	08	24	10	51
Technical	-	05	23	32	-	-	60
Intermediate	-	01	02	04	-	-	07
Clerical	-	06	13	28	-	-	47
Operative	-	06	15	35	-	-	56
Minor	-	39	50	59	-	-	148
Ungraded							
Drivers	-	05	09	25	-	-	39
Watchers (12hr)	-	-	-	-	-	-	18
Total	02	62	119	191	24	10	426

2. NEW APPOINTMENTS

Appointments

Mr D G Manamudali, Internal Auditor was appointed as the Administrative Officer, with effect from 01 January.

Miss C S Ranasinghe, Assistant Plant Physiologist, with effect from 08 February.

Mr W F T Fernando, Office Attendant, was appointed as the Supplies Assistant, with effect from 01 June.

Mr M T N Fernando, Assistant Agricultural Economist, with effect from 19 June (financed by the Agricultural Research Project).

Mrs M M I K Rahathungoda, Assistant Accountant, with effect from 01 August.

Mr M M P Wijesekara, Internal Auditor, with effect from 01 September.

Mr H A D Remy, Labourer, with effect from 01 November.

Mr J A Sunil Alexander, Labourer, with effect from 01 November.

Mrs M T Wimalawathie, Labourer, with effect from 01 November.

Mr W M E G Fernando, Labourer, with effect from 01 November.

Mr S M Somaratne, Labourer, with effect from 01 November.

Mr K M D Perera, Labourer, with effect from 01 November.

Mr S A C N Antony, Labourer, with effect from 01 November.

Mr S M Subasinghe, Labourer, with effect from 01 November.

Mr M A D M F Appuhamy, Labourer, with effect from 01 November.

3. REINSTATEMENTS

Mr W L D Fernando, Tractor Operator, Estates Management Division, reinstated on 01 June, effective from 27 December, 1978.

4. MUTUAL TRANSFER

Ms W A A M V M J K Dondeenu, Clerk/Typist, from CDA.

Mrs A M D Rodrigo, Clerk/Typist, Genetics & Plant Breeding Division, to CDA.

5. RETIREMENTS, RESIGNATIONS AND DEATHS

Retirements

Mr G L R Appuhamy, Labourer, Establishment Unit, with effect from 08 February.

Mr S M Podiappuhamy, Kangany, Estates Management Division, with effect from 11 February.

Mr N Ramasamy, Pollination Labourer, Genetics & Plant Breeding Division, with effect from 06 March.

Mr K K Michael Antony, Driver, Establishment Unit, with effect from 11 September.

Mr K W D de Silva, Senior Field Assistant, Soils & Plant Nutrition Division, with effect from 29 October.

Mr M P S Paris, Pollination Labourer, Genetics & Plant Breeding Division, with effect from 20 November.

Mr J D Ratnasekara, Clerk/Typist, Establishment Unit, with effect from 23 November.

Resignations

Mr K K G David, Electrician, Engineering Unit, with effect from 23 January.

Mr K P D Somapala, Watcher, Estates Management Division, with effect from 01 February.

Mr R H Bennet Silva, Head Clerk, Accounts Unit, with effect from 02 May.

Mr D G M Weerasinghe, Clerk/Typist, Accounts Unit, with effect from 05 June.

Dr (Miss) M R T Wickramaratne, Head/Genetics & Plant Breeding Division, with effect from 30 June.

Mr J M J Jayamanna, Field Attendant, Agronomy Division, with effect from 01 July.

Mr K M Punchibanda, Field Attendant, Agronomy Division, with effect from 01 July.

Mr P A D G A Appuhamy, Senior Technical Assistant, Soils & Plant Nutrition Division, with effect from 22 July.

Mr W M S Wijetunga, Clerk, Accounts Unit, with effect from 01 August.

Mr T Amarasekara, Technical Assistant, Soils & Plant Nutrition Division, with effect from 30 September.

Mr J A M Chandrasiri, Driver, Establishment Unit, with effect from 01 December.

Mr W G A Ratnasiri, Research Assistant, Genetics & Plant Breeding Division, with effect from 21 December.

Mr T R W Weralupitiya, Technical Assistant (Photography) Information Services Division, with effect from 31 December.

Deaths

Mr L D M Fernando, Senior Mechanic, Engineering Unit, on 02 January.

Mr B A L Mendis, Field Assistant, Estates Management Division, on 13 June.

Mr J M S N Appuhamy, Field Assistant, Estates Management Division, on 30 June.

Mr E A Remy, Field Attendant, Soils & Plant Nutrition Division, on 19 October.

6. VACATION OF POST

Mr T H G A G Perera, Accounting Assistant, with effect from 22 February.

7. OVERSEAS VISITS/TRAINING

Mrs S M Karunaratne, India, 22 - 28 January for **WORKSHOP ON BIOTECHNOLOGY AND ALLIED SCIENCE.**

Dr R Mahindapala, Thailand, 15 - 19 May, as an Observer/Resource person at the meeting of the **PERMANENT PANEL ON COCONUT TECHNOLOGY (COCOTECH).**

Mrs S M Karunaratne, Thailand, 15 - 19 May, as an Observer/Resource person at the meeting of the **PERMANENT PANEL ON COCONUT TECHNOLOGY (COCOTECH).**

Dr (Miss) M R T Wickramaratne, Thailand, 15 - 19 May, as an Observer/Resource person at the meeting of the **PERMANENT PANEL ON COCONUT TECHNOLOGY (COCOTECH)**.

Mrs W M U Fernando, U.K., three years from 01 June, for postgraduate training leading to Ph.D in **POPULATION GENETICS**

Mr M de S Liyanage, Malaysia, 04 - 10 June, for conference on **REGIONAL SYMPOSIUM OF RECENT DEVELOPMENT IN TREE PLANTATIONS IN THE TROPICS**

Mr M Jeganathan, Netherlands, 07 days from 30 July, for the **XI INTERNATIONAL PLANT NUTRITION COLLOQUIUM**.

Mr M J C Perera, Indonesia, 12 - 19 August, for conference on **INTEGRATED COCONUT INFORMATION SYSTEM FOR ASIA & PACIFIC REGION**.

Ms L K Periyapperuma, U.S.A., two years from 15 August, for postgraduate training leading to MS, in **TISSUE CULTURE**.

Mr U S Perera, India, 01 - 14 September, for training in **FERTILIZER USAGE**.

Mr T S G Pieris, Italy, 07 - 09 September, for conference on **STATISTICS FOR REPEATED MEASUREMENTS**.

Dr R Mahindapala, Singapore, 13 - 14 September, for a **MEETING OF RESEARCH MANAGERS IN COCONUT RESEARCH**.

Ms. C N K Rajapaksa, U.S.A., three years from 15 September, for postgraduate training leading to MSc in **ENTOMOLOGY**.

Mr L P Vidana Arachchi, Italy, 18 days from 09 October, for training in the **COLLEGE ON SOIL PHYSICS**.

Dr (Mrs) C Jayasekara, Malaysia, 32 days from 06 November, for conference on **ISOTOPES AND RADIATION TECHNIQUES IN SOIL/PLANT RESEARCH**.

Mr L P Vidana Arachchi, Malaysia, three years from 29 November, for postgraduate training in **SOIL PHYSICS**.

No-pay leave for employment abroad

Miss W E M Coonghe, Italy, for one year from 27 March.

Mr J K H V Perera, West Germany, for one year from 19 June.

Mr A C S Ibrahim, Saudi Arabia, for one year from 13 October.

Mr D M Jayakody, Sultanate of Oman, for one year from 20 October.

Mr G D George, Saudi Arabia, for one year from 08 December.

8. WELFARE

A. Financial Aid

1. **Gratuity** - Rs. 663,587.00 has been paid to employees as gratuity.
2. **Provident Fund** - The loans from the Provident Fund to employees amounted to Rs. 1,876,252.00
3. **Distress Loans** - Distress loans to employees amounted to Rs. 1,100,260.00
4. **Transport Loans** - Transport loans to employees amounted to Rs. 394,050.00
5. **Loans to Relieve Indebtedness** - Loans to relieve indebtedness to employees amounted to Rs. 136,000.00
6. **Medical Aid** - A sum of Rs. 304,595.00 has been contributed to the Medical Aid Scheme.

OTHER ACTIVITIES OF THE ADMINISTRATION DIVISION

Transport Section.

The Transport Section administered the drivers and upkeep of vehicles. The vehicle fleet at the end of the year was as follows:

Cars	06	Jeeps/Double Cabs	18
Vans	03	Lorries	06
Buses	03		

Accounts Unit

The usual accounting functions were satisfactorily carried out during the year.

Six trainees from the Technical College, Kuliypitiya and from the National Apprenticeship Board were trained during the year under review.

Three members of the staff was trained in application of computer for salary preparation.

Engineering Unit

The Engineering Unit continued to provide maintenance services for the Institute's buildings and other amenities. The civil and other works amounting to Rs. 708,392.86 were undertaken during the year. The expenditure incurred on Electricity and Water Supply Scheme at Bandirippuwa Estate and other Stations was Rs. 1,540,906.68. A sum of Rs. 1,090,113.89 was incurred for the maintenance of the vehicles while machinery upkeep cost Rs. 140,959.38. Some of the work undertaken were as follows:

1. Construction of Engineering Unit Office and Workshop.
2. Construction of Plant House for Plant Physiology Division.
3. Construction of Toilet for Estate Workmen at Bandirippuwa
4. Completion of Office and Workshop at Engineering Unit.
5. Security Grills & Doors for Engineering Unit Workshop.
6. Repairing the roof of the laboratory complex of the Soils & Plant Nutrition Division.