COCONUT RESEARCH INSTITUTE - REPORT FOR 1992

COCONUT RESEARCH BOARD

COCONUT RESEARCH INSTITUTE OF SRI LANKA

REPORT FOR 1992

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REPORT OF THE

COCONUT RESEARCH INSTITUTE

FOR 1992

Editors

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

M de S Liyanage, Ph D, M I Biol (S L)

THE COCONUT RESEARCH BOARD

Mr Naomal S Dias (*Chairman*)

Lt Col A Amarasekara - up to February

Mr J L Amaratunga

Mr D V Jayasooriya

Vidya Jyothi Dr C R Panabokke

Mr G P P N Perera

Mr A S Ranatunga

Vidya Jothi Mr P R Wijewardena

Mr J Alwis (*Ministry Representative*) - from September

Mrs M B Ekanayake (*Treasury Representative*)

COMMITTEES OF THE COCONUT RESEARCH BOARD

1. Research Committee

Mr Naomal S Dias (*Chairman*)
Mr T R Jayawardena (*JEDB*)
Mr K Karunanayake (*CCB*)
Vidya Jothi Dr C R Panabokke
Dr U Pethiyagoda
Mr A S Amaratunga
Vidya Jothi P R Wijewardena
Prof Y D A Senanayake
Dr R Mahindapala (*Director CRI*)

2. Adminstrative Committe

Mr Naomal S Dias (*Chairman*)
Mr J L Amaratunga*
Mr R M C Bandarnayake
Dr R Mahindapala
Mr S Vithanage - from August

* Mr Amaratunge chaired the first meeting in the absence of the Chairman.

3. Estates Committee

Mr J L Amaratunga (*Chairman*)
Mr G P P N Perera
Mr D V Jayasuriya
Mr B R T de Tissera
Dr R Mahindapal

CONTENTS

COCONUT RESEARCH INSTITUTE OF SRI LANKA

THE STAFF*

(as at 31 December, 1992)

DIRECTORATE

Director - R Mahindapala, B Sc; M Sc (Exon); Ph D (Exon); F I Biol (S L).

Acting Deputy Director (Research) - R Mahindapala, B Sc; M Sc (Exon); Ph D (Exon); F I Biol (S L).

Deputy Director (Administration and Finance) - D G Manamudali, B A; LICA

RESEARCH DIVISIONS

Agronomy Division

Head

M de S Liyanage, B Sc Agric; M Sc (New England); Ph D; M I Biol (SL)

Agronomist

D N S Fernando, B Sc Agric; Ph D (Reading)
H A J Gunathilake, B Sc Agric; Ph D (Wales)

Assistant Agronomists

K B Dassanayake, B Sc Agric
T G L G Gunasekera, B Sc Agric **
H P S Jayasundera, B Sc Agric **

Assistant Agricultural Economists

R A J R Perera, B Sc Agric **
M T N Fernando, B Sc Agric

Technical Assistants

H A Abeysoma
M H F G Ivan Appuhamy ***
M J I Costa
R Marasinghe
Mrs K C P Perera, B Sc
S D J N Subasinghe, Dip Ag.
A M U Wijeratne (To 31.07.92)

Lab & Field Assistants

D Amarasinghe
W S M A Fernando
E M Gunaratne Banda
M D V Saparamadu
D B Benet Silvan
W E J Tissera (To 15.06.92)

Senior Technical Assistant

M Bastian

Clerk Typist

A A D N Athauda ***

Genetics and Plant Breeding Division

Head

R R A Peries, B Sc Agric; Ph D (Qld)

Assistant Genetisists/ Plant Breeders

Mrs W M U Fernando, B Sc
Ph D (Birmingham)
J M D T Everard, B Sc, M Sc
A A F L K Perera, B Sc Agric

Lab and Field Assistants

W T H C Fernando
M Victor
T M W Peiris
M A Hemachandra
M H Dhanasena
P A D Milton Appuhamy

Technical Assistants

J D J Abeysekera
R B Attanayake
Mrs W B S Fernando
L M S R Jayathilake
M H L Padmasiri

Clerk

K P W Perera

Clerk/Typist

Miss I N Jayawardena

Soils and Plant Nutrition Division

Officer-in-Charge

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

Soil Scientist

Miss M B M N Dias, B Sc Agric, M Phil
Ph D (Qld)
L L W Somasiri B Sc; Ph D (Aberdeen);
C Chem; M I Chem C

Senior Technical Assistants

T W Fernando, L I Chem C
G D George
Miss S Periyathamby, N D S
Mrs N H R M de Silva, B Sc

Technical Assistants

E M A T Banda

Assistant Soil Scientists

Mrs M G F S Jayasundara, B Sc Agric **
N A Tennakoon, B Sc Agric; M. Phil **
L P Vidhana Arachchi, B Sc Agric **

Senior Lab and Field Assistants

K Murugiah
B C E Perera

Mrs S D H Bandara, B Sc
D P Panditharatne
U S S Perera
Miss J L J L Pinto
Miss G S Ranasinghe
R N Susantha
Miss M A Wasanthamala
Mrs D M D Wijebandara, BSc

Typist Clerk

Mrs H M W S Athauda

Crop Protection Division

Head

P A C R Perera, B Sc (Lond); M Sc (Lond); Ph D (Lond); D I C; M I Biol (S L)

Assistant Crop Protection Officers

Mrs L C P Fernando, B Sc Agric **
Mrs C N K Rajapaksa, B Sc Agric **
I Wickramananda, B Sc Agric
H T R Wijesekara, B Sc Agric; M Sc.

Senior Field Assistant

D M Jayakody

Technical Assistants

K A S Chandasiri
A H Norman
D C L Hapuarachchi
K F G Perera
Miss P H A P Siriwardena
S Prabath Manohar

Lab & Field Assistants

W E A Fernando
A S M Prefhalal
W W F Noel Fernando

Clerk

Mrs A Anula de Zoysa

Biometry Division

Head

D T Mathes, F I S (Lond); B Sc; Dip Stat (Vid); Dip. Bio (Reading)

Senior Field Assistant

E R Fernando

Senior Biometrician

T S G Peiris, B Sc; M Sc (Canterbury, NZ); F R S (UK)

Technical Assistants

H P de Zoysa, B Sc
J D J S Kularatne **

Lab and Field Assistants

W E R C Fernando
W B P Fernando
U T G Fernando
D T Fernandopulle
W K M K Herath
A Dasanayake
W M L G Fernando
J Wijedasa
A Wilson
F H A J R Silva

Tissue Culture Division

Officer-in-Charge

R R A Peries, B Sc Agric; Ph D (Qld)

Research Assistants

Mrs L K Weerakoon, B Sc **
Miss W N I S C Fernando, M Sc
Mrs V R M Kodikara Arachchi, B Sc Agric

Technical Assistants

Mrs C K A Gamage
E S Santha

Plant Physiology Division

Head

Mrs C Jayasekera, B Sc; Ph D (Qld)

Assistant Physiologists

N P A D Nainanayake, B Sc
Miss C S Ranasinghe, B Sc

Technical Assistants

Miss W P K K Fernando
Miss P S A de Saram
R D N Premasiri
L R S Silva

Information Services Division

Officer-in-Charge

P A Henry Nimal Appuhamy, B Sc Agric; M Sc (Reading)

Clerk/Typist

R A L C Fernando

Assistant Information Officer

J L J G Pinto

Coconut Information Centre & Library

Librarian/Project Leader

M J C Perera, ALA

Assistant Librarian

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

ADMINISTRATION

Deputy Director (Administration & Finance)

D G Manamudali, B A; LICA

Establishment Unit

Administrative Officer

P Daluwatta

Administrative Assistants

T Gunadasa
M Leelaratne, B A

Supplies Officer

P Premaratne, B A

Stenographers (English)

Mrs M P Premaratne
Mrs S Z Suhair

Supplies Assistant

W F T Fernando

Clerk/Typists

Mrs P C A Fernando

Secretary to the Chairman

Mrs T M H Fernando

Chief Clerk

Miss H D Mangalika, B A

Clerks

B M Dingiribandara
A I F Fernando
K P W Perera
Mrs M M M Fernando
Miss W S R Fernando
Miss Laxmi Jayathilake
Miss U I Gunasekera
Miss K P S Jayathilake
W A W Wijesuriya
Y H Wijesena

Record Keeper

I H Nelson

Internal Audit Unit

Internal Auditor

M M P Wijesekera, LICA; Dip B Mgt.; M A A T

Internal Audit Clerks

M R U Attanayake
Mrs M M J R Fernando
Mrs R D I Somasiri

Typist

Mrs W J M D M A Dias

Accounts Unit

Chief Accountant

R M G D Rajapakse

Accountant

D R C M Handalage

Accounting Assistant

A S Nanayakkara

Book Keepers

B M Jayathilakabanda
Mrs K M A Nonis
R D Sumanasiri
S M Sirisoma

Shroff

H B Thalgahagoda

Stenographer (E)

Miss A Herath

Clerk/Typists

Mrs A R S Hettiarchchi
Miss A A N P Kanthi
P A Nonis
Mrs J K F Perera
Mrs C M B I Salwatura

Clerk

Mrs C Munasinghe

N H R Sarathchandra

Store Keeper

M B Upali

Accounts Clerks

Miss A S M S Abeywickrema
Miss R H M Dilhani
E A P Edirisinghe
W P C Fernando

Engineering Unit

Resident Engineer

K N A S Perera, Dip (Mech Eng) T.

Foreman (Electrical)

M D Bernard Praxidus

Foreman (Mechanical)

M J M D S Jayawardena

Foreman (Buildings)

R M Dayaratne

Draughtsman

Mrs R M S Ratnayake

Clerk/Typists

Mrs K A P Chandani
J A N Thushari

Motor Mechanic

R M S Gamini Ratnayake

Estate Management Division

Manager

P S Liyanagama, B Sc Agric

Assistant Manager (Farms)

K P de Silva
A Thavaratnarajah

Bandirippuwa Estate

Superintendent

M R L A Perera

Clerk/Typists

Mrs N R Ayagama
W P R R Fernando
Mrs K A D N S Marian

Field Assistants

P P Jayasundara
J S Roberts

Supervisors

M J David
H H D B K Dissanayake

Field Officer

G B A Wijesekara

Field Assistant

W L B Silva

Ratmalagara Estate

Superintendent

G Vithanage

Field Officer

W M U Ratnayake

Isolated Seed Garden

Superintendent

S M Wijeratne Banda

Field Officer

D L J Nettasinghe

Pothukulama Research Station

Superintendent

D M Pathirana

Estate Clerk

B L Senaghosha

Walpita Estate

Officer-in-charge

Newton Gamage

M P W Fernando
M A Sunil Fernando

Clerk/Typist

H H J E Appuhamy

Supervisor

M P W Fernando

Estate Clerk

R P Victor

Supervisor

U C Hettiarachichi
A S Bimal Gihan Silva

Lab & Field Assistant

U V M Fernando

Supervisors

M Chandrasoma
T M Keerthiratne

Makandura Estate

Superintendent

L J C Perera

Supervisor

M S Perera

Maduruoya Seed Garden

Superindentent

A N Ekneligoda

Supervisors

W M P Weerasekara

R A Suwarnathilake

Minneriya Research and Demonstration Farm

Officer-in-Charge

I A N Hemasiri

Clerk/Typist

J A R Reginald

Passekudah Research and Demonstration Station

No staff.

AGRICULTURAL RESEARCH PROJECT

Project Coordinator

M Jeganathan M Phil

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* 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 FOR 1992

R Mahindapala, Ph D

1. GENERAL

A severe drought was once again experienced in the main coconut growing areas in the early part of 1992. This caused a significant reduction of crop island-wide in the latter half of 1992 and the decline will continue during first half of 1993.

Recurring droughts are causing much concern and are the principle factor for the wide fluctuation in cropping. The climate in some parts of the country, particularly in the northern areas of the coconut triangle, appears to be deteriorating and much difficulty and hardship are encountered in the establishment of coconut seedlings.

In the light of the above observations, the Coconut Research Institute (CRI) launched a timely study to demarcate lands suitable for coconut cultivation and to identify high potential areas. Much of the data on soils are already available and it is necessary to have land suitability maps prepared, considering the potential of the soils and climatic factors. These maps will provide a database for the extension service to implement government assistance programmes which can be ideally concentrated in the high potential areas so that the returns from investments could be maximized.

During the year, much of the coconut triangle was surveyed for soil types and the preparatory work on land suitability studies was completed. The results obtained so far give clear indications on the effect of soil type and climate on the performance of coconut. Indeed, some of the better soils in the drier parts of the country appear to be capable of sustaining coconut well and profitably.

These studies will also enable a critical review of the current recommendations on moisture conservation and other cultural practices. From the information available, it would appear that certain cultural practices can perhaps be confined to better soils and the recommendations in respect of soil moisture conservation can be based on the soil types. At the request of the Ministry of Coconut Industries and Crop Diversification, preparatory work was done to extend the land suitability mapping in all major coconut growing areas in the country.

The CRI continued to provide technical assistance to the estates sector and the services offered have become popular. This service has enabled the CRI to establish a close rapport with the estates sector.

The Inter-Institutional Research Programmes on Intercropping and Animal Husbandry funded by the Sri Lanka Council for Agricultural Research Policy (CARP), progressed well. The crop and farm models established in the farmers fields provided much-needed basic information on crop performance, land use and on economics of intercropping and animal husbandry.

The Makandura Seed Garden was once again affected by the drought during the early part of the year. Although nearly 200,000 seed nuts were produced during the year, it is likely that the crop in 1993 will be very much less consequent to the adverse effects of the drought.

The general agricultural conditions of the Maduru Oya Seed Garden were gradually improved and preliminary arrangements were made to provide a net-work of canals for irrigation of coconut.

The Isolated Seed Garden continued to perform well and its agricultural conditions were very satisfactory.

The other CRI properties, Bandirippuwa Estate, Ratmalagara Estate, Poththukulama Research Station and Walpita Estate continued to perform well and recorded high income consequent to the high coconut prices, realized during the latter part of the year.

The Passikudah Research & Demonstration Farm continued be out of control and could not be visited due to the disturbances in the area.

The Board decided to close down the Minneriya Research and Demonstration Farm as the majority of the experiments and other activities were completed. Non-availability of water at this farm continued to cause concern and was a serious constraint in continuing the activities.

All field experiments were conducted satisfactorily. The majority of these experiments were in the estates belonging to the Janatha Estate Development Board. Although the management of these estate was privatized during mid-1992, the CRI continued to conduct the experiments in these lands.

Once again, it is with great regret I report the lack of progress made by the authorities in resolving the salary anomalies which were created when the salaries were revised in January 1988. The undue delay experienced in this regard has been very disappointing and has caused much concern and dissatisfaction amongst the staff.

2. THE COCONUT RESEARCH BOARD

During the year the Board functioned under the Chairmanship of Mr Naomal S Dias and held 12 meetings (from 235th meeting to 246th meeting).

The membership and attendance at the meetings are as follows:

Mr Naomal S Dias (Chairman)	(attendance 12/12)
Vidya Jyothi Dr C R Panabokke	(attendance 06/12)
Vidya Jyothi Mr P R Wijewardena	(attendance 11/12)
Mr J L Amaratunga	(attendance 9/12)
Mr A S Ranatunga	(attendance 11/12)
Mr D V Jayasuriya	(attendance 11/12)
Mr G P P N Perera	(attendance 09/12)
Mrs M B Ekanayake * (Treasury Representative)	(attendance 08/12)
Mr J Alwis ** (Ministry Representative up to March)	(attendance 02/03)
Mr S Vithanage ** (Ministry Representative from April)	(attendance 08/08)
Mr S E Satharasinghe **	(attendance 0/12)

* Ex-officio Member

** Observer Member

All meetings of the Board excepting the 239 meeting were held at the CRI. One meeting (239) was held at the Coconut Development Authority, Narahenpita, Colombo 5. Several members of the Board visited Maduru Oya Seed Garden in June.

Dr R Mahindapala, Director, Coconut Research Institute continued to function as the Secretary to the Board.

3. COMMITTEES OF THE COCONUT RESEARCH INSTITUTE

3.1 The Research Committee

The Research Committee held three meetings and undertook an inspection tour on farming/cropping models.

Mr W L Bogtstra and Mr C C de Silva were appointed to the Research Committee as representatives of the Wayamba Plantations (Pvt) Ltd and Kurunegala Plantations (Pvt) Ltd for a period of one year with effect from 14

October and 17 November, 1992, respectively. These two Management Companies took over the management of JEDB estates in July.

Mr T R Jayawardena, who represented the JEDB in the Research Committee relinquished his position with the privatization of management of JEDB estates in July.

The membership of the Committee and attendance at meetings are as follows:

Mr Naomal S Dias (Chairman)	(attendance 2/3)
Vidya Jyothi P R Wijewardena	(attendance 2/3)
Dr U Pethiyagoda	(attendance 3/3)
Vidya Jyothi Dr C R Panabokke	(attendance 3/3)
Mr A S Ranatunga	(attendance 3/3)
Mr K Karunanayake (CCB)	(attendance 3/3)
Mr T R Jayawardena (JEDB)	(attendance 0/1)
Prof Y D A Senanayake	(attendance 2/3)
Mr W L Bogtstra	(attendance 1/1)
Mr C C de Silva	(No meetings held after appointment).

Eight members (NSD, PRW, UP, CRP, ASR, TRJ, YDAS, RM) participated in the inspection tour of crop/farming models in the NWP.

3.2 Administrative Committee

The Administrative Committee met four time during the year to consider matters referred to it by the Board and to advise the Board on certain administrative issues.

With the resignation of Mr R M C Bandaranayake from the Coconut Development Authority in early 1992, Mr G Bambaradeniya of the Ministry of Plantations Industries was appointed as a member of the Administrative Committee from August.

The membership and attendance of the Committee are as follows:

Mr Naomal S Dias (Chairman)	(attendance 4/4)
Mr J L Amaratunga	(attendance 4/4)
Mr R M C Bandaranayake	(attendance 0/1)

Mr S Vithanage	(attendance 3/4)
Dr R Mahindapala	(attendance 2/4)

Mr D G Manamudali, D D (A & F) continued to function as the Convenor and was present at all meetings.

3.3 Estates Committee

The Estates Committee was unable to have a meeting during the year. Mr B R T de Tissera who represented the JEDB, resigned in July with the privatization of the management of the JEDB estates.

The membership of the Committee was as follows:

Mr J L Amaratunga (Chairman)
Mr G P P N Perera
Mr D V Jayasuriya
Mr B R T de Tissera
Dr R Mahindapala

The Committee however, visited the Minneriya Research and Demonstration Farm on 12 October on a directive from the Coconut Research Board to examine the continuation of the activities of the farm in view of the shortage of water and due to completion of the mandated programme.

3.4 Other Statutory Committees

3.4.1 Provident Fund Committee

The Provident Fund Committee met regularly to attend to matters relating to the administration of the staff provident fund and disbursement of loans. Messrs Mr D T Mathes and D P Panditharatne were the members representatives in the committee while Mr R M G D Rajapakse functioned as the Board's nominee. Mr D G Manamudali continued to function as the Secretary.

The membership and attendance at the meetings are as follows:

Mr Naomal S Dias (Chairman)	(attendance 6/7)
Dr R Mahindapala	(attendance 4/7)
Mr D T Mathes	(attendance 6/7)
Mr D P Panditharatne	(attendance 4/7)

Mr R M G D Rajapaksa	(attendance 4/7)
Mr D G Manamudali (Secretary)	(attendance 7/7)

An interest rate of 20 % was declared for members for 1991.

3.4.2 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 which continued to provide relief and assistance to the members. Dr D N S Fernando and Mr M R L A Perera were the members nominees in the Board of Trustee. The Board's contribution to this scheme was Rs. 640,016.16.

The membership and attendance of meetings are as follows:

Dr R Mahindapala (Chairman)	(attendance 11/12)
Mr D G Manamudali	(attendance 11/12)
Dr D N S Fernando	(attendance 09/12)
Mr M R L A Perera	(attendance 12/12)
Mr P Daluwatte	(attendance 12/12)

The membership at the end of the year was 378.

The Medical Aid Scheme conducted a dental clinic for the members and their families on 21 November. Under a general health-care scheme, a sum of Rs. 56,147 was disbursed to the members mainly for the purchase of mosquito nets.

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 the improvement of water holding capacity and organic matter status in coconut soils, rehabilitation of low yielding palms, establishment and management of replantings/ under-plantings and coconut-based farming systems progressed satisfactorily. A total of 23 experiments were maintained during the year.

Work was intensified on the use of creeping and bush covers,

Pueraria phaseoloides and *Gliricidia* as bio-fertilizers and for improving fertility and moisture status of coconut soils. In *Gliricidia*, leaf biomass yield in seedlings was markedly higher (6 kg/tree/year) than that from cuttings (3 kg/tree/year) and pruning of trees at three and four-monthly intervals produced a higher leaf yield than at six-monthly intervals. Further, coconut palms benefitted from *Gliricidia sepium* as indicated by a 20-25% increase in nut yield at the end of three years. In a study on the establishment of coconut seedlings in the Dry Zone, palms in *G. sepium* planted plots performed better than those in *Leucaena* and control plots. In another trial, growth of palms was affected by the different management practices imposed on bush covers. Coconuts in the treatment with *Pueraria* cover and pitcher irrigation performed better than in other treatments. A study on Biological Nitrogen Fixation potential of *G. sepium* provenances demonstrated that exotic cultivar OFI 14/84 was capable of fixing as much as 308 kg N/ha while the local cultivar ranked second.

Mulberry continued to be a promising intercrop under coconut, giving a leaf yield of 12.5 MT/ha in the first year of production. Among multi-purpose tree species, *G. sepium* followed by *Leucaena leucocephala* and *Calliandra calothyrsus* performed well under coconut and showed no detrimental effects on the palm performance.

In coconut-based farming systems, intercropping with pepper, pineapple, banana and ginger and integration with cattle increased the productivity of coconut lands while improving the nut and copra yield. The economic viability of crop/farm models under different agro-climatic conditions was amply demonstrated in these models.

Work on agricultural economics progressed well with the assistance of the Consultant Agricultural Economist. Major studies during the year included the studies on economics of fertilizer use, moisture conservation and crop/farm models.

New experiments were set up to rehabilitate low yielding and 'LSD' palms in lateritic soil and improving the efficiency of fertilizer uptake by using freely available organic material.

4.2 Genetics & Plant Breeding Division

The pollination programme for the improvement of nut size and nut numbers in coconut at the Isolated Seed Garden was carried out successfully, and the first batch of seed was harvested in December. This material will be subjected to further evaluation, and will be used for planting at the Isolated Seed Garden (ISG).

The selection of coconut palm populations for physiological adaptation and their conservation in eco-banks was promoted. Several coconut populations worthy of conservation as *in situ* gene banks were identified.

Four out of five multi-locational cultivar evaluation trials were maintained successfully. The trial at Dambakande fell short of expectation under its present management by the Sri Lanka Army. *DG x T* hybrids in their 8th year gave as much as 10 kg of copra per palm in a deep latosol. The yield of *tall* cultivars ranged from 4 kg to 6 kg per palm over different sites.

Six progeny trials for the identification of elite palms for coconut breeding were maintained satisfactorily. In terms of early growth *T x DG* hybrid appeared to be generally superior to the others *T x T; T x SR; T (OP)* at every location.

Preliminary evaluation of the progeny trial at ISG indicated that there was a lack of genetic gain in the progenies resulting from crosses between selected parents at ISG. The environmental effects were much greater than the genetic effects.

Germplasm explorations were continued throughout the year. Several new accessions (Melsiripura, Horakelle, Keenakelle, Walahapitiya and Maliboda) were added to the existing collection. Purification of exotic material continued at Razeena Estate, Akuressa.

4.3 Soils and Plant Nutrition Division

Eleven field experiments and ten laboratory/glasshouse studies on nutritional, soil physical, and water use aspects of coconut were conducted satisfactorily. A new experiment on water balance studies in different coconut landscapes was started with a research grant from the CARP.

Studies on water use by weeds showed that most weeds transpire about 250 ml/plant/day when soil is at or close to field capacity under a pan evaporation of 5.2 mm/day. Nutrient balance of weeds showed that leaves and stems of most weeds have high levels of K and N. Results could be used to estimate possible loss of nutrients in a given population of weeds in coconut lands.

Studies showed significantly low bulk density in soils of intercropped coconut lands than in monocrop coconut lands. Aggregate mean weight diameter (MWD) and log-geometric mean diameter (LGMD) showed an increasing trend with the intensity of intercropping, showing better structure development. Wet sieving

results indicated that the highest stability was in coconut-cocoa combination and lowest for coconut monoculture. The estimated macropores using soil water retention relationship were also higher in intercropped treatments than for coconut monoculture.

Five laboratory extraction methods for soil P estimation were evaluated using 19 different soils collected from various locations in the coconut growing areas. Out of the five methods used for soil P estimation, only 2.5% acetic acid extraction could provide a reliable soil P index for soils in coconut growing areas.

Studies on rain-water interception by the coconut canopy showed that nitrogen levels in stem flow and canopy drippings were about 0.5-0.9 ppm and 1.2-2.9 ppm, respectively. Potassium levels in stem flow and canopy drippings ranged between 2-4 ppm and 10-50 ppm, respectively. Studies on the nutrient levels in ground water in coconut plantations indicated considerable leaching and accumulation of nutrients (N at 2.8-6.3 ppm and K at 2.9-6.6 ppm) in ground water after monsoonal rains, even in relatively flat lands with very low run-off. In contrast, the nutrient levels in ground water were higher in sloping lands.

In experiments on the use of coir dust as a soil ameliorant, application at the rates of 7,000 - 22,000 kg of coir dust/ha was found to be inadequate to provide significant response in coconut yield and copra content.

The computer model for the Differential Fertilizer Recommendation (DFR) was further refined to include soil type and agro-climate as input variables for cost-effective and better fertilizer use efficiency in the DFR package. The model differentiates the agro-climates into two soil water regimes ie: water limiting and water non-limiting. Plantations in water limiting environments require less nitrogen and dolomite, while it is necessary to supply phosphorous in a soluble form such as saphos phosphate or triple super phosphate. Plantations in water non-limiting conditions require high rates of nitrogen, dolomite and muriate of potash.

During the year, DFR service was provided to 215 large coconut estates (> 50 ac) covering an area of about 7,100 ha. Studies on nutrient mapping showed that about 50% of the coconut plantations were deficient in potassium (K) and magnesium (Mg). Deficiencies of sulphur (S), chlorine (Cl) and sodium (Na) were noted in several coconut estates, and these were provided with corrective fertilizer recommendations.

The DFR model was used to propose a general fertilizer mixture for King Coconut (*Thambili*) [*Cocos nucifera var. aurantiaca*] and for palms in tapping.

The progress of the FAO Fertilizer Project was reviewed in August by a Review Mission which examined the preliminary analysis of yield and nutrient data. This Mission recognized the importance of the Location-Specific Fertilizer Recommendations (LSFR) for the small-holder sector which is being tested as a new treatment in the fertilizer demonstration plots. Analytical and yield data collected under the project were analyzed and the final report was prepared. The nutritional sufficiency ranges for medium-yielding coconut palms (ie: small-holder sector) were reviewed vis-a-vis the Value Cost Ratios (VCR).

A new low-cost "Ball-tap" was tested for use in irrigation and other water reticulation systems. The Ball-tap is made up of a PVC tube with an internal spherical ball such as a glass marble as the valve which could be pushed in to open the flow of water. The Ball-tap was free of leaks, maintenance-free and could be made locally. In the underground reticulation network of the irrigation systems, conduit pipes, which were used instead of PVC pipes, did not show any signs of deterioration indicating their usefulness.

In experiments on placement of fertilizer, preliminary results indicated the benefits of axil application of fertilizer to correct nutritional deficiencies, particularly magnesium and potassium, in coconut.

A Land Suitability Mapping Project was launched with the main objective of identifying high potential areas for coconut cultivation, to be used by the extension staff for implementing Government's assistance schemes. Soil surveys in the topo-sheets of Chilaw, Battulu Oya, Puttalam, Kalpitiya and Dandagamuwa were completed and preliminary work on mapping completed.

4.4 Crop Protection Division

Field studies on the effect of leaf nutrient content on susceptibility to coconut caterpillar attack were continued. A significant differences in the percent dry weight of potassium was observed between treatments and bioassay studies are in progress.

The collaborative research project on pesticides from Sri Lankan plants for the control of coconut pests was concluded. Important findings of this project were that, the Dichloromethane extract of the fruit/flesh of *Melia dubia* recorded significant insecticidal activity while near significant activity was recorded with the extracts from *Phyllanthus debilis* and *Swietenia mahogani*.

An evaluation of the insecticides, Monocrotophos, Methamidophos, Carbofuran and Carbosulfan (controlled release granules) for the control of black

beetle control was in progress.

Studies on *Baculovirus oryctes* in the biological control of black beetle revealed that the effectiveness of the virus could last for about four to six weeks under field conditions.

Laboratory studies on the control of rats in coconut plantations, using specially designed cages, showed that a 30 cm wide polythene band was as effective as the currently recommended GI band when used as a barrier on coconut palms. Field evaluations are in progress.

Studies on the effect of planting method on susceptibility to termite attack showed that termite attack was heaviest when the seed nut was completely covered by soil and least with vertical planting, when half the seed nut was covered by soil. Evaluation of application methodology in the use of Chlorpyrifos, Carbosulfan and carbofuran in termite control were in progress.

4.5 Plant Physiology Division

During the year studies on drought screening and water-use efficiency of coconut received high priority. In an attempt to develop more accurate selection criteria for drought screening, stable carbon isotope (^{13}C) discrimination of coconut and its relationship to the transpiration efficiency was investigated with assistance received from the International Atomic Energy Agency, Vienna. This technique is novel in coconut and can perhaps be used to screen coconut palms for high water-use efficiency. Refinements to the technique were in progress for its practical application in the coconut breeding programmes relating to high water-use efficiency.

The project funded by the Canadian International Development Agency (CIDA) on the "Effects of nitrogen, potassium and chlorine on drought tolerant characters of coconut" was terminated this year. Concurrently, equipment worth Rs. 1.8 million received under this project were permanently transferred to the institute. Importance of potassium and chlorine for gaseous exchange and water relations of coconut was evident from the experiments conducted under this project. Results also revealed the deleterious effects of high chlorine levels in coconut leaf, which tends to reduce CO_2 assimilation and growth of coconut seedlings.

Evaluation of growth performance of amputated and ordinary nursery-raised seedlings in the field revealed that amputated seedlings grew faster and attained a vigour similar to ordinary nursery-raised seedlings, about 16 months after planting in the field.

The experiments on optimum canopy and root size for maximum yield were continued with satisfactory progress. Studies on the assimilation of CO_2 were continued throughout the year and the results indicated that the total canopy photosynthesis is significantly reduced during rain-free periods, when soil water availability was limiting and leaf-to-air vapour pressure deficit increased. Extreme climatic conditions which prevailed during the year provided an excellent opportunity to study the effects of climatic variations on CO_2 assimilation and water relations of coconut palms. With the use of canopy dry matter production data, light-use efficiency of a 12-year-old coconut plantation was estimated to be 2.4%, which is lower than other C_3 crops.

In an attempt to understand carbon budget and assimilate partitioning in coconut, ^{14}C labelling studies were continued on bearing coconut palms. Analysis of ^{14}C activity distribution revealed that more labelled assimilate was partitioned into the developing nuts in the fourth bunch from the youngest. Developing nuts in that bunch were found to be in the rapid endosperm and kernel filling stage. Distribution of ^{14}C in the root system showed more activity in tertiary and fine roots at 1 - 1.5 m radius away from the bole.

4.6 Tissue Culture Division

In experiments on clonal propagation of coconut, immature zygotic embryo explants consistently produced callus and somatic embryos. Leaf explants showed increased somatic embryogenesis. Germination of these somatic embryos from immature zygotic embryos and leaves leading to complete plant formation was still inconsistent.

Root cultures were initiated to select a basic medium for callogenesis from root explants.

The investigations on optimized rhysogenesis indicated a beneficial effect of salt stress on rhysogenesis. Further experiments were undertaken to improve the conditions for rhysogenesis.

The experiment on the development of a screening method for drought tolerant coconut germplasm by *in vitro* methods was extended to compare the response of putative drought tolerant parental palms and their open pollinated progeny to water deficit.

The effect of sodium chloride, coconut water and low-cost chemicals such as fertilizer grade potassium chloride and house-hold sugar on embryo cultured plants was tested.

A programme was launched to raise embryo-cultured seedlings of *dikiri pol* (Makapuno type), with a view to building up a breeders collection initially.

4.7 Biometry Division

The Division continued to assist the Research Division in designing field experiments, analysis and interpretation of data.

Rainfall distribution at different stations was subjected to probability and trend analysis.

The calibration trial recorded a steady decline in yield from the second pick onwards. The year showed a decrease in yield by 9.9% over 1991. The first three picks counted 71% of total year's crop. A 12.2% reduction in copra yield per hectare was shown.

Assistance was provided to various Divisions on the use of application of data base packages and statistical packages. In addition, training programmes were conducted for staff at various levels. The areas covered were, Introduction to Computers and operating systems, spread sheet packages, DBASE and the use of word processing package.

The three agri-meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained satisfactorily. At all three stations, first three months of the year experienced dry conditions.

4.8 Multi-disciplinary Projects

4.8.1 *Premature Decline of Palms*

Experiments conducted to determine possible cause/s for Leaf Scorch Decline (LSD) were continued. Results obtained so far in CO_2 assimilation and from analytical studies of secondary metabolites were inconsistent, possibly due to small sample size. The lack of sufficient number of palms within the same category of severity of symptoms has become one of the major limitations in these studies.

Root densities of healthy and LSD palms at different stages of severity were compared. The number of active live roots in LSD-affected palms was lower than in healthy trees. Also, the number of active live roots decreased with increasing severity of symptoms.

In view of the possibility that poor root systems may not be producing sufficient growth hormones, experiments were commenced on the use of cytokinin to change the LSD status of affected palms.

Studies on CO_2 assimilation of LSD-affected palms were continued. However, palm to palm variations within the same category of affected palms were high, and the experiments will have to be repeated with a larger sample.

Presence of higher levels of total polyphenolic compounds has been observed in LSD-affected palms. Withered leaves in the lower whorls gave higher levels of polyphenolic compounds. Higher content of flavonol group polyphenols was found in upper whorls with healthy leaves. However, the results are yet inconclusive.

4.8.2 *Immature Nut Fall*

Experiments conducted so far have given an insight of gas exchange characteristics during CO_2 assimilation, assimilate partitioning and 'source-sink' relationship in coconut.

Studies on $^{14}CO_2$ assimilation of coconut palms revealed that partitioning of current assimilates depends on the activeness of the sink. The fourth and fifth bunches from the youngest, which were in the active endosperm filling and kernel formation stage, received more labelled assimilates, compared to the younger bunches below the fourth bunch. Thus, limited availability of current assimilates for young developing bunches may be one reason for immature nut fall.

Three major factors, viz. disease, pest damage and mechanical causes were identified as predominant causes of button nut shedding. *Fusarium spp.* were recorded from nuts showing symptoms of disease. Insects feeding on immature nuts were mealy bugs, scale insects, mites, *Meredolus sp.* and *Cyclodes omma*. Insect damage was comparatively high in the first four months after fruit set. Mature nuts (five to six months) were shed mainly because of rat and bat damage.

Studies on the insects associated with the coconut inflorescence were continued and the results confirmed the earlier observations that the Diptera were the major insect group visiting the coconut inflorescence.

4.8.3 *Work on Earthworms*

Laboratory studies on the biology of earthworms were carried out

using clay, loam and gravel soils with humus and moisture content varying from 10 - 40% and 9 - 28%, respectively. These studies showed that under favourable conditions, earthworms lived for over two years and that clay soils with humus and moisture content of 20 and 28%, respectively were the most favourable of the media tested. These studies also showed that the reproductive phase of earthworms was more pronounced when they were about 180 days old and the number of offspring produced was significantly greater ($P < 0.001$) in gravel soils than in the other soil types, under all conditions of humus and moisture content tested.

4.9 Estates Management Division

The Division managed three seed gardens, two research and demonstration farms and four estates. In general, agricultural conditions in the properties were maintained in good order. This year too, special attention was paid for moisture conservation practices and mulching. The agricultural conditions particularly at Maduru Oya Seed Garden and Bandirippuwa Estate were improved. The properties recorded a very high profit consequent to the high prices obtained for nuts during the latter half of the year.

Special attention was also paid in regard to the nutritional standards and moisture conservation in the properties. Every attempt was made to correct nutritional disorders and imbalances.

Rainfall during the first quarter of the year was very disappointing with prolonged droughts up to even three (03) months at some of the stations. In general all properties excepting Walpita Estate, Makandura Seed Garden and Maduru Oya Seed Garden received a higher rainfall than in 1991. However, the number of wet days was significantly lower in all properties. The worst affected property was Makandura Seed Garden, where 24 bearing palms and 62 seedlings succumbed to the drought. There was considerable immature nut fall and shedding of fronds too.

As at the end of the year 281 ha (47 %) of all the properties (total of 600 ha) were under immature coconut. In the developed properties (Bandirippuwa Estate, Ratmalagara Estate, Poththukulama Research Station, Walpita Estate and Isolated Seed Garden), 36 % of the area were under immature coconut. During the year a total of 8.7 ha were replanted.

All developed properties excepting Walpita Estate recorded much improved crops compared with those of 1990 and 1991. This is mainly attributed to the improved rainfall experienced in 1991. The Isolated Seed Garden recorded a 200% increase in crop whereas Poththukulama Research Station, Ratmalagara

Estate and Bandirippuwa Estate recorded increases of 156%, 38%, 1%, respectively. On the other hand, Walpita Estate recorded a decrease of crop by 18%. The overall increase in crop in the properties was 82 %.

The agricultural conditions of Maduru Oya Seed Garden were much improved and a total of 12,384 nuts were harvested, from the blocks planted in 1986.

Experimental work at the Minneriya Research & Demonstration Farm, established for experimentation on dry zone farming with coconut, was completed. Availability of adequate water for house-hold consumption and for agricultural activities continued to cause concern, particularly since the irrigation canals did not have any water during the extended dry period. The Coconut Research Board, having considered the termination of experiments and other constraints, decided to close down the farm in early 1993.

Passikudah Research and Demonstration Farm at Kalkudah continued to be out of control due to the continued disturbances in the area. The property could not be visited by management staff and the general security situation in the area remained sensitive and did not improve to recommence operations in this farm.

The poly-bagged seedlings at Ratmalagara Estate continued to be a popular source for high quality seedlings. Although nearly 6,900 seedlings were sold, the demand was much higher.

Planting fuel wood trees and nitrogen-fixing trees (NFT's) in the properties was intensified. Over 45,000 seedlings of various types of trees were planted during the year. Nurseries were established to raise NFT plants required for the CRI estates.

During the 'tree planting campaign' a large number of plants were planted in the CRI properties, with the active participation of all employees.

The yields obtained during the last four years from the Board's properties are given in Table 1.

Table 1. *Perfromance of Estates and Seed Gardens*

Estate/Seed Garden	Year	Rainfall(mm)	Wet Days	Crop (Nuts)
ISG	1989	850.2	73	1,225,700
	1990	1180.1	75	458,133
	1991	1380.2	101	393,958
	1992	1696.4	87	1,180,460
PRS	1989	859.3	50	801,501
	1990	1213.4	56	435,712
	1991	1337.3	81	239,248
	1992	1498.9	57	613,875
RE	1989	1442.9	118	634,929
	1990	1465.5	86	550,359
	1991	1460.6	102	242,772
	1992	1867.9	86	335,062
BE	1989	1693.0	124	512,595
	1990	1911.5	115	535,644
	1991	1676.2	129	408,894
	1992	2053.7	114	412,956
MSG	1989	1582.1	99	----
	1990	2100.9	98	17468
	1991	2160.8	114	94,322
	1992	2143.8	108	168,783
WE	1989	2047.8	99	192,474
	1990	1896.2	95	166,671
	1991	2235.3	99	190,230
	1992	2139.8	98	156,242
MDF	1989	1281.3	50	4,335
	1990	1732.6	68	9,053
	1991	1250.8	56	18,580
	1992	1290.3	47	8,250
MOSG	1989	1371.6	74	----
	1990	1823.3	68	12
	1991	1889.5	76	1,075
	1992	1519.2	65	12,324

(ISG - Isolated Seed Garden; PRS - Pothukulama Research Station; RE - Ratmalagara Estate; BE - Bandiripuwa Estate; MSG - Makandura Seed Garden; WE - Walpita Estate; MDF - Minneriya Farm; MOSG - Maduru Oya Seed Garden)

4.10 Information Services Division, Library and the Coconut Information Centre

The Information Services Division continued to provide to the grower advisory assistance and technical information based on the recommendations of the CRI. A large number of coconut estates and small-holdings was inspected on request and advice given.

During the year several training programmes were conducted for students of different organizations and for middle-level management staff of coconut estates. A number of study tours was organized for groups of students and officials from higher educational institutions and different Departments.

One issue of *Pol Pawath* (Vol. 13, No 1/2), *Coconut Bulletin* (Vol. 7, No 1/2) and *COCOS* (Vol. 8) were published during the year. The Sinhala version of the guide-book on Coconut Cultivation ('Pol Wagawa') was also published during the year. Due to heavy demand, the guide-book on Coconut Cultivation was reprinted.

The Division coordinated the Coconut Day organized by the Institute for the second time at Bandirippuwa Estate. A number of research discussions, field days and workshops were also coordinated by the Division. The Institute participated in the "Gam Udawa" exhibition, Cambrian Exhibition at the Prince of Wales College, Moratuwa and "Environlanka '92" at the BMICH.

The Library resumed its normal activities during the year when re-furbishing was completed, after nearly an year. Acquisitioning and processing of material continued satisfactorily and the users were provided with uninterrupted services.

The activities of the Coconut Information Centre (CIC) continued on database management and servicing the clients. Services undertaken on behalf of the Asian and Pacific Coconut Community/IDRC Integrated Coconut Information Project continued satisfactorily.

External services undertaken by the Library in coordinating the activities of the AGRINET were well accomplished. In addition to the normal coordinating activities, a successful residential training programme for Librarians in the member libraries and a user seminar for the Southern region were conducted.

4.11 Administration Division

The internal promotions due in 1992 were effected, and the Administration Report for 1990 was submitted to the Parliament together with the annual accounts and the Auditor General's report which was only received during the early part of 1992.

The normal welfare activities were continued. Employer-employee relations were cordially maintained. It is however very unfortunate that the higher authorities failed to resolve some irksome outstanding salary anomalies.

The budgeted estimates for the year was Rs. 58.184 million, made up of Rs. 46.184 million as Recurrent Expenditure and Rs. 12 million as Capital Expenditure. The total revenue (excluding transport) for the year was Rs. 11.184 million. The Government grant was Rs. 47 million.

5. OUTSIDE FUNDED PROJECTS

5.1 Agricultural Research Project (ARP)

The Agricultural Research Project (ARP), funded by the World Bank and administered by the Ministry of Agricultural Development and Research continued its activities on the development of infrastructural facilities at the CRI. The improvements to the auditorium (complete with furniture) and renovations to the guest house were completed. The construction of an amenities building, a screen house, and six quarters were also completed. The manpower development programme continued satisfactorily. One officer completed the postgraduate programme overseas while three other officers were awarded scholarships to read for M Phil (two overseas and one locally).

The Project continued to provide equipment, spares for equipment and library books. During the year, it provided two vehicles. It also provided assistance for the conduct of extension activities.

5.2 Other Projects

The International Atomic Energy Agency (IAEA) provided two research grants. The Agronomy project funded by the Canadian International Development Agency (CIDA) was terminated in mid-1992. The fertilizer project for small-holders, funded by the FAO, progressed satisfactorily.

The Inter-Institutional Research Programme (IIRP) on Coconut Intercropping with the participation of the Coconut Research Institute, Department of Agriculture (Makandura Research Centre), Veterinary Research Institute, Department of Export Agriculture and the University of Ruhuna progressed satisfactorily with regular project monitoring reviews. The monitoring team also visited the field sites.

The CARP, under its Contract Research Programme, awarded three research grants during the year.

6. EXTENSION ACTIVITIES

The CRI conducted a very successful and much-appreciated 'Coconut Day' on 12 August at Bandirippuwa Estate on the theme "More Profits from Coconut Lands". About 3,000 persons visited the exhibition.

A Field Day was conducted at Rathmalagara Estate mainly for the extension staff of the CCB. A Workshop on Weed Management was also held for the benefit of extension staff.

The CRI participated in the "Gam Udawa" exhibition held at Buttala and at exhibitions organized by the Prince of Wales College, Moratuwa in April and the Ministry of Environment held in Colombo in December.

During the year, several training programmes were conducted. The main programme was for a batch of middle-level estate management staff.

The Institute undertook a diagnostic survey in the major coconut growing districts of Puttalam, Kurunegala and Gampaha and in four coconut growing districts in the Southern Province, namely, Kalutara, Galle, Matara and Hambantota. The data were being analyzed as at the end of the year.

7. VISITORS

The important visitors to the Institute included the following:

Dr R K Arora	-	IBPGR
Dr G Blaak	-	Food and Agricultural Organization (FAO) Rome
Mr W L Bogtstra	-	Chilaw Plantations (Pvt) Ltd.
Professor M K V Carr	-	Silsoe College, UK

Dr Susan Carr	-	Open University UK
Dr Phillip M Chalk	-	University of Melbourne
Mr E M DE Zoysa	-	Chilaw Plantations (Pvt) Ltd
Professor D L Deb	-	IARI, New Delhi
Dr Suki Devarajan	-	CIDA, Colombo
Dr Charles A Fewson	-	University of Glasgow, UK
Mr Galeotti Giammotto	-	Italy
Mr Hugh C Harris	-	IBPGR
Dr HO Thian Hua	-	CABI
Dr H Joachim holler	-	GTZ Consultant
Dr Kit Howells	-	CABI
Hon. Rupa Karunatilaka	-	Minister of Plantation Industries
Dr D Kirtisinghe	-	Agricultural Research Project
Ms Beaudoin Laurance	-	CIRAD, France
Mr D Y Liyanage	-	Secretary, Ministry of Coconut Industries & Crop Diversification
Mr Barry J Ryan	-	Nestle (Lanka) Ltd., Colombo
Dr Kenneth W Riley	-	IBPGR
Mr Gerhaz Schweizer	-	Germany
Dr Ivar Serejski	-	World Bank
Mr J P Snell	-	FAO, Colombo.
Dr John D Shortridge	-	CABI
Dr Tshitila	-	Bhutan
Mrs Joyce M Turk	-	USAID
Dr Keith Valentine	-	CIDA, Canada
Mr C Wijetunge	-	Nestle (Lanka) Ltd., Colombo
Dr Ian M White	-	Commonwealth Institute of Entomology
Mr W L Weerakoon	-	Director, Youth Rehabilitation
Dr D T Wettasinghe	-	Sri Lanka Council for Agricultural Research Policy, Colombo

8. ACKNOWLEDGEMENTS

The assistance of the staff of the Coconut Research Institute in the implementatior of the programme of work is gratefully acknowledged. Some field staff had to undergo considerable hardship in data collection, field supervision etc. Their service is deeply appreciated.

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

The assistance of the following organizations is also acknowledged.

The Agricultural Research Project of the Ministry of Agricultural Research and Development
The Australian Development Assistance Bureau
The British Council and the Overseas Development Administration
The Coconut Development Authority
The Commonwealth Agricultural Bureau International
The Sri Lanka Council for Agricultural Research Policy
The Food and Agriculture Organization
The International Atomic Energy Agency
Janatha Estates Development Board
The Ministry of Coconut Industries and Crop Diversification
The Ministry of Plantation Industries
The Natural Resources, Energy and Science Authority of Sri Lanka
The United States Agency for International Development
The Asian and Pacific Coconut Community

REPORT OF THE AGRONOMY DIVISION - 1992

Head - M de S Liyanage, Ph D

1. GENERAL

Studies on the management of creeping covers, tree legumes as a bio-fertilizer and on the improvement of soil fertility and moisture status in coconut lands continued to be a priority area in the research programme. A greater emphasis was also given to on-farm research projects in different agro-climatic zones, which provided a good opportunity for the staff to interact with farmer's and study their problems. A field survey was conducted in the Wet and Wet Intermediate Zones of the 'Coconut Triangle', to assess the impact of monocropping and intercropping of coconuts on land value.

The International Atomic Energy Agency (IAEA) in Vienna continued to support the project on Biological Nitrogen Fixation (BNF) studies in tree legumes. The Sri Lanka Council for Agricultural Research Policy (CARP) provided financial assistance for several on-going and new adaptive research trials and another project for screening medicinal plants under coconut in the Wet Zone.

Dr P Abeygunawardena was appointed as the Consultant in Agricultural Economics for the farming system research programme.

2. RESEARCH PROJECTS

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

Experiment 1.10: Effect of three management practices on the performance of *Pueraria phaseoloides* and their effects on coconut production - 1992

Experiment 1.10.1: Saddhatissa Estate, Divulapitiya (Wet Zone, Lateritic Soil) - 1992

The following treatments were imposed on the cover crop *P. phaseoloides*, to compare its performance under different management practices and its effect on coconut production.

T_1 - *Pueraria* lopped and applied to coconut palms

T_2 - *Pueraria* slashed to control excessive growth
T_3 - Light harrowing of Pueraria
T_4 - Coconut only (control)

Records on nut yields and on the performance of the cover were maintained during the year.

The experiment is in progress.

D N S Fernando, H P S Jayasundara and K C P Perera

Experiment 1.10.2: Pothukulama Research Station, Pallama (Dry Intermediate Zone, Sandy loam soil) - 1992

The same treatments as above, were imposedon *P. phaseoloides* during the year. Records on nut yield and on the performance of the cover were maintained.

The experiment is in progress.

D N S Fernando, H P S Jayasundara and H A Abeysoma

Experiment 1.11: Maximization of biomass production of Gliricidia sepium under coconut Ratmalagara Estate, Madampe - 1989

During the year, the second pruning cycle was completed to determine biomass production of *Gliricidia sepium.* There was a marked difference in leaf biomass yield of seedlings and cuttings and between pruning intervals. Leaf biomass yield of trees raised from seedlings was markedly higher (6.6-4.2 kg/tree/year) than those from cuttings (3.4-4.8 kg/tree/year). In both seedlings and cuttings, trees pruned at three and four monthly intervals produced a higher leaf yield than those pruned at 6 monthly intervals. The lower leaf biomass at 6 monthly cut was due mainly to the higher wood matter production (2.5-2.7 kg/tree/year)

Records on nut yield were maintained during the year. Palms in *Gliricidia* plots produced a mean yield of 68-70 nuts/palm/year whereas those in control plots produced only 58 nuts/palm/year, thus showing a 20-25% increase at the end of third year after planting.

The experiment is in progress.

M de S Liyanage and R Marasinghe

PROJECT 2: REHABILITATION OF LOW - YIELDING PLANTATIONS

Experiment 2.2: Effect of cultural operations designed to induce root formation on rehabilitation of low yielding plantations

Experiment 2.2.3: Lateritic Gravel Soil - Ratmalagara Estate, Madampe - 1992

Based on the results from two previous experiments (Expts. 2.2.1 and 2.2.2), a new experiment was set up to select suitable organic materials to improve new root formation of low yielding palms in Lateritic Gravel Soil.

Quarter circle trenches of 60 cm deep x 30 cm wide were cut either at 30 cm or 60 cm away from the base of the palm. The trenches were filled with different materials mixed with loamy sand at 1:1 ratio. The following treatments were imposed.

T_1	-	Control (recommended practices only)
T_2	-	Trenches at 30 cm away filled with green manure
T_3	-	Trenches at 30 cm away filled with cow dung
T_4	-	Trenches at 30 cm away filled with coir dust
T_5	-	Trenches at 30 cm away filled with top soil
T_6	-	Trenches at 60 cm away filled with green manure
T_7	-	Trenches at 60 cm away filled with cow dung
T_8	-	Trenches at 60 cm away filled with coir dust
T_9	-	Trenches at 60 cm away filled with top soil

Collection of data on growth performance of coconut commenced during the year.

The experiment is in progress.

D N S Fernando, T G L G Gunasekara and K C P Perera

PROJECT 3: STUDIES ON THE ESTABLISHMENT AND MANAGEMENT OF NEW PLANTINGS/REPLANTINGS

Experiment 3.3: Development of suitable cropping systems to increase the productivity of coconut lands in new plantings/replantings in the Dry Zone. Pothukulama Research Station, Pallama - 1990

Coconut palms in *Gliricidia* plots showed better growth, in terms of stem girth (52-67 cm) compared with those in *Leucaena* and control plots (42-43 cm), two years after establishment. But there was no marked change in leaf production between treatments. Both *Gliricidia* and *Leucaena* were pruned twice during the year, which produced an estimated green matter yield of 31.86 t/ha in both species. In addition to inorganic fertilizer, palms in *Gliricidia* and *Leucaena* plots. 70 kg green matter/year were applied too.

Planting of *Cassava* in the alley between *Gliricidia* and *Leucaena* hedgerows was completed during October/November rainfall ('Maha') season.

The experiment is in progress.

M de S Liyanage, H A J Gunathilake and H A Abeysoma

Experiment 3.4: Effects of management practices on the establishment and growth of coconut seedlings in the Dry Zone. Pothukulama Research Station, Pallama - 1990

Growth of coconut palms in terms of basal girth and leaf production was improved by different management practices compared with those in control plots. Among these, palms treated with *P. phaseoloides* cover followed by pitcher irrigation performed better than others. This could be attributed at least in part to the high soil moisture content and less weed growth in these plots.

Gliricidia trees and *Pueraria* cover were lopped twice during the year which produced a green matter yield of 860 kg/plot and 74 kg/plot, respectively. During the year, palms in *Gliricidia*, cover cropped and irrigated plots were applied with 96 kg, 16 kg loppings and 55 liters of water/palm, respectively.

The experiment is in progress.

M de S Liyanage and H A Abeysoma

Experiment 3.5: Study the feasibility of coconut/cashew mixed cropping in the Dry Zone, Kamandaluwa Estate, Andigama - 1991

The establishment and performance of both crops, coconut and cashew in the five crop models are satisfactory.

A row of nitrogen fixing trees (*G. sepium* and *Acacia auriculiformis* alternately) was established in the avenue between coconut and cashew rows, to suppress weeds and conserve soil moisture by providing shade.

The experiment is in progress.

H A J Gunathilake, M de S Liyanage and M J I Costa

PROJECT 4: STUDIED ON FIELD MANAGEMENT SYSTEMS

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

During the year, production of grass/legume mixture and *Leucaena* was poor due to the dry weather conditions experienced during the first quarter and due to overgrazing by cattle. As a result, cattle had to be fed mainly with urea - treated rice straw and *Gliricidia* leaf. During the year, the system produced 1119 liters of milk and the average milk production during the experimental period was 1624 liters/year.

In the integrated system, nut and copra yield of palms were not significantly different to those in the control plots (Table 1).

Table 1. *Comparison of nut yield and copra production of the coconut/cattle integrated system*

Year	System		Control	
	Nuts (ha/y)	Copra (kg/ha/y)	Nuts (ha/y)	Copra (kg/ha/y)
1986	14360	27.1	15760	3041
1987	12200	2098	12400	2195
1988	10360	2092	10800	2182
1989	17680	3554	16786	3525
1990	17200	3320	16424	3252
1991	9525	1505	7600	1208
1992	14560	2592	15240	2804
Mean	13698	2562	13572	2601

The experiment was terminated.

D N S Fernando, H P S Jayasundara and R Marasinghe

Experiment 4.2.3: On farm crop models in the Wet and Wet Intermediate Zone of Coconut Triangle - 1987

During the year, 11 existing crop models were maintained and 10 new crop models were established, with funds available from the Council for Agricultural Research Policy.

Records on agronomic and economic data from existing models were maintained. Of the perennial intercrops, pepper performed well and produced 800 g black pepper/vine. Preparation of a report based on socio-economic data is in progress. The area planted with cash crops such as ginger, banana, pineapple and cassava was expanded to generate an additional income to the farmer. Nut yield records show that there was no detrimental effect on coconut due to cropping intensity.

Out of the ten new models, nine crop/farm models were established during the year.

The experiment is in progress.

H A J Gunathilaka, M de S Liyanage, M T N Fernando and S D J N Subasinghe

Experiment 4.2.4: Coconut based farming system in smallholdings - 1989 (Inter-Institutional Research Programme)

Of the perennial intercrops, pepper performed well in the Wet and Wet-Intermediate Zone crop model, giving a mean yield of 300-375 g/vine on a dry weight basis. Among others, performance of coffee and cocoa was satisfactory in the wet zone but a high variability in coffee was observed. Among semi-perennial banana and ginger performed well in the Wet Intermediate Zone gave a mean yield of 125 fruits/bunch and 650 g cured ginger/clump with a conversion rate of 1:3, respectively. At one site, ginger was affected by soft rot due to water logging. In the Dry and Dry-Intermediate Zone, performance of cashew, mango and banana was satisfactory at both sites. Of these, banana commenced bearing and produced a mean yield of 50 fruits/bunch. The introduction of annuals (eg. cowpea, cassava, sweet potato) into these models enhanced farmers' income.

It has also been observed that coconut seedlings in the crop model performed better than those in monoculture. Records on coconut yield, economics of individual crop/animal components were maintained. It was observed that additional labour is required in maintaining crop farm models compared with monoculture system, which demonstrated their potential for employment generation. For example, in one crop/farm model, the labour input increased from 17 man

days/acre/year to 190 man days. Coconut yields and income from several crop/farm models are shown in Table 2.

The experiment is in progress.

M de S Liyanage, H A J Gunathilake M T N Fernando and S D J N Subasinghe

Experiment 4.2.5: Integration of coconut with cattle grazing natural pasture and fed straw-based ration in the Wet Zone. Elgiriya Estate, Hakmana - 1990 (Inter Institutional Research Project)

During the year, yield of coconut palms was maintained and there was a marked improvement in nut (16-40%) and copra (19-49%) yield in plots with grazing cattle compared with control plots (Table 3).

Performance of cattle grazing natural herbage and fed supplemented straw was much higher as indicated by liveweight gains of 106 g/head/day, as compared with 9 g/head/day in grazing only plots. As expected, herbage dry matter yield was higher in ungrazed plots, 7380 kg/ha/year.

The experiment is in progress.

M de S Liyanage, K K Pathirane and B Silvan

Experiment 4.2.6: Selection and evaluation of adaptable, stable high yielding and high quality cultivars of pasture grass species of *Brachiaria brizantha Panicum maximum* and Pennisetum purpureum - 1991 (Inter Institutional Research Project)

During the year 50 genotypes from all three species were collected from different agro-climatic zones, multiplied in a nursery and established in a randomized complete block design with two replicates to study the agronomic characteristics of the clones.

The experiment is in progress.

S G J N Senanayake and D N S Fernando

Table 2. *Coconut production and net returns from selected crop/farm models in 1996*

Components	Nut yield (palm/year) a	b	Copra yield (g/nut) a	b	Estimated Income (Rs./ac)
Coconut + Pepper + Cocoa (WZ)	37	33	200.0	174.4	3959
Coconut + Pepper + Coffee+ Gliricidia (IWZ)	59	40	241.3	212.4	7934
Coconut + Coffee + Pasture + Cattle + Gliricidia (IWZ)	65	60	250.4	239.6	7568
Coconut + Mango + Lime + Banana (IOZ)	58	56	226.1	197.3	5716
Coconut + Cashew + Lime + Banana (DZ)	42	45	186.6	164.2	685

(a = model area & b = control palms)

Table 3. *Productivity of Coconut/Cattle Integrated Systems in Wet Zone*

Treatments	Nuts/palm/yr	Copra (kg/ha/yr)	Herbage DM(kg/ha/yr)	Liveweight grain (g/head/d)
Coconut only	41.0	11.14	7380	-
Coconut + Cattle grazing (G)	47.9	13.29	3883	9
Coconut + Cattle grazing + fed straw (GS)	50.6	14.15	4187	42
Coconut + Cattle grazing and fed suppl. straw (GSS)	57.4	16.70	5033	106

PROJECT 7: STUDIES ON THE NUTRIENT REQUIREMENT OF COCONUT

Experiment 7.12.1 (a&b): Demonstration on the use of cover crops and *Gliricidia* in coconut lands. Ratmalagara and Walpita Estates - 1988

During the year, growth of *Pueraria* was severely affected by the drought resulting in a poor green matter production. In contrast, *Gliricidia* maintained a satisfactory growth to provide loppings at 20 and 25 kg per palm at Ratmalagara and Walpita, respectively. The balance amount of **Gliricidia** was supplied from outside. Records on nut production and performance of legume cover were maintained during the year.

The experiment is in progress.

D N S Fernando, M N Dias and K C P Perera

Experiment 7.12.2 (a): Substitution of inorganic nitrogen for coconut palms with two different sources of organic matter. Ratmalagara Estate - 1991

All treatment, excepting the application of 30 kg loppings of *Gliricidia* planted in situ, were imposed during the year. Although *Gliricidia* seedlings showed satisfactory growth, they were too immature to produce the required amount of loppings. Hence the balance was met from trees outside the plots.

Records on nut and copra yields were maintained during the year.

The experiment is in progress.

D N S Fernando, M N Dias and R Marasinghe

Experiment 7.12.2 (b): Substitution of inorganic nitrogen for coconut palms with two different sources of organic matter. Siringapatha Estate, Intermediate Wet Zone, Badalgama - 1992

The object of this experiment was to study the possibility of substituting inorganic nitrogen with *Gliricidia* cow dung. The fertilizer treatments were arranged in a randomized block design with four replicates.

T_1 - Control (no fertilizer for coconut)
T_2 - Adult palm mixture 3 kg/palm/year
T_3 - Gliricidia loppings 30 kg + 500 g superphosphate + 1400 g muriate of potash/palm/year
T_4 - Cow dung 35 kg + 500 g super phosphate + 1200 g muriate of potash/palm/year

Different fertilizer treatments will be imposed during 1993.
The experiment is in progress.

D N S Fernando, M N Dias, M Bastian amd M A Wasanthimala

Experiment 7.12.3: Demonstration on the use of cover crops and *Gliricidia* in young coconut plantations, Bandirppuwa Estate - 1992

A block of three year old coconut palms, was selected in a Lateritic Gravel Soil and the experimental area was divided into four blocks, each with 24 palms and a row of coconut palms was used as the border between plots. The following fertilizer treatments will be applied to each palm in each block.

Block 1 - 03 kg Adult Palm Mixture/palm/year
Block 2 - *Pueraria* loppings 60 kg + 0.55 kg saphos phosphate + 1.2 kg muriate of potash/palm/year
Block 3 - *Gliricidia* loppings 30 kg + 0.55 kg saphosphosphate + 1.4 kg muriate of potash/palm/year
Blcok 4 - *Pueraria* and *Gliricidia* loppings only.

P. phaseoloides was planted in the avenue between coconut palms while *gliricidia* was planted in double rows at 0.6 x 0.6 m triangular along the boundary of each block . Application of fertilizer mixtures will commence in 1993.

The experiment is in progress.

D N S Fernando, M N Dias and K C P Perera

PROJECT 17: PREMATURE DECLINE OF PALMS

Experiment 17.4: Studies on the effect of root pruning and incorporation of organic manure on LSD palms. Walpita Estate - 1989

During the year, yield records were maintained and data on the size and shape of nuts were collected at alternate picks.

Pits of 30 x 30 cm to a depth of 60 cm were opened in treated area of palms to estimate new root formation. The length and Volume of new roots were also measured.

The experiment is in progress.

D N S Fernando, C Jayasekara and M Bastian

PROJECT 20: INTERCROPPING

Experiment 20.6: Effect of mixed cropping on the yield and productivity of coconut in the Dry and Dry Intermediate Zone. Margaret Estate, Pallama - 1990

Papaw was removed due its poor performance and replaced with pomegranate. The temporary shade crop, banana was also removed from all treatment plots. It was decided to include wood apple as an observation plot.

The coconut and copra yield showed no significant difference between treatments.

The experiment is in progress.

H A J Gunathilake, M de S Liyanage and M J I Costa

Experiment 20.7: Performance of mulberry under coconut in the Intermediate Zone. Ratmalagara Estate - 1990

Mulberry was harvested four times during the year at two pruning heights, 50 and 120 cm, which produced a fresh leaf yield of 12.74 and 12.72 mt/ha respectively. The drought during the first four months of the year affected the growth of mulberry and consequently dropped the leaf yield by 19% compared with previous year.

The coconut yields were maintained during the year which showed no adverse effects due to intercropping with mulberry.

The experiment is in progress.

H A J Gunathilake, M de S Liyanage and M J I Costa

Experiment 20.8: Adaptability of selected multipurpose tree species for coconut lands. Ratmalagara Estate, Madampe - 1990

Among multipurpose tree species, growth in terms of height and basal girth was found to be higher in *Gliricidia* and *Leucaena* followed by *Calliandra*. Tree were pruned twice during the year. Among species, *Gliricidia* and *Leucaena* produced a fresh weight of 3.4 kg/tree and 2 kg/tree, respectively. Prunings were applied around palms at the rate of 40.50 kg/palm. *Gliricidia* followed by *Calliandra* showed the highest coppicing ability producing six and four resprouts/tree, respectively.

Coconut yields were maintained during the year but showed no detrimental effect due to intercropping with these fast growing tree species.

The experiment is in progress.

M de S Liyanage and M Bastian

PROJECT 29: STUDIES ON FERTILIZER USE

Experiment 29.2: Studies on the localized application of fertilizer in coconut, Lateritic Gravel Soil. Ratmalagara Estate, Madampe - 1992

Objective of these experiments are, to assess the efficiency of localized application of inorganic fertilizer and to select a suitable material to retain the nutrients in soil until they are absorbed by the palm.

Pits of 60 x 60 x 60 cm were dug at 60 cm away from the bole of the palm. Recommended fertilizer mixture at the rate of 3 kg/palm/year in split doses. Treatments are as follows:

T_1 - Control (no fertilizer)
T_2 - Recommended fertilizer (broadcast and mulch)
T_3 - Two pits/palm filled with cowdung
T_4 - Two pits/palm filled with coir dust
T_5 - Four pits filled with cowdung
T_6 - Four pits filled with coir dust

Records on nut yield were maintained. The experiment is in progress.

D N S Fernando, K S Jayasekara and R Marasinghe

FOREIGN AIDED PROJECTS

Experiment 1.14: Studies on Biological Nitrogen Fixation (BNF) in *Gliricidia* provenances and improvement of BNF in *Gliricidia* and *Leucaena* grown under coconut by tree management. Bandirippuwa Estate, Lunuwila - 1990

In the first experiment (short-term) to determine BNF potential in Gliricidia provenances, results showed that there was a significant variation in total dry matter, total nitrogen, nodulation and nitrogen fixation among provenances. Selection OFI 14/84 obtained from the Oxford Forestry Institute, UK (OFI) demonstrated the highest potential in terms of biomass production and nitrogen fixation, followed by the local cultivar (Table 4). In all species, shoots had more dry matter and nitrogen (80-90%) than roots. The high BNF potential of OFI 14/84 which fixed 61 g N_2/tree (= 308 kg N_2/ha) is attributed to the high nodulating ability. Also, the amount of N_2 fixed in *Gliricidia* provenances was found to be strongly correlated ($r = 0.71^{**}$) with the proportion of N_2 derived from the atmosphere. This experiment was terminated in 1991.

During the year, the second experiment (long-term), to determine the effect of tree management on the improvement of BNF in *Gliricidia* and *Leucaena* grown under coconut, was shifted and re-located at Ratmalagara Estate, Madampe. Further, the number of treatment and replicates were increased to nine and four, respectively. The nine management treatments combinations are as follows:

T_1 - Gliricidia pruned at 4 monthly intervals
T_2 - Gliricidia pruned at 6 monthly intervals
T_3 - Gliricidia unpruned
T_4 - Leucaena pruned at 4 monthly intervals
T_5 - Leucaena pruned at 6 monthly intervals
T_6 - Leucaena unpruned
T_7 - Cassia pruned at 4 monthly intervals
T_8 - Cassia pruned at 6 monthly intervals
T_9 - Cassia unpruned

During the year, polybagged seedlings of fixing species (Gliricidia, Leucaena) and non-fixing species (*Cassia siamea*) were planted 2 m apart in a single row in the avenue between coconuts. Three months after planting, four plants from each species were treated with 5% ^{15}N enriched ammonium sulphate at the rate of 10 l solution per 12 m^2 area. During the latter part of the year, each plot consisting of nine plants, three from each species, was trenched to a depth of 75 cm and lined with black polythene.

Table 4 *Nitrogen Fixing Potential of Gliricidia provenances*

Provenance	Total dry matter (kg/tree)	Total nitrogen (g/tree)	Nodule (no./tree)	N2 fixed proportion %	N2 fixed amount g/palm
OFI 14/84	5.02	96.13	280.70	64.4	61.73
OFI 17/84	3.15	38.38	92.70	52.5	18.39
OFI 12/86	2.90	38.54	129.50	51.6	17.78
Local	4.48	78.37	188.00	52.6	17.78
Sig.	**	**	**	NS	*
LSD (P =0.05)	1.56	33.08	55.78	-	25.68
CV%	23.37	34.11	20.16	20.46	46.43

The experiment is in progress.

M de S Liyanage, D N S Fernando, H P S Jayasundera and H A Abeysoma

3. LECTURES AND SYMPOSIA

Drs M de S Liyanage, D N S Fernando and H A J Gunathilake functioned as resource persons in two training courses on coconut cultivation for Agricultural Officers of the Department of Agriculture, North Eastern Province and middle level management staff of coconut estates.

Drs M de S Liyanage and H A J Gunathilake delivered lectures on "Weed control and weed management in coconut at the training workshop for Regional Managers, Managers of agro-chemical companies, Asst. Managers of the Coconut Cultivation Board and Estate Superintendents of the Coconut Research Institute.

Dr H A J Gunathilake delivered several lectures on intercropping in coconut lands to coconut growers in the Gampaha and Ratnapura Districts.

Mr M T N Fernando delivered several lectures on soico-economic constraints in coconut-based intercropping and soil moisture conservation practices in coconut lands to officers of the Coconut Cultivation Board.

4. EXTENSION ACTIVITIES

The staff actively participated at the second Coconut Day held at the Coconut Research Institute for coconut growers.

Dr H A J Gunathilake visited several on-farm crop models in the Ratnapura District and advised the farmers and CCB field officers in systematic management of intercrops and collection of agronomic and socio-economic data.

5. RESEARCH SERVICES

Dr M de S Liyanage supervised a 500 series research project titled "A study on the adaptability of three multipurpose tree species for use in coconut based agroforestry systems", conducted by Miss T Ranasinghe, a final year student of the Faculty of Agriculture, Peradeniya University.

6. ACKNOWLEDGEMENTS

The co-operation and assistance given by the staff of Agronomy Division in implementation of the research programme and in the preparation of this report are gratefully acknowledged. Thanks are also due to the Head and the Staff of Biometry Division, for assistance in providing nut yield records of experiments and for statistical analysis.

REPORT OF THE GENETICS AND PLANT BREEDING DIVISION

Head - R R A Peries, Ph D

1. GENERAL

Selection of coconut palm populations for physiological adaptation and the eco-bank concept was promoted during the year. Several genetic resources worthy of conservation as adapted material were identified and a full study of this material will be undertaken next year.

Improved weather conditions resulted in significant yield increases at the Isolated Seed Garden (ISG) compared to 1991. The first harvests resulting from pollinations done in 1991 were made in the programme for improvement in seed nut size at ISG. These progenies will be planted at ISG in 1993.

2. RESEARCH PROJECTS

PROJECT 5: Production of improved coconut varieties

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

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

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

These three experiments were maintained satisfactorily during the year. At Bandirippuwa, 4 vacancies (120, 295, 313, 344) occurred as a result of drought and were replaced with *T x T* seedlings. Another palm (94) was uprooted due to red weevil damage. Routine fertilizer application was carried out twice during the year at the rate of 3 kg of urea based APM on each palm. The trials have now completed eight years after planting and the pattern of flowering from 5 years (60 months) onwards is given in Tables 1, 3 and 5 respectively. The number of palms harvested, nuts collected and the yield of nuts per palm during the year at the Bandirippuwa and Thammenna sites are also shown in Tables 1 and 3.

With respect to flowering, percentages exceeding 80% have been attained in all five cultivars at Bandirippuwa and Thammenna but the number of nuts produced was much higher at Thammenna, particularly in the hybrids. The

difference in the number of nuts/palm in the tall cultivars was not marked between Bandirippuwa and Thammenna.

The results of the fruit component analysis at the 2 sites Bandirippuwa and Thammenna are given in Tables 2 and 4 respectively. The total copra yield has been estimated using the conversion factor of 32% of the dehusked nut weight.

At Thammenna copra content per nut was not different between *DG x T* and *DY x T* (169 g, 167 g respectively) but the total copra production per palm was higher in *DG x T* due to a 28% higher nut production in *DG x T* (60/palm) over *DY x T* (47/palm). At Bandirippuwa, nut production was not different between *DG x T* and *DY x T*. While other tall cultivars showed only minor fluctuation in production between sites, Moorock tall appeared to be somewhat stable than others in overall production.

The better yields realized at Thammenna is clearly the effect of availability of a large volume soil water compared to Bandirippuwa, due to the depth of soil. In this deep latosol, roots were found to extract soil water at a depth of 3 m and below during the prolonged rain-free period of January to April this year.

The status was different at Dambakande in which only the hybrids had attained 80% flowering at the end of the 8th year (1992). While the severe soil water deficit that develops from time to time in this field as a result of the heavy clay may have been a contributory factor, the most important single factor for the present state of the plantation is the profound neglect of the plantation by the present management (Sri Lanka Army). During the year, cattle were allowed to graze freely in the block, resulting in severe damage to the foliage of the young palms and tender nuts were picked and consumed by the inhabitants of the estate, despite our repeated requests. No nuts could be collected for analyses during the year. The matter was reported to the Research Committee on 29 September which decided that consideration be given for the experiment at Dambakande to be terminated.

R R A Peries, J M D T Everard and W B S Fernando and M H L Padmasiri

Table 1. *The progress in flowering from five years (60 months) onwards, the number of palms harvested during the year and the number of nuts collected from each cultivar in the Evaluation of Cultivars trial at Bandirippuwa Estate.*

Cultivar	Time after field planting (yrs) 5 89 Dec	6 90 Dec	7 91 Dec	8 92 Dec	Number of palms harvested	Number of nuts harvested	Nuts/ palm
DG x T	67	70	74	74 (97%)*	74	1664	22
DY x T	61	75	78	79 (99%)*	73	1891	26
T x T	28	52	69	74 (93%)*	61	1397	23
M.T	26	49	68	72 (90%)*	59	1203	20
P.P.T	21	43	66	71 (89%)*	59	1321	22

(* Percentage flowering as at December 1992)

Table 2. *Results of fruit component analysis of the evaluation of cultivars trial at Bandirippuwa. (Data are the means of six picks in 1992).*

Fruit component	Time after field planting (yrs) *DG x T* A	B	*DY x T* A	B	*T x T* A	B	MT A	B	PPT A	B
Fresh nut weight (g)	1022	0.10	1111	0.12	1282	0.10	1305	0.13	1156	0.08
Dehusked weight (g)	523	0.16	608	0.15	589	0.14	614	0.10	584	0.14
Split nut weight (g)	407	0.10	435	0.11	460	0.14	472	0.11	459	0.13
Kernel weight (g)	237	0.12	280	0.11	294	0.16	296	0.11	289	0.14
Est. copra weight (g/nut)	167	na	194	na	188	na	196	na	186	na
Est. copra weight (kg/palm)	3.7	na	5.0	na	4.3	na	3.9	na	4.1	na

(na = not analyzed; A = weight in grams; B = CV)

Table 3. *The progress in flowering from five years (60 months) onwards, the number of palms harvested during the year and the number of nuts collected from each cultivar in the Evaluation of Cultivars trial at Thammenna Estate.*

Cultivar	Time after field planting (yrs) 5 89 Dec	6 90 Dec	7 91 Dec	8 92 Dec	Number of palms harvested	Number of nuts harvested	Nuts/ palm
DG x T	62	76	78	78 (98%)	76	4526	60
DY x T	48	64	72	74 (96%)	64	2990	47
T x T	18	49	65	72 (94%)	57	1490	26
M.T	20	45	61	66 (84%)	49	1217	24
P.P.T	34	57	71	76 (97%)	63	1884	30

Table 4. *Results of fruit component analysis of the evaluation of cultivars trial at Thammenna. (Data are the mean of six picks).*

Fruit component	Time after field planting (yrs) *DG x T* A	B	*DY x T* A	B	*T x T* A	B	MT A	B	PPT A	B
Fresh nut weight (g)	945	0.27	920	0.27	1105	0.23	1130	0.25	1119	0.24
Dehusked weight (g)	530	0.29	523	0.28	627	0.27	623	0.32	628	0.29
Split nut weight (g)	404	0.24	400	0.23	480	0.20	470	0.22	470	0.22
Kernel weight (g)	264	0.26	262	0.25	307	0.22	308	0.22	305	0.25
Est. copra weight (g/nut)	169	na	164	na	201	na	199	na	201	na
Est. copra weight (kg/palm)	10.7	na	7.9	na	5.2	na	4.8	na	6.1	na

(na = not analyzed; A = weight in grams; B = CV)

Table 5. *The progress in flowering from 5 years onwards in the evaluation of cultivars trial at Dambakande estate, Kurunegala.*

Cultivar	--- Time after planting (yrs) ---- 5	6	7	8	Percentage of palms in flower as at 31 December
DG x T	22	57	67	71	91
DY x T	03	24	46	62	80
T x T	00	01	04	25	33
M.T	00	02	17	36	46
P.P.T	00	00	12	26	34

A combined analysis of variance (ANOVA) of leaf production data was carried out using the block means of the 3 trials Thammenna, Bandirippuwa and Dambakande. The contribution made by the environment to the total variation was greater than the varietal effects whilst no significant variation was caused due to variety x environment interaction. The overall means of the five cultivars along with their regression coefficients (b) according to the Finlay Wilkinson method appear in Table 6. The regression coefficients indicate that Moorock tall has the most stable performance and highest mean for leaf production data at 5 years amongst the tall cultivars. Out of the two hybrids DY x T appeared to have a more stable growth performance than DG x T.

Table 6. *The leaf number at 60 months from planting of the 5 cultivars (mean over the 3 sites Bandirippuwa, Dambakande and Thammenna) and their Finlay Wilkinson regression coefficients (b).*

Cultivar	Mean	S D	b
DG x T	47.45	4.06	0.614
DY x T	45.64	5.54	0.893
T x T	38.35	7.70	1.258
MT	39.02	6.23	0.996
PPT	38.24	7.66	1.237

Experiment 5.1.4: Evaluation of five improved cultivars at Suriyapura Estate, Henegama (1986).

The management of this trial continued to be under sub-optimal conditions due to change of ownership over time. The routine fertilizer application was carried out twice during the year with 3 kg of urea based APM per palm. The temporal change in flowering from 4 years onwards, the number of palms harvested and the number of nuts collected during the year are shown in Table 7. The hybrids again were far superior in performance compared to the tall cultivars with DG x T performing better than DY x T. Despite the fact that Suriyapura is located in the Wet Zone the percentage of tall cultivars in flower compared to Thammenna and Bandirippuwa trials at 7 years after planting were comparatively low (Table 7) indicating that the soil and site specific interactions were greater than the general agro climatic effects.

R R A Peries, J M D T Everard, W M U Fernando and H S G Kularatne

Table 7. *The temporal change in flowering from four years (48 months) onwards, the number of palms harvested during the year and the number of nuts collected from each cultivar in the Evaluation of Cultivars trial at Suriyapura Estate.*

Cultivar	---Time after filed planting (yrs)--- 4 89 Dec	5 90 Dec	6 91 Dec	7 92 Dec	Number of plams harvested	Number of nuts harvested	% flowering at 7 years Thammenna	Bandirippuwa
DG x T	18	41	57	59 (97%)	56	774	78	74
DY x T	11	22	44	50 (81%)	37	392	72	78
T x T	00	00	06	22 (33%)	05	17	65	69
M. T	00	00	09	18 (30%)	08	31	67	68
P.P.T.	00	00	05	19 (36%)	05	39	71	66

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).

Experiment 5.2.1: Programme for the improvement in nut size and nut number in the Isolated Seed Garden.

The pollination programme on selected palms (cf. Annual Report 1991) commenced in December 1991 was carried out successfully during the year. The first harvest of seed nuts (around 100-115) is to be done in early January 1993. The progress of the pollination programme during the year is summarized in Table 8.

Table 8. *The progress of the pollination programme in field No. 4 of ISG for the improvement of nut size and nut number in coconut.*

Month	Number of palms pollinated	Number of inflorescences emasculated	Number of buttons pollinated	Number of buttons developing after 3 months	6 months
91 Dec	30	30	559	127	117
92 Jan	55	61	1098	239	218
Feb	55	58	1095	257	246
Mar	56	64	1119	287	264
Apr	55	74	1188	253	232
May	56	77	1363	361	329
Jun	55	74	1264	282	246
Jul	56	74	1086	371	-
Aug	56	78	1087	334	-
Sep	55	60	815	227	-
Oct	56	64	1037	-	-
Nov	54	65	1213	-	-
Dec	04	04	85	-	-
92 Tot	56	753	12530	2611	1535

(Note: The pollination programme continues on 57 selected parent palms with 16 pollen parents.)

R R A Peries, J M D T Everard and M H L Padmasiri

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

Attempts to obtain the required spare parts for the freeze dryer proved futile. It was also noted that the success of pollination at ISG was affected by low pollen viability due to the frequent failure of the kerosene operated refrigerator. During the year action was initiated to purchase a new deep freezer for ISG.

R R A Peries and W B S Fernando

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 selected for high and stable yields.**

Progeny trials arising from these 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 Rathmalagara 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: **Trail at JEDB Mangala Eliya Estate, Puttalam for the evaluation of progeny (1987).**

The four trials were maintained satisfactorily during the year. Routine application of fertilizer was carried out twice during the year as scheduled. Growth parameters such as number of new leaves added and total leaf number were recorded at six monthly intervals up to the fifth year after planting and the performance of the varieties were compared using the analysis of variance. The appearance of the first inflorescence was also recorded at monthly intervals in all trials.

A total of 14 young palms died during the year at Bandirippuwa of which 5 were due to drought, 3 were due to Red Weevil attack and the rest as a result of lightning. Five seedlings died at Andigama (Mudalihamy block) probably

due to drought and one each at Mudalihamy block and JEDB Mangala Eliya estate due to Red Weevil attack.

The trials at Bandirippuwa and Ratmalagara have now completed six years from planting and the final growth measurements were recorded in 1991 at the end of the 5th year (CRI Annual Report, 1990). The total number of palms in flower at the end of six and a half years at Bandirippuwa and Ratmalagara are summarized in Tables 9 and 10 respectively. The percentage of palms in flower at Bandirippuwa were comparatively higher in all 3 varieties with *T x DG* attaining 100% at the end of 5.5 years. A marked difference in percentage flowering of *T x T* and *T x SR* was evident at Ratmalagara with *T x SR* leading ahead of *T x T* but both varieties performed similarly at Bandirippuwa. On overall performance *T x SR* appeared to be a more stable variety with the lowest site differences.

Table 9. *Cumulative number of palms in flower in the three types of progeny T x DG, T x T, T x SR at Bandirippuwa (1986).*

Progeny	Years after planting			
	3.5 89 Dec	4.5 90 Dec	5.5 91 Dec	6.5 92 Dec
T x DG	50	69	88 (100%)	88 (100%)
T x T	00	02	41 (47%)	51 (59%)
T x SR	00	05	37 (42%)	50 (56%)

(DG: dwarf green; T: tall; SR: San Ramon)

Table 10. *Cumulative number of palms in flower in the three types of progeny T x DG, T x T, T x SR at Ratmalagara (1986).*

Progeny	Years after planting			
	3.5	4.5	5.5	6.5
T x DG	10	38	58 (64%)	61 (67%)
T x T	00	02	03 (3%)	08 (9%)
T x SR	01	01	10 (11%)	23 (26%)

The trial at Andigama Farm, Giriulla (Mudalihamy Block), is now in its 6th year after planting and the final growth parameters, the total leaf number increase during the preceding year and total leaf production at 60 months are given in Table 11. All three parameters revealed highly significant differences ($P<0.0001$) between varieties and *T x DG* was superior to the rest of the varieties whilst *T x SR* out performed *T x T* for all three parameters. At six years after planting 64% of palms had flowered, out of which 60% was from the variety *T x DG* (Table 12).

The trial at JEDB Mangala Eliya Estate has now completed 51/2 years from initial planting and the results of the final growth measurements at 60 months from planting are given in Table 13. Although highly significant differences were apparent between varieties for the characters analyzed, the differences were mainly due to the superiority of *T x DG* over the rest of the varieties. The comparison of means showed no significant differences between *T x T and T x SR* for all characters. Considering the initial flowering, the hybrid, *T x DG* had attained 70% at the end of 51/2 years whilst only less than 10% were achieved by each of the other cultivars (Table 14).

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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 yield.

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).

The progenies evaluated in these two trials are *T x DG, T x T, T x SR* and *DG x SR*. The trial at Daisy Valley Estate in addition, had a *DG x T* progeny for evaluation.

The results of the analyses of growth parameters, total leaf production to 48 months, leaf increase during the preceding year and total leaf number at 48 months at the Puras block Andigama are shown in Table 15.

The analysis of variance procedure for all the growth parameters indicated highly significant differences ($P < 0.0001$) between varieties. The comparison of means indicated that DG x SR was superior to the rest of the varieties with significant differences compared to *T x DG* for all the growth parameters. The performance of *T x SR* was also significantly better than *T x T* for all characters

analyzed. The flowering at the end of the 5th year reached 27% for *DG x SR* while *T x DG* and *T x T* had attained only 3% and 1% respectively (Table 16).

Table 11. *Total leaf production, leaf number at 60 months and the increase in leaf number of three types of progeny T x DG, T x T, T x SR at Andigama (Mudalihamy block) (1986).*

	Mean	SD	LSD at 5% level
Total leaf production to 60 months			
T x DG	44.76	6.19	1.73
T x T	35.08	4.76	
T x SR	37.49	5.22	
Increase in leaf number (48 - 60 months)			
T x DG	7.77	1.71	0.52
T x T	5.72	1.70	
T x SR	6.34	1.93	
Total leaf number at 60 months			
T x DG	15.32	4.32	0.97
T x T	10.56	3.14	
T x SR	12.39	3.75	

(DG: dwarf green; T: tall; SR: San Ramon; LSD: Least significant difference; SD:Standard deviation)

Table 12. *Cumulative number of palms in flower in the three types of progeny T x DG, T x T, T x SR at Andigama (Mudalihamy Block 1986)*

Progeny	Years after planting			
	3	4	5	6
T x DG	1	5	43	53 (60%)
T x T	0	0	0	1 (3%)
T x SR	0	0	2	3 (1%)

(DG: dwarf green, T: tall; SR: San Ramon)

Table 13. *Total leaf production, leaf number at 60 months and the increase in leaf number of four types of progeny T x T, T x SR, T x DG and T (OP) at Mangala Eliya (1987).*

	Mean	SD	LSD at the 5% level
Total leaf production to 60 months			
T x DG	49.03	7.87	2.39
T x T	38.38	8.91	
T x SR	39.84	8.46	
T (OP)	39.07	9.28	
Increase in leaf number (48 - 60 months)			
T x DG	8.47	1.58	0.87
*T x T*13	6.99	1.73	
T x SR	6.96	1.30	
T (OP)	6.99	1.55	
Total leaf number at 60 months			
T x DG	18.43	3.84	2.01
T x T	13.89	4.41	
T x SR	14.44	3.32	
T (OP)	14.94	4.06	

(DG: dwarf green; T: tall; SR: San Ramon; T (OP): tall open pollinated
LSD: Least significant difference)

Results at Daisy Valley indicated highly significant differences ($P < 0.000.1$) between varieties with *DG x T* performing best. Although significant differences were present between *DG x SR and DG x T* for leaf number and total leaf production at 48 months the difference was not significant for leaf number increase during the preceding year. Highly significant differences were present between the reciprocal crosses *DG x T* and *T x DG* with *DG x T* performing better than *T x DG* for all the characters (Table 17).

The variety *T x DG* scored highest with 63% flowering at the end of the 5th year after planting while *DG x T* and *DG x SR* had attained 61% and 48% respectively (Table 18).

Table 14. *Cumulative number of palms in flower in the three types of progeny **T x T, T x SR, T x DG and T (OP)** at Mangala Eliya (1987).*

Progeny	-------- Years after planting --------		
	3.5	4.5	5.5
T x DG	1	22	56 (70%)
T x T	0	0	6 (7%)
T x SR	0	0	3 (4%)
T (OP)	0	0	9 (10%)

(DG: dwarf green; T: tall; SR: San Ramon; T(OP): tall open pollinated)

Table 15. *Total leaf production, leaf number at 48 months and the increase in leaf number of four types of progeny **T x DG, T x T, T x SR and DG x SR** at Andigama (Puras Block) (1987).*

	Mean	SD	LSD at the 5% level
Total leaf production to 48 months			
T x DG	34.42	2.18	1.03
T x T	29.19	2.18	
T x SR	30.67	2.80	
DG x SR	35.80	4.99	
Increase in leaf number (36 - 48 months)			
T x DG	7.33	1.52	0.55
T x T	5.48	1.06	
T x SR	6.13	1.16	
DG x SR	8.22	1.52	
Total leaf number at 48 months			
T x DG	10.02	1.42	0.68
T x T	7.56	1.42	
T x SR	8.39	1.24	
DG x SR	11.05	1.94	

Table 16. *Cumulative number of palms in flower in the three types of progeny **T x DG, T x T, T x SR, and DG x SR** at Andigama (Puras Block) (1987).*

Progeny	Years after planting		
	3	4	5
T x DG	0	2	3 (3%)
T x T	0	0	0 (0%)
T x SR	0	0	1 (1%)
DG x SR	1	19	23 (27%)

(DG: dwarf green; T: tall, SR: San Ramon)

Table 17. *Total leaf production, leaf number at 48 months and the increase in leaf number of five types of progeny, **T x DG, T x T, T x SR, DG x SR and DG x T** at Daisy Valley Estate (1987).*

	Mean	SD	LSD at the 5% level
Total leaf production to 48 months			0.87
T x DG	40.59	5.12	
T x T	33.11	3.86	
T x SR	34.72	3.99	
DG x SR	40.18	4.55	
DG x T	42.20	5.17	
Increase in leaf number (36 - 48 months)			0.58
T x DG	7.57	1.91	
T x T	5.80	1.61	
T x SR	6.11	1.65	
DG x SR	7.80	1.85	
DG x T	8.19	2.36	
Total leaf number at 48 months			0.94
T x DG	12.31	4.15	
T x T	8.54	3.09	
T x SR	9.34	3.28	
DG x SR	12.13	3.68	
DG x T	13.43	4.08	

(DG: dwarf green: DY, T: tall, SR: San Ramon; LSD: Least significant difference; SD: Standard deviation)

Table 18. *Cumulative number of palms in flower in the three types of progeny, T x DG, T x T, T x SR, DG x SR and DG x T at Daisy Valley Estate (1987).*

Progeny	----- Years after planting -------		
	3	4	5
T x DG	1	26	54 (63%)
T x T	0	2	02 (2%)
T x SR	0	0	05 (6%)
DG x SR	2	20	43(48%)
DG x T	2	26	54 (61%)

(DG, dwarf green: DY, dwarf yellow: T, tall: SR, San Ramon.)

Experiment 5.4.3: **Combination 3. Ambakelle Special, selected *dwarf green* and *dwarf yellow* seed palms using *tall, dwarf green, San Ramon* and *dwarf yellow* pollen from palms selected for high and stable yield (1986)**

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

Experiment 5.4.3.1: **Trial at SLSPC Sirikandura Estate, Dodanduwa, for the evaluation of progeny (1989).**

Experiment 5.4.3.2: **Observation trial at Ratmalagara Estate, Madampe for the evaluation of progeny (1989).**

The progeny subjected for evaluation at the Sirikandura Estate are *T x DG, T x DY, T x T* and *T x SR*. The objective of the Ratmalagara trial was to evaluate the hybrid progenies *DG x T, DY x T, DG x SR* and *DY x SR*.

The trial at the Sirikandura Estate is now in its fourth year after planting. The results of the growth parameters, total leaf production to 36 months, increase in leaf number during the preceding year and the leaf number at 36 months are given in Table 19. The results indicated that the hybrid progenies performed better than the tall cultivars and the difference between *T x DG* and *T x DY* was not significant for leaf increase and total leaf number at 36 months. The performance of *T x SR* was not significantly different from *T x DY* for total leaf production and leaf increase.

The summary of growth parameters of the four hybrids under evaluation at Ratmalagara are given in Table 20. The results of the ANOVA procedure indicated that significant differences ($P < 0.001$) were present between the varieties only for the total leaf number at 24 months and for the leaf number increase during the preceding year. The hybrid progeny *DG x T* performed significantly better than all others whilst the 3 remaining varieties had similar performance for the total leaf number and leaf number increase.

Table 19. *Total leaf production, leaf number at 36 months and the increase in leaf number of four types of progeny, **T x DG, T x T, T x SR and T x DY** at Sirikandura estate (1989).*

	Mean	SD	LSD at the 5% level
Total leaf production to 36 months			
T x DG	30.32	3.63	0.87
T x T	26.22	2.78	
T x SR	28.08	2.84	
T x DY	30.17	3.19	
Increase in leaf number (24 - 36 months)			
T x DG	6.40	1.54	0.40
T x T	5.58	0.90	
T x SR	5.98	1.07	
T x DY	6.23	1.25	
Total leaf number at 36 months			
T x DG	12.11	2.77	0.65
T x T	10.37	1.42	
T x SR	11.24	1.86	
T x DY	11.20	2.34	

(DG: dwarf green; DY: dwarf yellow; T: tall; SR: San Ramon,
LSD: Least significant difference; SD: Standard deviation)

Table 20. *Girth, height, total leaves, leaf number and the increase in leaf number of four types of progeny, **DG x SR, DG x T, DY x SR and DY x T** at Ratmalagara estate (1989).*

	Mean	SD	LSD at the 5% level
Girth at 24 months (cm)			
DG x SR	40.62	5.82	6.08
DG x T	48.5	12.76	
DY x SR	31.47	8.93	
DY x T	28.29		13.05
Height at 24 months (cm)			
DG x SR	280.43	43.34	23.97
DG x T	304.72	46.14	
DY x SR	280.20	50.68	
DY x T	290.76	58.16	
Leaf number at 24 months			
DG x SR	14.25	2.38	1.29
DG x T	16.83	1.95	
DY x SR	13.8	2.40	
DY x T	14.00	2.72	
Increase in leaf number (12 - 24 months)			
DG x SR	7.50	2.03	1.33
DY x SR	7.60	1.80	
DG x T	10.17	1.34	
DY x T	8.12	2.55	

(DG: dwarf green, DY: dwarf yellow; T: tall; SR: San Ramon,
LSD: Least significant difference, SD: Standard deviation)

Experiment 5.4.3.2: Observation trial at Open Prison Camp, Dalupota, Negombo, for the evaluation of Progeny (1989)

This experiment was terminated in June due to the difficulties in management which resulted in a state that the data from this trial could not be used for any evaluation purpose or comparison. The poor sanitation at the site had resulted in heavy black beetle infestation and the damage done by cattle was so

severe despite the repeated requests made to the management.

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Experiment 5.4.5.1: Progeny trial for testing of putative drought tolerant palms by the performance of their progeny at ISG

The trial comprises 441 seedlings obtained by crossing 22 selected palms from fields 1 and 2 in 56 combinations (CRI Annual Report, 1988). The selection of parent palms in Fields 1 and 2 at ISG were based on yield data of 16 years (1965 - 81). Out of a total of 51 selected tall palms, the palms which had an excess of 100 nuts/palm/yr for the mean over 16 years and in which the lowest nuts/year exceeded 30 nuts/palm/year, were selected as pollen parents. The Finlay Wilkinson "b" values for regression coefficients range from 0.66-1.06 for these pollen parents indicating their stability in nut production.

Analyses of variance of 24 half sib families arising from 12 female parents from the total of 51 tall palms showed that there was no significant difference either between the female parents or between male parents within a female for girth at 24 months and total leaf production at 48 months (Table 21). The broad heritability i.e. the ratio of the genetic variance to the total variance was surprisingly low with 15% and 6% for girth and total leaves respectively, indicating the large environmental component controlling these characters. However as the selection of parents was based on the yield characters, the results on yield data of these progenies need to be analyzed before any firm conclusions can be made. The trial was maintained satisfactorily during the year and 13 palms were in flower at 48 months from planting.

The results highlight some important points which needs to be considered in the general coconut breeding programme.

(a) The lack of genetic variability among the parents could be traced back to the narrow genetic base from which these palms originated. (eg. few palms each from Achchitotam, Marandawila, Letchemmy etc.). Therefore the genetic gain likely to be obtained in the next generation by crossing these palms is rather limited.

(b) Introgressing these highly selected material with selected parents from other sources (probably from the germplasm collection) could be an alternative to enhance the genetic variability.

(c) The analyses of the vegetative data of the progenies of 10 selected mother palms (the same set of mother palms used in this trial) at Bandirippuwa and Ratmalagara (Exp. 5.4.1.1 and 5.4.1.2) revealed no significant differences between families for vegetative growth characters in the varieties T x T and T x DG. Crossing of these parents with San Ramon resulted in significant differences among the progeny (only 8 families were present) for vegetative growth characters (Table 22) which indicate the potential of San Ramon in creating diversity among the progeny.

Table 21. *Analysis of variance of 24 progeny families at ISG.*

Total leaves at 48 months

Source	df	M.S	F	P
Between female parents	11	15.391	< 1	NS
Between male parents/female	24	15.135	1.11	NS
Error	117	13.628		

Girth at 24 months

Source	df	M.S	F	P
Between female parents	11	246.917	< 1	NS
Between male parents/female	24	420.653	1.27	NS
Error	117	331.618		

Table 22. *Analysis of variance of progeny families of selected female parents crossed to tall, dwarf green and San Ramon, replicated at the two sites Bandirippuwa and Ratmalagara Estates.*

Source	df	TL MS	TL P	GR MS	GR P	RLPT MS	RLPT P
T x T							
Site	1	966.05	***	744[illegible].80	***	0.4848	**
Families	9	5.42	NS	233.55	NS	0.0087	NS
Site x Family	9	15.02	*	242.13	NS	0.0075	NS
Error	60	7.52		441.78		0.007	
T x DG							
Site	1	495.01	***	2543.112	**	0.149	***
Families	9	7.84	NS	385.93	NS	0.022	NS
Site x Family	9	12.18	NS	250.58	NS	0.016	NS
Error	60	11.83		421.75		0.012	
T x SR							
Site	1	76.56	**	95.06	NS	0.0284	NS
Families	7	45.27	***	1234.56	***	0.0273	***
Site x Family	7	6.77	NS	143.16	NS	0.0052	NS
Error	48	12.59		332.52		0.0089	

(M.S, Mean square; P, probability; N.S, not significant; [illegible] *, P<0.0001; **, 0.05<P<0.001; *, P=0.05; TL = total leaves at 5 yrs. ; GR = girth at 3 yrs.; RLPT = rate of leaf production from planting up to 60 months in six monthly intervals.)

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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).

This plantation was maintained satisfactorily. A hand pollination programme was launched this year aiming to fill one vacancy of *pora pol* and seven vacancies of *navasi thembili* in 1993.

Experiment 5.5.2: Purification of local (indigenous) germplasm, Bandirippuwa Estate, (B/E) Lunuwila (1984).

This plantation was satisfactorily maintained. Total of 18 vacancies comprising 11 *gon thembili*, 04 *pora pol*, 02 *nawasi* and 01 *ran thembili* were reported this year.

A hand pollination programme launched last year resulted in a total of 165 seednuts comprising 122 *bodiri*, 13 *ran thembili*, 16 *pora pol*, and 14 *navasi* for the purposes of infilling and new planting.

The pollination programme was continued this year. *kamandala* and *gon thembili* were also included in the programme. The summary of the pollination programme is presented in Table 23.

Table 23. *Progress of the pollination programme on indigenous germplasm.*

Form/Var	Number of inflorescences handled	Number of Female flowers pollinated	Number of buttons after 3 months	6 months	Number of nuts harvested
Nawasi	20	658	85	22	-
Ran thembili	13	270	24	15	-
Pora pol	333	61	27	-	
Bodiri	04	100	13	08	-
Kamandala	10	134	35	12	-
Gon thembili	14	208	20	14	-

Although *pora pol* and *Bodiri* belong to the variety *typica* and are categorized as cross pollinating, it has now been observed that all available palms of *bodiri* and one palm of *pora pol* at Bandirippuwa Estate are self pollinating. Further investigations on these forms are planned for 1993. The current status of the indigenous germplasm conservation block at Bandirippuwa Estate is shown in Table 24.

Table 24. *The status of the local germplasm collection at Bandirippuwa Estate as at 31 December.*

Status of collection	Type (form) of coconut						
	Bodiri	*Gon thembili*	*Pora pol*	*Ran thembili*	*Nawasi*	*Dikiri pol*	*Kamandala*
Number							
established	80	69	57	19	36	03	06
Vacancies	35	17	24	05	07	-	02
Young palms	17	36	33	12	09	02	04
In flower	11	08	-	02	01	-	-
In bearing	17	08	-	-	-	-	-
Seeding	-	-	-	-	19	-	-

Total no. of standing palms = Young palms + Seedlings + in flower + Seedlings in bearing.

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

This plantation was maintained satisfactorily during the year. Twenty nine palms were in bearing as at 31 December and 6 casualties were reported.

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

A self pollination programme launched last year resulted in a total of 98 seednuts comprising 60 ***dwarf green***, 15 ***dwarf yellow***, 23 ***dwarf red***. The pollination programme was suspended in April this year due to the severe 'drought' conditions and would recommence in 1993. The details of the pollination programme are summarized in Table 25.

Table 25. *Summary of the pollination on "dwarfs" in the "field gene bank".*

Form/Var	Number of inflorescences handled	Number of Female flowers pollinated	Number of buttons after 3 months	6 months	Number of nuts harvested
Dwarf Green	13	364	79	55	-
Dwarf Yellow	05	146	-	-	-
Dwarf Red	05	82	12	02	-

Experiment 5.5.5: Germplasm from other countries (1985)
Experiment 5.5.5.1: Import of exotic material

As an outcome of the expert consultation on the import of coconut germplasm for breeding held in 1991 it was decided that due to the current risks involved, such importations cannot be allowed for the time being.

Experiment 5.5.5.2: Purification and multiplication of exotic material already available.

Cameroon Red Dwarf (CRD); Brazilian Green Dwarf (BGD)

The self pollination programme launched for *Cameroon Red Dwarf* (CRD) resulted in 127 seednuts and these were laid down at Bandirippuwa research nursery. A hand pollination programme was launched this year on BGD and 50 seed nuts were laid at the Bandirippuwa research nursery. Despite the fact BGD is classified under variety nana, it has been observed that under the local climatic conditions this variety was predominantly cross pollinating. Therefore hand pollination (selfing) was necessary to purify the material.Further investigations on this form are planned for 1993.

The details of the pollination programme on CRD and BGD varieties are summarized in Table 26.

Table 26. *Details of the pollination programme of BGD and CRD.*

Month	Number of inflorescence	Number of buttons selfed	Number of buttons after 3 months	Number of buttons after 6 months	Nuts harvested
Brazilian Green Dwarf					
January	04	115	13	13	
February	04	79	11	11	
March	01	16	03	02	
Cameroon Red Dwarf					
January	05	73	21	21	09
February	04	59	16	10	
March	03	43	17	13	
April	01	13	04	04	

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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*).**

Five new accessions (Melsiripura Group, Horekelle Estate, Keenakelle Estate, Maliboda Estate and Walahapitiya Estate) were added to the collection during this year. Nut collection was also done from St. Johns Estate, Mangala Eliya, from palms selected in 1991.

Four estates, namely Wilhelmina Estate, Puttalm, Shakerley Estate, Ambakote, and Marandawila Estate, Bingiriya, were also identified as sources of elite germplasm, but palm selection and nut collection was postponed to 1993, due to the limited budget in 1992.

A sample of seednuts was also collected from Mudunawatta Estate, Wellawa (cf. Annual Report, 1988) for the purpose of replicating in the PRS conservation block.

Melsiripura Estate, Melsiripura

This is a private estate belonging to Melsiripura Group. Personal communication revealed that in the past they had their own replanting programme based on their own mother palm selection programme. Twenty five palms were randomly selected from each of four Divisions of the estate (Walpolayaya, Dematagolla, Raththarankotuwa and Diyathure) and three nuts were collected from each palm.

Horekelle Estate, Kudawewa

This estate belongs to the NLDB. Hundred palms were selected randomly from Block No. 01 and 08 where the older plantation still exists. Three nuts per palm were collected from each selected palm.

Keenakelle Estate 4, Mudukatuwa

This is also a private estate belonging to Mr. R.A. Jayawardena. Hundred palms were selected randomly from the older plantation and two nuts per palm were collected from each selected palm.

Maliboda Estate, Deraniyagala

This estate was formally managed by the JEDB and now managed by the Bogawathalawa Plantations (Pvt) LTD. This estate is mainly planted with tea and nearly 72 ha of the steep land where tea was not successful had been planted with coconut by the then Superintendent about 30-40 years ago. The elevation of the estate is around 1500 ft above see level where coconut is very rarely grown. Available information suggests that the seednuts for planting had been obtained from Nattandiya area. There are also some conflicting reports that the seed material was obtained from Shakerly Estate, Ambakotte. Detailed investigations on the origin of this material will be undertaken in 1993.

The palms in the estate bear big nuts with heavy bunches giving kernel weights much higher than in other well managed plantations. The first information on the existence of this population was obtained through Serendib Coconut Products to whom Maliboda Estate was the supplier of the largest sized nuts.

Three hundred palms were initially selected from the field No. 03 on the basis of size of the nut and the number of nuts per bunch and then they were screened down to one hundred palms on the basis of husked nut weight (1000 g and above per nut). Two nuts per palm were collected from each selected 100 palm for nut component analysis and nursery laying.

Walahapitiya Estate, Nattandiya

This is also a private estate belonging to Noorani Estates Ltd. This estate has also been identified by the CRI as a potential source of seed nuts and it was found that seed material collected from this estate had been established in countries such as Malaysia, Bangladesh, Pakistan and Papua New Guinea. This material is internationally referred to as 'Luwa Pol' meaning thick kernel.

One hundred palms were selected from fields 05 and 06 where there is an older plantation in existence. Two nuts per palm were collected from each selected palm this year.

Wilhelmina Estate, Puttalam

This is also a private estate owned by Mr. Lalith Fonseka. According to the Superintendent, some of the palms on the estate bear as much as 17-18 bunches per year despite the 'drought' condition of the area. The nuts are large with few nuts per bunch. The kernel was found to be quite thick in the sample studied qualitatively but the proportion of husk was comparatively higher than in many populations studied.

Since it might also be possible to find the individual palm yield from past records to base the selection, the perusal of such records and palm selection was programmed for 1993.

Marandawila Estate, Marandawila

This estate belongs to the NLDB. The palms on the estate had been selected as parent palms for the Isolated Seed Garden at Ambakelle based on the results of the 'Marandawila Progeny Trial'. Palm selection and nut collection would be carried out in 1993.

Fruit Component Analyses and other population characteristics for Maliboda Estate, Horakelle Estate, Keenakelle Estate, Walahapitiya Estate, Meesripura Estate, and St. Johns Estate are summarized in Table 27, 28, 29, 30, 31 and 32 respectively.

From 8 out of 11 palms selected from Mudunawatta Estate, Wellawa, (see Annual Report, 1988) 109 nuts were collected for the purpose of replicating the material at Poththukulama Research Station.

Table 30. *Fruit, inflorescence and other characteristics of the selected palm population at Walahapitiya Estate, Nattandiya.*

Characteristics*	Mean	SD
Fruit		
Fruit weight (g)	1277.6	275.1
Husk weight (g)	712.2	209.8
Nut weight (g)	571.2	120.5
Split nut weight (g)	466.7	89.4
Fresh weight of kernel (g)	295.0	61.7
Dry weight of kernel (g)	166.7	39.9
Estimated copra weight (g)	187.0	
Inflorescence		
Length with spikelet (mm)	635.0	138.9
Length without spikelet (mm)	276.0	168.4
Average length of a spikelet (mm)	482.9	176.9
Spikelet/bunch	31.3	5.9
Female flowers in 1st bunch	11.3	9.3
Female flowers in 2nd bunch	10.4	9.0
Total number of female flowers	13.1	11.8
Total resulting fruits	7.3	3.7
Other		
Height of palm (m)	16.8	1.2
Nuts/pick	7.3	3.7

(* Sample size was one fruit per palm from 100 palms for fruit characteristics, one inflorescence per palm from 10 palms for inflorescence characteristics and 10 palms per population for height of palm and nuts/pick.)

Table 31. *Fruit, inflorescence and other characteristics of the selected palm population at Melsiripura Group, Melsiripura.*

Characteristics*	Mean	SD
Fruit		
Fruit weight (g)	1855.6	447.8
Husk weight (g)	1067.2	410.5
Nut weight (g)	771.8	210.7
Split nut weight (g)	582.3	103.6
Fresh weight of kernel (g)	363.3	71.1
Dry weight of kernel (g)	193.2	44.4
Estimated copra weight (g)	233.0	
Inflorescence		
Length with spikelet (mm)	747.0	135.9
Length without spikelet (mm)	153.3	62.2
Average length of a spikelet (mm)	378.6	76.1
Spikelet/Bunch	29.0	9.1
Female flowers in 1st bunch	16.5	8.6
Female flowers in 2nd bunch	9.3	9.4
Total number of female flowers	26.0	14.2
Total resulting fruits	9.3	3.7
Other		
Height of palm (m)	15.1	1.4
Nuts/pick	9.3	3.7

(* Sample size was one fruit per palm from 100 palms for fruit characteristics, one inflorescence per palm from 10 palms for inflorescence characteristics and 10 palms per population for height of palm and nuts/pick.)

Table 27. *Fruit characteristics of the selected palm population at Maliboda Estate, Deraniyagala.*

Fruit component	Mean	SD
Fruit weight (g)	1985.4	429.9
Husk weight (g)	935.0	386.0
Nut weight (g)	1032.5	175.3
Split nut weight (g)	765.8	104.0
Fresh weight of kernel (g)	487.4	69.6
Dry weight of kernel (g)	266.1	42.3
Estimated copra weight (g)	306.0	

(Sample size was one fruit per palm from 100 palms).

Table 28. *Fruit, inflorescence and other characteristics of the selected palm population at Horakelle Estate, Kudawewa.*

Characteristics*	Mean	SD
Fruit		
Fruit weight (g)	1557.6	321.9
Husk weight (g)	821.2	267.5
Nut weight (g)	720.6	169.8
Split nut weight (g)	557.3	104.8
Fresh weight of kernel (g)	357.3	79.2
Dry weight of kernel (g)	193.5	60.2
Estimated copra weight (g)	222.0	
Inflorescence		
Length with spikelet (mm)	690.0	63.2
Length without spikelet (mm)	151.0	48.2
Average length of a spikelet (mm)	393.8	48.3
Spikelet/Bunch	27.0	6.2
Female flowers in 1st bunch	8.4	5.0
Female flowers in 2nd bunch	10.1	3.6
Total number of female flowers	16.5	8.9
Total resulting fruits	8.3	3.4
Other		
Height of palm (m)	14.3	1.9
Nuts/pick	8.3	3.4

(* Sample size was one fruit per palm from 100 palms for fruit characteristics, one inflorescence per palm from 10 palms for inflorescence characteristics and 10 palms per population for height of palm and nuts/pick.

Table 29. *Fruit, inflorescence and other characteristics of the selected palm population at Keenakelle Estate, Marawila.*

Characteristics*	Mean	SD
Fruit		
Fruit weight (g)	1531.6	336.9
Husk weight (g)	805.1	328.0
Nut weight (g)	698.1	156.9
Split nut weight (g)	528.9	100.5
Fresh weight of kernel (g)	355.4	75.5
Dry weight of kernel (g)	197.2	41.7
Estimated copra weight (g)	212.0	
Inflorescence		
Length with spikelet (mm)	773.7	134.5
Length without spikelet (mm)	172.5	45.3
Average length of a spikelet (mm)	435.9	70.1
Spikelet/Bunch	29.2	7.5
Female flowers in 1st bunch	20.4	16.9
Female flowers in 2nd bunch	18.6	10.4
Total number of female flowers	39.0	26.1
Total resulting fruits	12.5	3.4
Other		
Height of palm (m)	15.8	1.0
Nuts/pick	12.5	3.4

(* Sample size was one fruit per palm from 100 palms for fruit characteristics, one inflorescence per palm from 10 palms for inflorescence characteristics and 10 palms per population for height of palm and nuts/pick.)

Table 32. *Fruit, inflorescence and other characteristics of the selected palm population at St. John's Estate, Mangala Eliya.*

Characteristics*	Mean	SD
Fruit		
Fruit weight (g)	1131.8	259.6
Husk weight (g)	649.4	229.7
Nut weight (g)	473.2	121.4
Split nut weight (g)	397.3	84.0
Fresh weight of kernel (g)	249.4	60.0
Dry weight of kernel (g)	144.7	37.7
Estimated copra weight (g)	159.0	
Inflorescence		
Length with spikelet (mm)	645.0	93.5
Length without spikelet (mm)	135.0	48.4
Average length of a spikelet (mm)	362.6	44.0
Spikelet/Bunch	27.4	6.5
Female flowers in 1st bunch	23.5	15.5
Female flowers in 2nd bunch	15.6	12.7
Total number of female flowers	39.0	18.8
Total resulting fruits	13.2	9.6
Other		
Height of palm (m)	17.5	1.3
Nuts/pick	13.2	9.6

* Sample size was one fruit per palm from 100 palms for fruit characteristics, one inflorescence per palm from 10 palms for inflorescence characteristics and 10 palms per population for height of palm and nuts/pick.

Assembly and evaluation of collected material

Conservation Block - Poththukulama Research Station (PRS)

This plantation was maintained satisfactorily during the year. Growth measurements were recorded twice this year in May and November and fertilizer was applied during the south-west monsoon rains. The germplasm accessions introduced during the year are summarized in Table 33.

Table 33. *The germplasm accessions introduced during the year.*

Date of planting	Accession	Number of seedlings established	Number of mother palms
26 May	*Kundasale (Dwarf)*	85	100
11 October	*Cameroon Red Dwarf (CRD)*	86	3
18 November	*Goyambokka*	85	100
19 November	*Mangala Eliya*	85	100
20 November	*Melsiripura*	91	100
02 December	*Goluwapokuna*	82	30

In addition to this the entire block of the *Debarayaya* (81) and *Kasagala* (81) seedlings had to be replanted in a different block in the conservation site due to death of a large number of seedlings in the previous location as a result of the water logging.

Several vacancies that occurred during the year. (26 *Ambakelle Special*, 10 *St.Anne's*, 04 *Margaret*, 07 *Pitiyakanda*, 04 *Clovis*, 01 *Moorock*, 07 *Namalwatta*, 19 *Akurassa* 03 Kundasale dwarf and 05 *Palugaswewa*) were supplied in the conservation block while 42 *Ambakelle Special* seedlings were supplied on the guard rows.

Canonical discriminant analysis (Krzanowski, 1988) was applied to several germplasm accessions (*Moorock, Palugaswewa, Pitiyakanda, Clovis, Namalwatta, St.Anne's* and *Margaret*) using 10 quantitative variables (Growth parameters only) with the hope of identifying their grouping ability. The first two canonical variables explain 75% of the variation and when the accession scores were plotted with the individuals of the accessions, Clovis, St.Anne's and Namalwatta grouped on their own indicating their distinctiveness. Individuals of the remaining accessions were grouped together. The Mahalanobis generalized distance

(D^2) between pair-wise accessions are shown in Table 34. The accession Clovis had the widest separation from St.Anne's, Pitiyakanda and Moorock indicating the possibility of heterosis by crossing between these two accessions.

Table 34. *Canonical Discriminant Analysis of seven selected 7 germplasm accessions.*

From Accession	Squared Distance to Accession						
	MOO	PAL	PIT	CLO	NAM	ST.ANN	MAE
MOO	-	1.99	3.02	**15.86**	7.62	9.67	6.34
PAL		-	3.79	13.84	7.83	9.08	4.15
PIT			-	**18.03**	14.20	14.43	7.43
CLO				-	8.66	**24.35**	6.72
NAM					-	11.82	6.72
ST. ANN						-	10.95

(MOO: Moorock, PAL: Palugaswewa, PIT: Pitiyakande, CLO: Clovis, NAM: Namalwatta, ST. ANN: St. Annes, MAE: Margaret)

Conservation Block - Bandirippuwa Estate

All management practices on this conservation site were handed over to the Estates Management Division this year. Growth parameters were recorded twice this year in June and December and *Razeena* (Mahahena, Akurassa) (84) accession was introduced to the block in June.

In addition, the entire block of *Ambakelle Special* (60) which was damaged by rats last year, 15 *Wellawa*, 28 *Pitiyakanda*, 53 *Moorock*, 78 *Namalwatta*, 52 *Debarayaya*, 49 *Clovis* and 41 *Palugaswewa* seedlings were supplied during the year.

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

(a) San Ramon: Collection from Uhumiya Estate was satisfactorily maintained at Bandirippuwa Estate and Poththululama Research Station and 04 vacancies were supplied this year.

(b) Dwarf forms:

(i) Kundasale farm: Eighty five seedlings of DG, Dy and DR forms of Kundasale dwarf were planted at PRS and were satisfactorily maintained.

(ii) Mirishena Estate, Bulathsinhala: It was not possible to visit the estate this year due to the lack of funds. The nut collection would be done next year after negotiating with the parties in dispute (cf. Annual Report,1991).

(iii) Brown (Russet) dwarf: Another two palms were identified this year at Marawila and Nattandiya. A total of 134 nuts comprising 132 open pollinated nuts and 02 selfed nuts were collected during the year and of this 35 seed nuts have germinated up to now. A self pollination programme was commenced on the Madampe, Kirimatiyana, Marawila and Nattandiya palms to obtain purified progenies. The summary of the selfing programme is presented in Table 35.

Table 35. *Summary of the self - pollination programme on Brown dwarfs*

Month	Number of palms	Number of inflorescences	Number of buttons selfed	Number of buttons after 3 months	6 months
January	-	-	-	-	-
February	-	-	-	-	-
March	1	1	53	-	-
April	1	2	103	-	-
May	2	2	75	3	2
June	2	3	53	11	-
July	2	2	30	11	-
August	2	2	16	1	-
September	1	2	27	7	-
October	2	3	45	-	-
November	2	2	28	-	-
December	1	1	13	-	-

Poor nut set in March, April and May, is attributed to the high temperature within the pollination bag, as a result of 'drought' conditions in the area.

Apart from this, 2 dwarf yellow palms were observed at Weralugama Estate, Kuliyapitiya which were established from seednuts collected from Johana Estate, Pallama several years ago. Since Johana Estate has now been blocked out and the original dwarf plantation has disappeared, it was decided to collect and conserve this material next year.

A A L Perera, R R A Peries, R B Attanayake and W B S Fernando

(d) Others:

Hybridization and selfing of the remaining palms at Akurassa (cf. Annual Report 1991) were continued this year. Pollen from Akurassa was collected continuously and D x T hybrids were produced at ISG.

Few palms were identified at Dikkanda Estate, Waturagama, which were believed to have been imported from Burma a long time ago. Correspondence was made with the Superintendent regarding the purification of the material and this would be undertaken in 1993.

Two West African Tall palms which were imported during 1950's by the Botanist and established in the old crop museum were showing signs of senility and attempts were made during the latter part of the year to rehabilitate them for use as pollen parents.

Razeena (Mahena) Estate:

The pollination programme for the purification of material and production of hybrids which was temporarily suspended early in the year due to the prevailing drought in the area was resumed in July. Pollen was collected from one inflorescence each in palms T2, T4, T5, T6 and T8 and from two inflorescences in palms T7. The number of emasculated inflorescences and the number of female flowers pollinated are shown in Table 36. The number of button nuts of the different crosses developing after 3 months of pollination are shown in Table 37.

Table 36. *The total number of inflorescence emasculated, female flowers pollinated and the number of buttons remaining after 3 months at Razeena Estate, Akuressa.*

Month	Number of palms pollinated	Number of inflorescence emasculated	Number of buttons pollinated	Number of buttons after 3 months of pollination
July	06	07	102	29
August	07	09	109	34
September	07	07	80	18
October	07	08	84	-
November	07	07	80	-
December	02	02	26	-
Total	07	40	481	81

Table 37. *Number of button nuts remaining on the inflorescence after 3 months of pollination in the different crosses at Razeena (Mahahena) Estate, Akuressa.*

	Male parent						
Female	T-2	T-4	T-5	T-6	T-7	T-8	D-2
T-2	-	08	x	-	x	05x	-
T-4	04x	-	x	-	03	03	-
T-5	x	06	-	x	03	01x	-
T-6	05x	03	x	01	02x	-	
T-7	06	04	x	x	-	04	-
T-8	06x	06	x	04	-	-	-
D-2	-	-	x	x	04	03	05

(x Female flowers pollinated in November and December.)

As a result of hand pollinations carried out since June 1991, 138 seed nuts were collected up to November and laid at the Bandirippuwa research nursery. The harvest for December is yet to be done. The summary of harvested nuts according to their crosses to presented in Table 38.

Table 38. *The number of nuts harvested from each of the different crosses during the year at Razeena Estate, Akuressa*

Female	Male parent								
	T-2	T-4	T-5	T-6	T-7	T-8	D-2	Nuts harvested	Nuts to be harvested
T-2	12	-	03*	02	08	02	-	24	03
T-4	05*	13	06*	04	01	06	-	24	11
T-5	-	01*	06	02	06	01	-	15	01
T-6	-	-	02*	06	01*	04	-	10	03
T-7	03	-	04	-	24	-	-	31	-
T-8	-	01	03*	01*	03	20	-	24	04
D-2	-	01	04*	01	03	-	05	10	04

(* To be nuts harvested)

R R A Peries, A A L Perera and M H L Padmasiri

Collection of drought tolerant germplasm

A total of 184 nuts, 154 from Debarayaya Estate, Netolpitiya and 30 nuts from Goyambokka Estate, Tangalle (see Annual report, 1988) were collected this year for the purpose of infilling.

A A L Perera, R R A Peries, and R B Attanayake

PROJECT 6: PRODUCTION OF HIGH QUALITY SEEDS AND SEEDLINGS

3. MISCELLANEOUS RESEARCH

3.1 *Improvement of nursery techniques*

Water use and water use efficiency in putative drought resistant tall palms in the Isolated Seed Garden at Ambakelle

Seed nuts collected from ISG were sprouted in a pre-nursery bed and subsequently transferred to polybags using the amputated seedling technique. The

seedlings are showing slow establishment under glass house conditions. Measured quantities of water are being applied to the seedling during the establishment phase. Treatments will begin when seedlings have fully established.

R R A Peries and J M D T Everard

Raising coconut seedlings in polybags with sand-based potting mixtures with and without fertilizer application (1991)

This experiment was successfully completed this year. It had been observed that the substitution of top soil in polybag mixture with river sand had no effect on the development of coconut seedlings. It was also found that even pure river sand could be successfully used up to 7 months from seed nut laying provided seedlings were kept free from water deficit.

Application of fertilizer on the other hand improved the seedling height and girth but this effect was significant only 5 month after seed nut laying. However, the study revealed that the improvement in seedling vigor was inadequate to justify the extra expense on fertilizer.

The results have been prepared for publication.

A A L Perera, R R A Peries and R Jayatilaka

3.2 *Variety Evaluation trials*

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. Yield recording was carried out by the resident staff of the station. Fruit component studies were not undertaken due to the limited budget during the year.

Evaluation of performance of *tall x tall, dwarf x tall, San Ramon* and *dwarf x San Ramon* at Dambuwa Mukalana, Demonstration Farm (Dry Intermediate Zone) Thabbowa, Naththandiya. (1991).

Yield data were continuously collected from all picks and nut component analysis was also continued from 2 nuts per palm per pick for total of 6 picks during the year. As summary of collected data is given in Table 39.

Table 39. *A comparison of fruit components of tall x tall; dwarf x tall, dwarf x San Ramon and San Ramon at Dambuwa Mukalana Demonstration Farm, Nattandiya 1992.*

Variety	Mean nut yield/palm	Mean fruit wt. (g)	Mean husked nut wt. (g)	Mean split nut wt. (g)	Estimated copra wt./palm (kg)
SR	60.48	2222.82	1215.36	836.21	23.5
D x SR	74.76	1724.40	800.37	586.50	19.1
D x T	76.32	1635.69	992.93	632.66	24.3
T x T	106.68	1388.48	676.07	509.73	23.0

Data indicated little difference between D x T, T x T and SR. However, the total copra yield D x SR palms were less than SR a D x T palms. Despite the fact that nut production per palm in their 11th year was not different between D x SR and D x T, it would appear that combining ability of D x T was superior to that of D x SR in improving the copra production per nut. This is reflected in the total copra production per palm. A five conclusion can be made after yield records have been studied for a further 2 years and comparing their with the results of the progeny trials where similar crosses are evaluated.

4. SEED GARDENS

4.1 THE ISOLATED SEED GARDEN AT AMBAKELLE

4.1.1: *Rainfall*

The amount and distribution of rainfall for 1992 are shown in Table 40 along with the values for the previous year and the 10 year average (1983-1992). The total rainfall for the year (1696 mm) was 316 mm higher than that of the previous year. Despite the fact that the rainfall was generally well distributed between the months of April and December the months of January, February and March was completely dry with zero rainfall.

The excessive rain (406 mm) in November caused temporary water stagnation in several fields (1, 2, 4, 8, 11b etc) resulting in slight yellowing of both adult and young palms. It was suspected that the temporary water stagnation had led to the wash-off of soil stored Mg into the network of drains in the estate. It was decided to give an additional application of Mg (5 kg Dolomite/palm) as a measure against the possible repercussion of Mg deficiency in the year ahead.

Table 40. *The amount and distribution of rainfall for 1991 and 1992 and the 10 year average (1983-1992) for comparison at ISG.*

Month	1991			1992			10 yrs (1983-1992) average		
	A	B	C	A	B	C	A	B	C
Jan	44.0	5	5	0.0	0	0	52.79	4.2	4.1
Feb	0.0	0	0	0.0	0	0	54.56	3.3	3.1
Mar	116.0	9	9	0.0	0	0	70.98	5.1	4.9
Apr	147.9	10	10	217.8	9	9	193.97	9.2	8.8
May	182.5	8	8	207.3	11	11	142.09	9.0	8.5
Jun	236.5	17	17	239.5	8	8	104.19	10.2	9.8
Jul	29.2	6	6	116.9	7	6	54.73	6.0	5.0
Aug	17.1	2	2	28.4	5	5	29.53	4.3	4.1
Sep	25.8	4	4	62.3	7	6	107.35	9.4	8.6
Oct	221.6	21	21	342.3	10	10	223.54	13.9	13.5
Nov	208.1	11	11	406.0	22	20	258.86	13.9	13.5
Dec	151.5	8	8	75.9	8	7	92.01	6.9	6.7
Total	1380.2	101	101	1696.4	87	82	1384.6	95.4	90.6

(A = Rainfall amount in mm; B = Number of rainy days; C = Number of wet days (rainfall > 1 mm)

Table 41. *Total nut yields at ISG from the six picks of the year.*

Pick	1991	1992	Ten year (1983- 1992) average
01	61012	123985	109970.2
02	74737	254460	153618.4
03	70664	234640	168265.6
04	65056	244565	152476.4
05	51474	162206	143208.1
06	71007	160604	116589.3
Total	393950	1180460	844128.0
Number of bearing palms	12868	14451	
nuts per palm	31	82	

Table 42. *Nut yields from the tall and dwarf palms at ISG during the year.*

Tall Crop

Pick	1991	1992	Five year (1988-1992) average
01	57546	101377	83986.0
02	69339	219274	116659.6
03	54274	197158	115575.8
04	51973	184865	105443.2
05	40754	120027	94840.6
06	51771	119758	92805.8
Total	325657	942459	609311.0
Number of palms in bearing	10133	11527	
nuts per palm	32		

(* Of this total, 527 palms were adversely affected by drought.)

Dwarf (D x T) Crop

Pick	1991	1992	Five year (1988-1992) average
01	3466	22608	19156.4
02	5398	35186	25261.8
03	16390	37482	25252.4
04	13083	59700	24673.4
05	10720	42179	27122.2
06	19236	40846	22687.6
Total	68293	238001	144153.8
Number of palms in bearing	2735	2924	
Nuts per palm	25	81	

4.1.2: Nut yields

Total crop figures for 1991 and 1992 are shown in Table 41 with the 10 year average (1983-1992). As a result of the improved rainfall distribution over

Table 43. *Classification of palms at ISG*

Field	Tall							Dwarf green							Dwarf yellow							
	B	PB	YP	S	D	V	X1	B	PB	YP	S	D	V	X2	B	PB	YP	S	D	V	X3	X123
01	272	11	41	-	5	18	347	-	-	-	-	-	-	-	-	-	-	-	-	-	-	347
02	244	4	133	-	9	26	416	-	-	-	-	-	-	-	-	-	-	-	-	-	-	416
03	251	17	39	-	9	25	341	-	-	-	-	-	-	-	-	-	-	-	-	-	-	341
04	1841	45	70	-	6	627	2562	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2562
05 old	-	-	-	-	-	-	-	7	-	-	-	-	-	7	-	-	-	-	-	-	-	7
05 new	351	22	84	-	6	31	494	165	6	-		3	80	254	-	-	-	-	-	-	-	748
06	828	-	26	-	7	551	1412	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1412
07	622	-	-	-	16	778	1416	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1416
08A	225	-	9	2	1	136	373	-	-	-	-	-	-	-	-	-	-	-	-	-	-	373
08B	383	-	-	-	2	197	582	-	-	-	-	-	-	-	-	-	-	-	-	-	-	582
08C	235	-	-	-	22	354	611	-	-	-	-	-	-	-	-	-	-	-	-	-	-	611
09	616	28	190	-	13	10	857	497	17	57	-	12	261	944	-	-	-	-	-	-	-	1801
10A	171	21	171	-	8	4	375	78	43	6	-	8	19	154	836	11	273	-	10	383	1513	2042
10B	123	-	161	22	4	29	339	288	5	135	-	6	316	750	320	5	2	-	1	165	493	1582
11A old	197	5	25	10	7	37	281	-	-	-	-	-	-	-	-	-	-	-	-	-	-	281
11Anew	402	104	1302	10	7	37	281	-	-	-	-	-	-	-	-	-	-	-	-	1989		
11B old	220	-	8	34	6	10	278	-	-	-	-	-	-	-	-	-	-	-	-	278		
11Bnew	616	266	857	32	-	89	1860	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1860
12 old	152	-	-	45	4	12	213	-	-	-	-	-	-	-	-	-	-	-	-	-	-	213
12 new	1189	99	133	51	-	45	1517	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1517
13 old	187	-	31	40	11	16	285	-	-	-	-	-	-	-	-	-	-	-	-	-	-	285
13 old	2139	90	190	14	10	80	2523	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2523
14	290	2	1	44	14	111	462	733	-	-	-	15	1898	2646	-	-	-	-	-	-	-	3108
Total	11527	714	3471	999	160	3393	20264	1768	171	198	-	44	2574	4755	1156	16	275	-	11	548	2006	27025

(B, Bearing palms; PB, partially bearing; YP, Young palms; S, Seedling; D, Duds; V, Vacancies;
X1 = Total planting points for tall; X2 = Total planting points for dwarf green; X3 = Total planting points for dwarf yellow; X123 = Total for field)

that of 1991, there was a gradual increase in the crop and a revival of the adverse trend in crop since 1989. The individual palm yields showed a 156% increase over that of 1991, but it was still 25% less than what the palms achieved in 1989 (109 nuts/palm). With the improved rainfall distribution and agronomic practices, it is expected that these yields will further increase in 1993.

The nut yields of *Talls* and *Dwarfs* are shown separately in Table 42. The average number of nuts per tall palm increased from 32 to 82 while in the dwarfs it increased from 25 to 81. Improvement in crops was seen in all six crops over that of the previous year. The highest crop in the talls was reached in the first crop, which was the result of heavy November/December rains of 1990. In fields 1 and 4 where the palm population has a greater yield potential, individual palm yields reached up to 127 and 125 respectively during the year. It is likely that the effect of the rain-free period in 1992 will be felt in all the fields at ISG over the second and third crops of 1994. The classification of palms (census) as at 31 December is shown in Table 43.

4.1.3: Emasculation of *dwarf* palms for the production of CRIC 65 hybrid nut:

Details of the emasculation programme are shown in Table 44. A total of 3040 *dwarf* palms comprising 1866 *dwarf green* and 1174 *dwarf yellow* forms were emasculated during the year.

Table 44. *Emasculation of dwarf palms for the production of CRIC 65 seednuts.*

Field number	Number of palms emasculated		Number of inflorescences emasculated		Number of button nuts at emasculation	
	DG	DY	DG	DY	DG	DY
05	180	-	2144	-	40648	-
09	628	-	6368	-	105453	-
10A	87	847	1350	12823	20949	209422
10B	300	327	4232	4666	75252	70459
14	671	-	12149	-	180575	-
Total	1866	1174	26243	17489	422877	279881

4.1.4: Controlled pollination

Talls: No controlled pollinations were done this year in field No. 3 since the staff was involved in the pollination work in field No. 4 (improvement of nut size project). Resulting from the pollination of 1991, 3575 nuts were harvested during the year from field number 3c (cf. Annual Report 1991).

Dwarfs: As result of selfing continued on 5 *dwarf palms* (3339, 3569, 3677, 3714 and 3715) that survived the recurrent droughts and those used as parents of the mini seed garden, a total of 124 seed nuts were harvested between February and July, out of 209 buttons that were developing at the end of 1991. The details of monthly harvests of seed nuts are shown in Table 45.

Table 45. *Summary of harvests in the self-pollination programme undertaken in field number 5 of ISG.*

Month	Number of inflorescences handled	Number of buttons at emasculated	Number of buttons at 3 months after selfing	Number of selfed nuts harvested
February	02	144	25	22
March	08	344	84	57
April	04	178	27	12
May	05	269	24	05
June	03	195	32	24
July	03	144	17	04
Total	25	1274	209	124

The same dwarf palms were pollinated with pollen from 'Mahahena' (cf. Annual Report 1991) to produce a *D x T* hybrid. The number of nuts harvested as a result of pollination done in 1991 are summarized in Table 46.

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Table 46. *Number of seed nuts harvested from green dwarfs in field no. 5 of ISG pollinated with pollen from Mahahena (Akuressa)*

Male / Female	T-2	T-4	T-5	T-6	T-7	T-8	Total
3339	06	09	01*	03*	-	-	19
3569	05	06		04	01		16
3677	06	04	02	03		04	19
3714	05	03		02		-	10
3715		02				-	02

(x: Pollinated in January 1992)

4.2: MAKANDURA SEED GARDEN

The seed garden suffered severely the adversities of the prolonged rain-free period of January to March this year. No further selection was attempted (cf. Annual Report 1991) until the palms recovered from the drought effects.

R R A Peries and J M D T Everard

4.3: MADURU OYA SEED GARDEN

Systematic numbering of palms was undertaken as a pre-requisite to rouging the poor palms. Selection work was postponed to 1993 in view of the limited budget in 1992.

5. SEED PRODUCTION

No requests for palm selection or reselection were received from the Coconut Cultivation Board during the year. Few requests were received from state owned and private estates to select palms to raise seedlings for their own replanting programmes. These requests will be met in 1993.

6. POLLEN AND POLLINATION

6.1 Pollen collection and issue

Details of pollen collection and issues are summarized in Table 47. Pollen of the *typica* variety was collected during the year from 62 inflorescences from 16 selected palms in field 4 of the ISG. A total of 1200 ampoules of unadulterated pollen were sealed.

Pollen of the *typica* variety was collected from 07 inflorescences from 06 selected palms from Razeena Estate, Akuressa ('Mahahena') and 476 of such ampoules of pollen were sealed. Small quantities of pollen were sealed in ampoules in order to avoid the wastage of pollen. No new pollen of the form *pumilla* from Akuressa ('Mahahena') was collected as this was not required for the pollination programme.

Pollen of the form *pumilla* from ISG was collected during the year from 05 inflorescences in 05 selected palms on Field 5 (old plantation) and 98 ampoules of pollen were sealed. Pollen from local forms of typica on the variety block (Field no. 9) at Bandirippuwa Estate was collected from 08 inflorescences in 06 palms and 45 ampoules of pollen were sealed.

Pollen of *Brazilian green dwarf* was collected from 02 inflorescences up to April and since then no pollen was processed as the palms did not produce any healthy inflorescences. A total of 10 ampoules were sealed.

As the demand for processed pollen from the private estates fell, pollen of the typica varieties at ISG were neither mixed nor adulterated with Lycopodium.

Table 47. *Pollen collection and issue during the year.*

	No. of ampoules					
	typica			nana		
	ISG	Tall (Mahahena)	Variety palms (B/E)	DG (Mahahena)	DG (ISG)	BGD (BE)
Carried over from 1991						
Pollen from individual palms	249	425	29	25	42	31
Mixed pollen adulterated with *Lycopodium*	33	-	-	-	-	-
Sealed in 1992						
Pollen from individual palms	1200	476	45	-	98	10
Mixed pollen adulterated with *Lycopodium*	-	-	-	-	-	-
Issued for pollination programmes						
Pollen from individual palms						
1. At ISG	554	-	-	-	30	-
2. At Akuressa	-	180	-	-	-	-
3. At BE	-	-	45	-	-	11
Issued to estates (at Rs.10/= per ampoule)						
Mixed pollen adulterated with *Lycopodium*	-	-	-	-	-	-
Other uses						
(Viability tests, demonstrations, breakages etc.)						
Pollen from individual palms	55	50	12	-	26	5
No viability /Low viability						
Pollen from individual palms	349	375	-	-	-	-
Mixed pollen adulterated with *Lycopodium*	33	-	-	-	-	-
Balance as at 31 December 1992						
Pollen from individual palms	491	296	17	-	-	-
Mixed pollen adulterated with *Lycopodium*	-	-	-	-	-	-

(DG: Dwarf green; BGD: Brazilian Green Dwarf)

W B S Fernando

Table 48. *Seednuts laid in the Bandirippuwa Nursery during the year.*

Variety	Source	----- Number of seednuts -------- In beds	In Polybags	Total
Hand pollinated nuts				
Akurassa	Razeena Estate	57	-	57
Cameroon Red Dwarf	Old nursery B/E	-	127	127
Brazilian Green Dwarf	Old nursery B/E	-	50	50
Pora pol	Old variety block	-	12	12
Bodiri	Old variety block	-	122	122
Nawasi	Old variety block	-	14	14
Ran thembili	Old variety block	-	13	13
Dwarf green	New variety block	-	67	67
Dwarf yellow	New variety block	-	15	15
Dwarf red	New variety block	-	23	23
Ambakelle tall	ISG	346	-	346
Germplasm Collections				
Debarayaya	Debarayaya	154	-	154
Wellawa	Mudunawatta	109	-	109
Akuressa	Razeena estate	97	-	97
Goluwapokuna	Goluwapokuna	205	-	205
Goyambokka	Goyambokka estate	30	-	30
Dwarf Russette	Kirimetiyana temple	-	31	31
Dwarf Russette	Madampe	-	51	51
Dwarf Russette	Mawathagama	-	13	13
Dwarf Russette	Marawilla	-	20	20
Dwarf Russette	Ninamadama	-	16	16
Dwarf Russette	Thimbiriguskatuwa	-	03	03
Mangala Eliya	Mangala Eliya	198	-	198
Horakelle	Kudawewa	199	-	199
Keenakelle	Mudukattuwa	104	-	104
Walahapitiya	Nattandiya	195	-	195
Maliboda	Daraniyagalla	142	-	124
Melsiripura	Melsiripura	197	-	197
Willhelmina	Puttalam	07	-	07
Waralugama	Kuliyapitiya	10	-	10
Other				
Ambakelle special(i)	ISG	2891	-	2891
Ambakelle tall	ISG	290	-	290
Mahawawa	Mahawawa	-	16	16
Sirikandura	Rathgama	216	-	216
Pottukulama	PRS	40	-	40

Table 49. *Seedling issues from the Bandirippuwa Research Nursery during the year.*

Variety/ Accession	G & PBD		Other Divisions		Other purposes		Commercial issues		Total
	A	B	A	B	A	B	A	B	
T x T	-	-	-	-	-	-	-	674	674
AS	-	130	-	-	-	01	476	732	1339
SR x SR	-	11	-	-	-	-	24	57	92
CRD	-	87	-	-	-	-	-	-	87
BGD	-	-	-	-	-	-	-	-	-
Akuressa	-	103	-	-	-	-	-	17	120
MT	-	54	-	15	-	-	-	69	
Maragaret	-	04	-	-	-	-	-	-	04
St. Anne's	-	10	-	-	-	-	-	05	15
Kundasale	-	92	-	-	-	-	-	22	114
Wellawa	-	15	-	-	-	-	-	04	19
Clovis	-	53	-	-	-	-	-	13	66
Palugaswewa	-	46	-	-	-	-	-	46	
Pitiyakanda	-	36	-	-	-	-	-	-36	
Debarayaya	-	137	-	-	-	-	-	137	
Kasagala	-	81	-	3	-	-	-	12	96
Namalwatta	-	85	-	-	-	-	-	85	
Goyambokka	-	90	-	-	-	-	-	90	
Mangala Eliya	-	86	-	-	-	-	-	86	
Melsiripura	-	91	-	-	-	-	-	116	
Goluwapokuna	-	82	-	-	-	-	-	82	
Total	-	1294	-	18	-	01	500	3374	

(CRD: Cameroon Red Dwarf; BGR = Brazilian Green Dwarf; MT: Moorock tall; A and B are seedlings from conventional seed beds and polybags respectively.)

Table 50. *Availability of planting material at Bandirippuwa Research Nursery as at 31 December*

Variety	------ Seedlings over 5 months in age ----- In seedbeds	In polybags	Total
Germplasm collections			
Debarayaya	-	12	
Wellawa	-	05	05
Moorock	-	20	20
Palugaswewa	-	18	18
Kirimatiyana	-	08	08
kundasale	-	20	20
Goluwapokuna	-	78	78
St. Annes	-	07	07
Goyambokka	-	38	38
Melsiripura	-	36	36
Madampe	-	16	16
Mangala Eliya	-	58	58
Mawathagama	-	12	12
Weralugama	-	06	06
Horekelle	-	131	131
Keenakelle	-	90	90
Cameroon Red Dwarf	-	75	75
Brazelian Green Dwarf	-	08	08
Bodiri	-	08	08
Akurassa	-	83	83
Other			
Ambakelle Special	418	703	1096
Ambakelle Tall	-	19	19
Sirikandura	-	146	146
Pothukulama	-	38	38
Ambakelle Tall (H.P)	-	211	211
Total	418	1846	2264

7. RESEARCH NURSERY

7.1 Bandirippuwa Research Nursery

Tables 48, 49 and 50 summarizes the data on seednuts laid, seedlings issued and the availability of seedlings as at 31 December. Seedlings from the germplasm conservation programme were used throughout the year for infilling vacancies and/or establishing new blocks in the Bandirippuwa Estate and Poththukulama Research Station germplasm fields.

R R A Peries,A A L Perera, R Jayatilaka and J D J Abeyasekera

8. ACKNOWLEDGEMENTS

The assistance and cooperation of the staff of the Genetics and Plant Breeding Division in compiling this report is gratefully acknowledged.

REPORT OF THE SOILS AND PLANT NUTRITION DIVISION

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

1. GENERAL

Eleven field experiments and nine laboratory/glasshouse studies on nutritional, soil physical and water use aspects of coconut were continued. A new experiment on the effect of chloride nutrition on yield of coconut was commenced.

Studies on nutrient mapping showed that about 50% of the coconut plantations were deficient in potassium (K) and magnesium (Mg). However, data indicate an improvement in Mg nutrition in coconut with the increased use of dolomite in coconut in response to CRI recommendations under Differential Fertilizer Recommendation and Adult Coconut fertilizer mixture. Nutritional deficiencies of sulphur (S), chlorine (Cl), and sodium (Na) in several coconut estates were provided with corrective fertilizer recommendations.

A new project was commenced on the water balance of coconut in relation to soil landscapes, agro-climates and management practices. Land suitability mapping project was also initiated to classify coconut lands for suitability.

1.1 Grants

A research proposal prepared by Mr K S Jayasekara on "Studies on Water Balance of Coconut under different Soil Landscape, Agro-climates, and Management Practices" was approved by the Sri Lanka Council for Agricultural Research Policy (CARP) on 20 February. Collaborating scientists of the project are Dr (Mrs) C Jayasekara (Plant Physiology/CRI), Mr Sunil Dimanta (Land Use Division of the Irrigation Department) and Dr K R R A Peries (Genetics and Plant Breeding/CRI).

1.2 Other Activities

Dr (Mrs) M N Fernandopulle (nee Dias) supervised the final year research project of Miss M Cleda Kanthi from Faculty of Agriculture, University of Peradeniya, Peradeniya.

Dr L L W Somasiri supervised the final year research project of Miss Sudharshani Perera from Faculty of Agriculture, University of Peradeniya, Peradeniya.

2. LABORATORY AND GLASSHOUSE STUDIES

2.1 Studies on the nutrient balance and water use of weeds in coconut plantations (Expt. 4.5)

Twelve common weeds were planted in 5 l plastic pots (30 cm diameter, 30 cm deep) filled with sandy loam soil. Water use by weeds under water non-limiting conditions (ie: field capacity) were monitored and results are given in Table 1.

Table 1. *Water use of some common weeds grown in 5 l plastic pots under water non-limiting conditions (average of 5 samples; pan evaporation 5.2 mm/day).*

Weed	Plant dry mass (g/plant)			Water use per plant (g H2O / plant)		
	Leaf	Stem	Root	Day time (0900-1500h)	Night time (1500-0830h)	Total per day (24h)
Abutilon indicum (Wal anoda)	8	13	5	236 + 66	73 + 22	309 + 50
Achyranthes aspera (Karal Heba)	8	25	6	203 + 18	57 + 6	260 + 16
Chromolaena odorata (Podisinghomarang)	27	54	32	169 + 27	70 + 15	239 + 40
Crotolaria retusa (Andanahiriya)	13	47	7	236 + 66	73 + 22	309 + 49
Imperata cylindica (Illuk)	3	4	3	7 + 2	1 + 0.3	8 + 1
Lantana camara (Baloliya)	31	58	34	254 + 23	36 + 11	290 + 20
Mimosa pudica (Nidikumba)	5	13	2	188 + 38	64 + 21	252 + 43
Panicum repens (Atora)	2	4	3	3 + 1	3 + 1	6 + 1
Stachytarpheta indica (Balunaguta)	5	3	2	168 + 13	106 + 19	274 + 14
Tephrosia perpurea (Pila)	9	20	7	240 + 11	26 + 5	266 + 16
Urena lobata (Wal epala)	7	13	3	250 + 24	44 + 10	294 + 60

Data show that most weeds transpire about 250 ml/plant/day when soil is at/close to field capacity under a pan evaporation of 5.2 mm/day. Hence weeds will exhaust the available water in top 25 cm of soil layer within about 30 days in sandy soils and within about 60 days in loamy soils. Studies are in progress

to evaluate the water balance of weeds under field conditions using neutron probe measurements. Table 2 show the nutrient content in weeds and the equivalent fertilizer rate.

Table 2. *Nutrients removed or fixed in some common weeds and equivalent fertilizer rates.*

Weed	Plant parameter	Dry mass (g)	Nutrient (% dry mass)				Equivalent fertilizer* (g/plant)			
			N	P	K	Mg	Urea	Sapo	KCL	Dolamite
Achyranthes	Leaf	8	2.6	0.33	4.0	0.95	0.46	0.25	0.66	0.66
aspera	Stem	25	0.9	0.24	2.7	0.19	0.48	0.50	1.29	0.42
(Karal haba)	Root	6	0.7	0.15	1.4	0.16	0.09	0.07	0.14	0.07
	Whole Plant	39					1.03	0.82	2.1	1.15
Cassia floribunda	Leaf	4	4.4	0.56	2.5	0.76	0.35	0.17	0.18	0.25
(Pani thora)	Stem	9	0.7	0.14	1.0	0.12	0.13	0.08	0.18	0.08
	Root	2	0.8	0.68	0.6	0.12	0.02	0.08	0.02	0.01
	Whole plant	14					0.50	0.33	0.38	0.34
Chromolaena odorata	Leaf	27	4.5	0.50	2.4	1.20	2.65	1.17	1.31	2.65
(podisinghomarang)	Stem	54	0.8	0.28	2.1	0.30	0.93	1.25	2.27	1.41
	Root	32	1.0	0.17	1.2	0.26	0.69	0.42	0.76	0.66
	Whole plant	113					4.27	2.84	4.34	4.72
Cleome viscosa	Leaf	6	4.6	0.36	2.1	0.34	0.63	0.17	0.28	0.17
(Wal aba)	Stem	10	1.9	0.36	4.2	0.20	0.43	0.33	0.89	0.17
	Root	4	1.3	0.30	2.3	0.11	0.09	0.08	0.17	0.03
	Whole plant	20					1.15	0.58	1.34	0.37
Crotolaria retusa	Leaf	13	7.8	0.57	2.4	0.41	2.17	0.58	0.62	0.41
(Andanahiriya)	Stem	47	2.0	0.35	2.2	0.22	2.06	1.42	2.09	0.83
	Root	6	1.2	0.18	1.0	0.11	0.17	0.17	0.12	0.05
	Whole plant	67					4.40	2.17	2.83	1.29
Euphorbia heteropylla	Leaf	2	2.4	0.35	1.8	0.37	0.13	0.07	0.08	0.07
(Wal rubber)	Stem	2	0.5	0.31	2.5	0.23	0.02	0.06	0.12	0.04
(Wal rubber)	Root	1	0.5	0.10	0.9	0.12	0.01	0.01	0.02	0.03
	Whole plant	6					0.16	0.14	0.22	0.14
Mimosa pudica	Leaf	7	4.6	0.25	0.9	0.43	0.46	0.08	0.08	0.17
(Nidi kumba)	Stem	13	1.2	0.20	0.4	0.29	0.35	0.25	0.10	0.33
	Root	2	1.4	0.11	0.3	0.23	0.07	0.02	0.01	0.03
	Whole plant	20					0.88	0.35	0.19	0.53
Par...n repens	Leaf	2	2.2	0.13	1.1	0.21	0.11	0.01	0.04	0.03
(Atora)	Stem	4	1.1	0.07	0.6	0.07	0.09	0.02	0.04	0.02
	Root	3	0.8	0.05	0.6	0.08	0.07	0.02	0.04	0.02
	Whole plant	9					0.27	0.05	0.12	0.07
Stachytarphetaindica	Leaf	5	3.4	0.18	2.3	0.41	0.35	0.07	0.22	0.16
(Balu naguta)	Stem	3	1.0	0.09	1.7	0.12	0.07	0.02	0.10	0.03
	Root	2	0.8	0.06	1.4	0.10	0.02	0.01	0.04	0.01
	Whole plant	9					0.44	0.09	0.36	0.20
Tephrosia perpurea	Leaf	8	5.4	0.35	2.0	0.44	0.98	0.25	0.34	0.25
(Pila)	Stem	20	1.8	0.17	1.2	0.96	0.78	0.25	0.68	1.58
	Root	7	2.3	0.24	1.2	0.18	0.33	0.17	0.16	0.08
	Whole plant	36					2.09	0.67	1.18	1.91

Table 2 (Continued).

Weed	Plant parameter	Dry mass	Nutrient (% dry mass)			Equivalent fertilizer* (g/plant)				
	(g)	N	P	K	Mg	Urea	Sapo	KCL	Dolamite	
Tridex procumbens	Leaf	4	3.1	0.35	3.5	0.58	0.26	0.08	0.28	0.17
(Kurunegala desia)	Stem	5	1.1	0.34	4.1	0.20	0.11	0.17	0.38	0.08
	Root	1	0.9	0.18	1.3	0.07	0.01	0.01	0.02	0.01
	Whole plant	9					0.38	0.26	0.68	0.26
Urena lobata	Leaf	7	4.2	0.66	2.5	0.78	0.65	0.42	0.36	0.50
(Wal apala)	Stem	13	0.8	0.40	1.7	0.44	0.22	0.42	0.44	0.50
	Root	4	0.8	0.30	1.4	0.58	0.06	0.08	0.10	0.17
	Whole plant	23					0.93	0.92	0.90	1.16
Vernonia cinerea	Leaf	2	2.4	0.32	2.9	0.40	0.11	0.03	0.08	0.04
(Monara kudumbia)	Stem	2	0.8	0.18	3.2	0.14	0.02	0.03	0.12	0.02
	Root	1	0.5	0.07	1.6	0.08	0.01	0.04	0.02	0.01
	Whole plant	4					0.14	0.10	0.22	0.07

(* Urea 46% N; Saphosphosphate 27.5% P2O5; KCl 60% K2O and Dolomite 20% MgO)

Data show that leaves and stems of most weeds have high levels of K and N. However, any competition with coconut under field conditions needs to be evaluated based on weed population. Data presented could be used to estimate the possible nutrient/fertilizer removal in a given population of weeds considering the number of plants.

Studies in progress.

K S Jayasekara, C Jayasekara (Plant Physiology) & G D George

2.2 Effects of intercropping of coconut on soil structure development and stability.

A study was initiated for the final year report of Ms M Cleda Kanthi, Faculty of Agriculture, University of Peradeniya, under the supervision of Dr R B Mapa (University of Peradeniya) and Dr M N Dias (Soils and Plant Nutrition Division, CRI).

This study was carried out using soil samples obtained from the research station at Walpita. Four treatments from well established intercropping systems in coconut with three species of perennial crops namely a) cocoa, b) coffee, c) pepper and d) pepper & cocoa and coconut as a monocrop (control) were investigated in this study. Soil samples from two depths were collected from the unfertilized areas of the plots.

Soil structure development was studied using aggregate size distribution. Dry and wet structural stability were evaluated using dry and wet sieving methods. In addition to these, soil bulk density, macroporosity and organic matter content were also studied.

All intercropped treatments showed significantly lower soil bulk densities than the coconut monocrop. The aggregate development and dry stability were compared using indices as mean weight diameter (MWD), log-geometric mean diameter (LGMD) and log standard deviation (LSTD). The MWD and LGMD of aggregates showed an increasing trend with intercropping, showing better structure development. Wet sieving results indicated that the highest stability was in coconut-cocoa combination and lowest for coconut monoculture. The estimated macropores using soil water retention relationship were also higher in intercropped treatments than for coconut monoculture for both depths.

These results show that, there is beneficial affect on soil structure development and stability by intercropping coconut lands.

M N Fernandopulle (nee Dias)

2.3 Evaluation of laboratory methods for soil phosphorus estimation

If the soil nutrient level estimated by a laboratory method shows a good correlation with the percent response of a specific plant for a range of soils, the particular method can be successfully calibrated to provide a laboratory index for the same nutrient. The percent response for phosphorus (P) can be defined as:

$$\frac{\text{growth parameter with all nutrients}}{\text{growth parameters with all nutrients except P}} \times 100$$

Five laboratory methods for soil P estimation was evaluated using nineteen different soils collected from various locations of the coconut growing areas. The methods subjected to the evaluation were (1) Olsen's bicarbonate extraction (2) Bray and Kurtz extraction (3) 0.005 M $CaCl_2$ extraction (4) 2.5% acetic acid extraction and (5) equilibrium phosphate potential. The percent response was obtained with glyricidia plants.

Glyricidia plants were grown in a green house in pots filled with 1.5 l of soils. Four pots were prepared for each soil. Two pots were treated with 1 g of urea, 4 g of triple super phosphate and 3 g of muriate of potash and the other two pots were treated only with urea and muriate of potash at the same rates mentioned above. Glyricidia seeds were planted in each pot.

The percent response in the height of glyricidia plants was estimated

weekly. The percent response increased gradually from fourth week onward and became a constant after a period of ten weeks in case of many soils, but the percent response was quite uniform from the fourth week onward in case of other soils. It appeared that after the twelve week, the percent response of plants on each soil was not varying significantly and therefore pots were dismantled and the total dry matter weight was estimated.

The percentage response in height and the total dry weight of glyricidia on each soil was correlated with soil P values of each soil (only soils treated with urea and muriate of potash) estimated by each laboratory method before planting. Out of the five methods, only soil P values by 2.5% acetic acid showed a significant curvilinear relationship with percent response of glyricidia and soil P estimate by none of the other methods showed any significant relationship.

2.5% acetic acid P was rated based on the curvilinear relationship obtained with the percent response of glyricidia as indicated below:

Low	< 2.3 mg P/kg of soil
Medium	(2.3 -4.2) mg P/kg of soil
High	> 4.2 mg P/kg of soil.

It was concluded that out the five laboratory methods used for soil P estimation, only 2.5% acetic acid extraction could provide a reliable soil P index for soils in coconut growing areas. The method has to be calibrated with respect to the response of coconut in order to obtain a soil P index for coconut.

Sudrshani Perera and L L W Somasiri

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).

Experiment was terminated in 1990 as the response was found to be non significant due to the low rates of coir dust (CD) used. Table 3 gives the relevant yield response of coconut with time.

Table 3. *Effect of application of coir dust on coconut yield.*

Treatment*	Year				
	1985	1986	1987	1988	1989
Copra (kg/palm/y)					
T1	9.7	10.8	4.0	3.6	6.8
T2	9.8	10.3	5.6	4.6	6.8
T3	9.3	9.5	4.7	4.7	5.7
T4	9.2	9.4	4.6	3.9	5.2
T5	9.1	10.2	5.7	4.3	7.0
CV %	19.0	22.0	25.0	23.0	24.0
Significance	ns	ns	ns	ns	ns
Yield (nuts/palm/y)					
T1	48	57	30	21	44
T2	46	63	39	28	45
T3	48	58	35	27	42
T4	38	59	35	23	37
T5	48	58	39	27	45
CV %	20	12	20	25	16
Significance	ns	ns	ns	ns	ns
Female flowers (palm/y)					
T1	115	203	44	27	58
T2	92	172	52	43	62
T3	85	134	50	37	53
T4	114	159	68	54	62
T5	139	214	89	58	74
CV%	45	35	40	39	35
Significance	ns	ns	p0.07	p0.06	ns
Rainfall (mm)	1262	885	1134	807	1170
Wet days	55	44	59	42	51

(ns: not significant at p=0.05 level; significant at p=0.07 and 0.06 level)

Treatment* :- T1: Control (no fertilizer, no coir dust); T2: Recommended rate of fertilizer (F) only; T3: F + 3000 kg of CD/0.405 ha (7407 kg/ha; layer thickness of CD 0.3 cm; Volume ratio of CD/soil 0.03); T4: F + 6000 kg of CD/0.405 ha (14815 kg/ha; layer thickness of CD 0.6 cm; Volume ratio of CD/soil 0.06); T5: F + 9000 kg of CD/0.405 ha (22222 kg/ha; layer thickness of CD 0.9 cm; Volume ratio of CD/soil 0.08)

Results did not show significant response to the application of coir dust treatments, except in the number of female flowers which was significant at p=0.06-0.07 in 1987 and 1988. Data show that the rates of coir dust used in the experiment was low for coconut palms to show any significant response and the experiment was terminated in 1990. However, in the parallel experimental site at Marichchikattiya Estate, Madurankuliya the rates were increased up to 180 000 kg coir dust/ha (layer thickness of CD 6.9 cm) as reported in the annual report for 1987.

K S Jayasekara

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 October. Soil water levels were monitored using a neutron probe. Table 4 and 5 gives the relevant yield responses of coconut with time. The six treatments are as follows:

T1: Control (no fertilizer, no coir dust)
T2: Recommended rate of fertilizer (F) only
T3: F + 45000 kg of CD/ha (Layer thickness of CD 1.7 cm; Volume ratio of CD/soil 0.17)
T4: F + 90000 kg of CD/ha (Layer thickness of CD 3.4 cm; Volume ratio of CD/soil 0.34)
T5: F + 135000 kg of CD/ha (Layer thickness of CD 5.2 cm; Volume ratio of CD/soil 0.51)
T6: F + 180000 kg of CD/ha (Layer thickness of CD 6.9 cm; Volume ratio of CD/soil 0.68)

Modified increased rates of coir dust (45000-18000 kg CD/ha) were applied in 1988 and hence the treatment T6 was not existed during the period 1985-1987. Results clearly demonstrate the beneficial effects of increased rates of CD introduced in 1988 as against the low rates prior to 1988 at Marichchikattiya Estate and Heemmaliyagara Estate.

Production of female flowers did not statistically significant response due to its high variability, except in the year 1990. However, the nut yield of coconut showed a significant response for the years 1988, 1989 and 1992. Copra yield also showed a sgnificant response to the application of CD in 1988, 1989, 1990 and 1992. In 1992, the highest copra yield of 283 kg was achieved from the CD rate of 135000 kg/ha (T5) showing an increase of 72 kg of copra/palm/y due to the application of CD only (T5-T2).

Table 4. *Effect of application of coir dust on the production of female flowers and nut yield of coconut with time.*

Treatment	Year							
	1985	1986	1987	1988	1989	1990	1991	1992
Female flowers (palm/y)								
T1	124	114	74	46	53	42	36	33
T2	92	136	95	65	77	55	45	43
T3	94	124	98	46	75	66	47	46
T4	121	153	103	54	64	76	45	39
T5	97	105	76	41	57	55	38	42
T6	ne	ne	ns	55	56	65	45	40
Significance	ns	ns	ns	ns	ns	0.05	ns	ns
CV %	25	36	31	31	31	23	31	22
LSD	--	--	--	--	--	18	--	--
SE	--	--	--	7	9	6	6	4
Yield (nuts/palm/y)								
T1	42	45	32	24	31	17	14	20
T2	32	48	36	30	46	20	18	27
T3	29	52	37	29	37	19	16	22
T4	36	46	33	28	38	26	16	21
T5	33	50	36	31	40	23	19	29
T6	ne	ne	ne	23	31	23	19	19
Significance	ns	ns	ns	0.05	0.01	ns	ns	0.05
CV%	28	18	19	16	17	26	24	25
LSD	--	--	--	6	8	7	--	7
SE	--	--	--	2	3	2	2	2

(ns - not significant at p=0.05 level; sig. indicates the level of significancy.
ne - the treatment was not established during the year)

In general the the cor dust rate of 135000 kg/ha found to be beneficial with a yiled increase of 7 nut/palm/y due to the application of coir dust only (T5-T2). Hence the the yield increase of 1106 nut/ha/y may give an increase income of Rs 4424/ha/y, if the price of a coconut is Rs 4/nut. Cost of transporting coir dust was about Rs 100 per tractor load of 14 m3 (480 ft3) in 1988. Cost of transporting 32 tractor loads of CD (135000 kg CD) was about Rs 3000. Thus the net profit of coir dust application at the rate of 135000 kg/ha may be about Rs 1424/ha, excluding the cost of application and harrowing of CD in the field. Detail cost benefit analysis is in progress.

K S Jayasekara, D S Wijetunge & D E V R Wijetunge

Table 5. *Effect of the application of coir dust on copra.*

Treatments	Copra (kg/palm/year) 1985	1986	1987	1988	1989	1990	1991	1992
T1	6.2	7.3	4.1	3.4	5.3	3.2	1.9	2.8
T2	5.3	7.7	3.7	4.3	8.0	2.6	1.9	3.3
T3	4.9	7.8	3.1	3.6	5.3	2.8	1.9	3.4
T4	6.8	7.6	3.9	3.1	6.7	3.7	1.8	3.2
T5	5.7	7.5	4.5	4.3	6.8	4.9	2.4	4.4
T6	ne	ne	ne	3.2	5.5	3.2	2.0	2.8
significance	ns	ns	ns	0.05	0.01	0.05	ns	0.05
CV%	22	16	30	20	19	32	30	24
LSD	--	--	--	0.9	1.6	1.4	--	1.0
SE	--	--	--	0.3	0.5	0.5	0.3	0.4

(ns - not significant at p=0.05 level; sig. indicates the level of significancy.
ne - the treatment was not existed during the year)

PROJECT 4: FIELD MANAGEMENT SYSTEMS

Experiment 4.5: Evaluation of input balance in coconut plantations under different agro-climatic conditions, Bandirippuwa Estate, Lunuwila (1990).

Studies on rain-water interception by the coconut canopy was continued during the rainy period. Distribution of rain water reaching ground after interception by the coconut canopy was similar to that reported in annual report for 1991. Nitrogen levels in stem flow and canopy drippings were about 0.5-0.9 ppm and 1.2-2.9 ppm, respectively. Potassium levels in stem flow and canopy drippings ranged 2-4 ppm and 10-50 ppm, respectively. Studies are in progress to ascertain the degree of nutrient recycling due to rain-water interception by coconut and its mechanisms.

Nutrient levels in the ground water table at Bandirippuwa Estate were monitored by chemically analyzing the water in total of twelve wells/streams during the year. Study aims to monitor possible leaching of nutrients after the application

of fertilizer in coconut plantations as any accumulation in ground water aquifer is a waste and could be a health hazard. Table 6 provides the range of nutrient levels noted before and after monsoonal rains in four main locations in Bandirippuwa Estate.

Table 6. *Nutrient levels in ground water samples collected in different wells/streams at Bandirippuwa Estate before and after the monsoonal rains (673 mm in 56 days and 945 mm in 78 days).*

Location/topography	Before monsoonal rains		After monsoonal rains	
	N ppm	K ppm	N ppm	K ppm
Raman block well (Sandy soil, flat land, 45 y old coconut)	0.3-0.9	2.2-3.6	2.8-3.2	4.2-6.3
50 ac block well (Gravelly soil, sloping land, 10 y old coconut)	0.8-1.5	3.6-4.4	4.1-5.7	4.2-5.0
Kotakanda deep tube well (Gravelly soil, sloping land, 10 y old coconut)	0.6-0.7	2.0-2.8	3.1-4.4	2.9-3.4
Kotakanda stream (valley of a catchment area of 20 ac young coconut)	0.8-1.6	2.2-4.4	3.2-6.3	5.8-6.6

Preliminary data indicates the high leaching and accumulation of nutrients (N 2.8-6.3 ppm and K 2.9-6.6 ppm) in ground water after monsoonal rains, even in flat lands with negligible run-off. High nutrient levels in the well and stream in the sloping land may be due to leaching and run-off factors. However, nutrient levels in deep aquifer (tube well) was less affected compared to shallow wells and stream. Study indicates the appreciable loss of applied fertilizers into the ground water aquifers in coconut plantations. Hence split application of fertilizer or other remedial steps may be necessary to avoid wastage and possible health hazards.

K S Jayasekara, C Jayasekara (Plant Physiology Division), E M A T Banda & U S S Perera)

PROJECT 7: STUDIES ON THE NUTRIENT REQUIREMENT OF COCONUT

Experiment 7.7: Nutrient requirement of coconut based on leaf and soil analysis.

(a) Differential Fertilizer Recommendation (DFR)

The computer model for the Differential Fertilizer Recommendation (DFR) was further refined to include soil type and agro-climate as input variables for cost-effective and better fertilizer use efficiency in the DFR package. The model differentiate the agroclimates into two soil water regimes ie: water limiting and water non-limiting. Plantations in water limiting environments require less nitrogen and dolomite, while it is essential to supply phosphorous in soluble source such as saphosphosphate or triple super phosphate. Plantations in water non-limiting conditions require high rates of nitrogen, dolomite and KCl, while in acidic soils less soluble Eppawala Rock Phosphate could be used. Soil samples (0-25 cm and 25-50 cm) were also collected from manure circle area and centre of square of four coconut palms and soil nutrient levels were also used as a complementary parameter in the DFR model. Data on relevant chemical analysis of soils are given under Expt. 7.13.

During the year, DFR service was provided to 215 large coconut estates (> 50 ac) covering an area of about 7100 ha. Total of 723 leaf (14th) samples, collected from these estates were analyzed for N, P, K, Mg, Ca, Na, Cl, S, B, Fe, and Mn (Figs. 1-12).

Annual monitoring of nutrient status of coconut plantations showed similar trends in all nutrients. However, K and Mg levels have shown an improvement in the samples collected during the year 1992. This is encouraging and may have been due to the DFR package and the increased use of dolomite by the inclusion of it in the Adult Coconut (0-6-32-5) fertilizer mixture. Data show that the nutritional priority order for adult coconut as K > Mg > N > P > Cl > S > Na > > > B > Cu > Zn.

Leaf samples collected during the year 1992 also showed a wide range (ie: highest level is about 4-10 times the lowest level) in leaf nutrient levels for Fe, Cu, Mn, and Zn indicating the possibility of nutrient imbalance in certain coconut estates. Considering the large sample size obtained during the 1991 and 1992, the possibility of nutrient imbalance can not be ruled out and studies are in progress on these aspects.

Appropriate fertilizer recommendations were given to correct the

deficiencies related to K, Mg, N, P, Cl, S, and Na. Several high-yielding coconut estates were advised to apply gypsum, ammonium sulphate and agricultural salt as a preventive measure against possible deficiencies of S, Ca, Cl, and Na.

Annual monitoring of the nutritional status of coconut plantations under the DFR package provided a cost-effective way to detect any shift in nutritional status of coconut plantations and to make remedial actions, even with a limited sampling size, while providing a service to the coconut growers.

DFR model was used to develope a general fertilizer mixture for king coconut (thamibili) palms. Following King Coconut (0-4-28-8) fertilizer mixture is recommended to be applied at the rate of 4.5 kg/palm/y for king coconut palms yielding 12000 nut/ha/y (ie: 5000 nut/ac/y or 78 nut/palm/y).

King Coconut (Approximate composition: 0-4-28-8)

Eppawala Rock phosphate (Apatite)	2 parts by mass
Saphosphosphate	4 parts by mass
Potassium chloride (muriate of potash)	21 parts by mass
Dolomite	18 parts by mass

In addition to above "King Coconut (0-4-28-8)" fertilizer mixture, urea at the rate of 0.8 kg/palm/y should be applied. Method of application also should be similar to that described for Adult Coconut and urea package. Up to 1 1/2 times the above rates may be applied to high yielding palms or blocks with a potential for high yield.

Similarly a general fertilizer mixture for Toddy tapping coconut palms was also developed. Following Tapping Coconut (0-4-36-5) fertilizer mixture is recommended to be applied at the rate of 3 kg/palm/y for toddy tapping coconut palms yielding about 400 l of toddy/palm/y.

Tapping Coconut (Approximate composition: 0-4-36-5)

Eppawala Rock phosphate (Apatite)	2 parts by mass
Saphosphosphate	2 parts by mass
Potassium chloride (muriate of potash)	18 parts by mass
Dolomite	8 parts by mass

In addition to above "Tapping Coconut (0-4-36-5)" fertilizer mixture, urea at rate of 0.6 kg/palm/y and Agricultural Salt at the rate of 1 kg/palm/y also should be applied. Method of application should be similar to that described for Adult Coconut and urea package. Up to 1 1/2 times the above rates may be applied to high yielding palms or blocks with a potential for high yield.

K S Jayasekara, T W Fernando, S Periathamby & G D George

(b) FAO Fertilizer Project

Progress of the project was reviewed in August by a Review Mission consisting of representatives of the donors and the FAO, which acknowledged the preliminary analysis of yield and nutrient data. Mission recognized the importance of the Location Specific Fertilizer Recommendation (LSFR) for small-holder sector which is being tested as a new treatment in the already existing fertilizer demonstration plots (Annual report for 1991).

Analytical and yield data collected under the project were analyzed and the final report was prepared (Rezania, Jayasekara, Mathes and Karunanayaka, 1992) for submission to the FAO, donor countries and the Government of Sri Lanka. Analysis of yield and soil/leaf nutrient data indicate the necessity for a modified sufficiency ranges for medium yielding coconut palms (ie: small-holder sector) which provides high Value Cost Ratios (VCR). Following sufficiency ranges (14 th leaf; % dry mass basis) were established based on the available data generated under the project:

Potassium (K) 0.8 - 1.2 % (VCR ~1.9)
Magnesium (Mg) 0.25 - 0.46 % (VCR ~1.9)
Nitrogen (N) 1.6 - 1.9 % (VCR ~2.4)
Phosphorous (P) 0.11 - 0.13 % (VCR ~1.9)

Table 7 summarizes the coconut yield after five years of the application of fertilizer [without fertilizer (-F) and with fertilizer (+F)] in Demonstration Plots. Table 7 summarizes the average yield increases of 70 plots in 10 districts for two consecutive years for without fertilizer and with fertilizer. The value without fertilizer (-F) is from the yield of 10 palms/plot. Hence it was an average from 700 palms, while the value with fertilizer (+F) treatment was from 1400 palms.

Results show a wide variation of yield in response to fertilizer application in different districts ie: in Anuradhapura district the yield even without the application of fertilizers is high (ie: 54 nut/palm/y) and the response to fertilizer is low, whereas in Kegalle the initial yield is low but the response is high enough to pay the cost. In Kalutara district both yield and response to fertilizers are low indicating the existence of limitations other than NPK nutrition. The yield limitation may be due to Mg deficiency as shown by the low levels of leaf Mg.

With the current cost of fertilizer at Rs 28.00/palm/y and coconut price of Rs 3.50/nut, it essential to have a yield increase of at least 16 nut/palm/y due to the application of fertilizer alone in-order to obtain the required VCR of 2. Hence the analysis show that in Anuradhapura, Hambantota, Kalutara, Kuliyapitiya, and Puttalam districts the conventional application of NPK fertilizers is not

economical. Thus it is necessary to identify the exact reasons for these low response to NPK fertilizers in certain districts/locations. Preliminary analysis show that in these sites, the yield limitation may be due to the severe Mg deficiency as observed in the coconut palms and indicate the problems associated with the conventional NPK approach in fertilizer recommendations. What is necessary is the "judicious" application of bio/organic/chemical fertilizers to achieve a sustainable high productivity with increased profits. Studies are in progress at CRISL along these lines and to consider the formulation of Location Specific Fertilizer Recommendations (LSFR), even for small-holders in-order to provide a high VCR (Annual report for 1991).

K S Jayasekara

Table 7. *Coconut yield in Demonstration Plots under different fertilizer treatments [without fertilizer (-F) and with fertilizer (+F)] (adapted from Rezania, Pers. Comm.).*

Agro-ecological zone	District	No of Plots	Coconut yield (nut/palm/y) (-F)	(+F)	Response to F only
Dry Zone	Anuradhapura	8	54	60	+ 6
	Hambantota	8	33	41	+ 8
	Puttalam	6	64	73	+ 9
Intermediate	Kuliyapitiya	5	32	40	+ 8
	Kurunegala	24-25	31	48	+17
	Matara	3-4	15	32	+17
Wet	Galle	5	42	59	+17
	Gampaha	9	34	51	+17
	Kalutara	3	38	44	+ 6
	Kegalle	2-3	26	49	+23

Experiment 7.12.1: Effect of green manure on the nitrogen status of coconut palms. Ratmalagara Estate, Madampe (1988).

Details of the experiments are given in under Agronomy Division.

M N Fernandopulle (nee Dias) & D N S Fernando (Agronomy)

Experiment 7.13: Evaluation of nutrient status in coconut growing soils ("Nutrient Mapping").

Soil samples were collected under the DFR programme were analyzed for relevant chemical analysis. For comparison, the soil analytical data collected in 1982/83 period under the FAO Fertilizer Project were also collated into frequency histograms similar that of leaf analytical data, in-order to study the nutrient status of soils in coconut lands.

Total of 1271 soil samples collected under the FAO Fertilizer Project were from coconut lands where fertilizer was not applied for at least 5 years and hence represent the natural soil nutrient status (Table 8).

Table 8. *Chemical parameters of soil samples collected from small-holdings in the FAO Fertilizer Project collected in 1982/83.*

Agro climatic zone	Chemical parameter							
	pH	Conductivity (mmhos/cm)	Total (ppm)	Organic matter (%)	P* ppm	Exc.K meq / 100	Exc.Ca	Exc.Mg soil
Dry (25 sites)								
0-25 cm	5.7	128	906	1.9	12	0.27	9.0	1.6
25-50 cm	5.8	100	666	1.5	8	0.21	9.2	1.4
Intermediate (68 sites)								
0-25 cm	4.9	68	948	2.3	17	0.23	2.5	1.0
25-50 cm	5.0	70	795	1.9	9	0.20	2.6	1.0
Wet (43 sites)								
0-25 cm	4.5	76	1138	3.1	20	0.14	1.4	0.3
25-50 cm	4.5	67	940	2.7	12	0.12	1.2	0.2

(* Olsen-P for soil samples from Dry zone and Bray-P for soil samples from Intermediate and Wet zones.)

Data show that intermediate and wet zone soils are acidic and low in Mg nutrition indicating the benefits from the application of dolomite for coconut. Results show that the limiting nutrients for coconut production as K and Mg which conform with the leaf nutrient levels reported under the DFR programme.

Soil samples collected under the DFR programmes were from both manure circle area and from the centre of square (ie: centre of four palms). Data given in Fig. 13-18 show a wide variation in soil nutrient levels as well as the pH.

Low levels of pH values noted in the samples from the FAO Fertilizer Project require a detail study.

K S Jayasekara, D T Mathes & L L W Somasiri

Experiment 7.15.1: Effects of N, K, and Mg on the performance of coconut seedlings (TxT). Ratmalagara Estate, Madampe (1991).

Detail of the experiment was given in the annual report for 1991. The first differential manuring was done in May. Growth measurements of the different treatments were taken in every three months.

M N Fernandopulle (nee Dias)

Experiment 7.15.2: Effects of phosphorous nutrition on the performance of coconut seedlings (TxT). Ratmalagara Estate, Madampe (1991).

Detail of the experiment was given in the annual report for 1991. The first differential P-manuring was done in May, with NKMg (2-0-2-1) fertilizer mixture as the basal dressing with rates similar to that of YPM. Growth measurements of the different treatments were taken in every three months.

M N Fernandopulle (nee Dias)

Experiment 7.16: Effect of chloride on the yield of coconut. Poththukulama Estate, Pallama (1992).

A field experiment was commenced to study the effect of chloride nutrition on the yield of coconut. The design of the experiment is 3x3 factorial randomized block design and each plot is split into two (one half is treated with chloride while the other half is treated with sulphate). Treatments are as follows:

(a)	Chloride source		meq of K or Na	
K0	0 kg KCl/palm/y	Na0	0 kg NaCl/palm/y	0
K1	1.0 kg KCl/palm/y	Na1	0.778 kg NaCl/palm/y	13.3
K2	2.0 kg KCl/palm/y	Na2	1.556 kg NaCl/palm/y	26.6

(b)	Sulphate source		meq of K or Na	
K0	0 kg K2SO4/palm/y	Na0	0 kg Na2SO4/palm/y	0
K1	1.167 kg K2SO4/palm/y	Na1	0.809 kg Na2SO4/palm/y	13.3
K2	2.333 kg K2SO4/palm/y	Na2	1.619 kg Na2SO4/palm/y	26.6

A basal dose of 0.8 kg of urea/palm/year and 0.6 kg of saphosphosphate/palm/year and 1 kg of dolomite/palm/year were applied in addition to above K and Na treatments.

L L W Somasiri

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. In August, the National Livestock Development Board (NLDB) decided to remove the irrigation pipes, to be used in another project where ground water is available. The irrigation system was installed by the NLDB and CRI was given an opportunity to monitor the response of coconut yield to irrigation. However, the irrigation treatments could not be imposed as scheduled due to the lack of sufficient water available in the existing wells. Hence it was not possible to obtain data related to soil-plant water relations as expected. However, the studies on the reticulation system has lead to develop a low-cost and maintenance free drip irrigation system for coconut as implemented at Ratmalagara Estate (Annual report for 1991). Analysis id data is in progress.

K S Jayasekara, D P Panditharatne & N M D Chandrasoma

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).

Differential irrigation treatments were imposed and palms were fertilized with YPM (13-12-17) fertilizer mixture at the rate of 2 kg/seedling in June and in November, and dolomite at 1 kg per seedling in July. Leaf number and palm height were monitored. Leaf water status and rate of photosynthesis were also monitored. The trial is in progress.

K S Jayasekara, C Jayasekara & D P Panditharatne

Experiment 24.3 Studies on irrigation systems for coconut plantations

(a) Ratmalagara Estate, Madampe (1990)

The new "Screw Dripper" developed (annual report for 1991, Expt 24.3) and fixed in the prototype irrigation system installed at Ratmalagara Estate is

functioning well without blockages. Dripping rate of water was adjusted to different rates to supply the water requirement of coconut and intercrops in the system (coconut- 5 l/h, citrus- 2 l/h, coffee- 2 l/h, pepper- 1 l/h and banana- 4 l/h).

Mr D P Panditharatna, Technical Assistant developed a new low-cost "Ball-tap" to be used in irrigation and other water reticulation systems. Ball-tap is made up of a PVC tube with a spherical ball (ie: glass marble) inside as the valve which could be pushed in to open the tap for water. Because of the weight of the ball and pressure of water, the ball gets pressed down and closes the tap. Ball-tap is free of leaks as no parts for ware and tare. It could be easily prepared locally and may be beneficially used in irrigation and water distribution systems.

(b) Bandirippuwa Estate, Lunuwila (1991)

Screw Dripper installed at Bandirippuwa Estate is also functioning without significant changes in dripping rates. Conduit pipes used, instead of PVC pipes, in the reticulation system installed at Bandirippuwa Estate did not show any signs of decay even buried in soil under field conditions.

Water use of coconut, glyricidia, ipil ipil and *Pueraria decumbens* under field conditions were monitored using a neutron probe. Studies are in progress.

K S Jayasekara, D P Panditharatne & E M A T Banda

PROJECT 26: STUDIES ON WATER RELATIONS OF COCONUT AND INTERCROPS

Experiment 26.1: Studies on Water Balance of Coconut under different soil Landscapes, Agro-Climates and Management Practices (CARP Funded)

a. **Bandirippuwa Estate, Lunuwila (1990)**
b. **Thammenna Estate, Puttalam (1991)**
c. **Ratmalagara Estate, Madampe (1992)**
d. **Isolated Seed Garden (ISG), Rajakadaluwa (1992)**

Objectives of the research project awarded on "Studies on Water Balance of Coconut under different Soil Landscapes, Agro-Climates and Management Practices" by the CARP and the on-going project 26.1 and 26.4 (annual report for 1990 & 1991) on Water Balance of Coconut conducted at Bandirippuwa Estate and Thammenna Estate are similar. Hence all three experiments will be reported under one experiment.

Soil water depletion of different coconut cultivars was monitored using a neutron probe at Bandirippuwa Estate, Thammenna Estate and Isolated seed Garden. Total of 46 Al-access tubes (3 m long) per palm were installed at different distances away from the base of the palm along the row and diagonally.

Preliminary results show that with the on-set of rain-free period, root water uptake was initially confined to the top 0-50 cm layer of soil. After 2-3 weeks, coconut roots extract water mainly from soil layers below 1 m depth.

Three research discussions were held related to the project with Vidya Jyothi Dr C R Panabokke.

Experiment is in progress.

K S Jayasekara, C Jayasekara (Plant Physiology), K R R A Peries (Genetics and Plant Breeding), W M P B Wahala, D P Panditharatne, E M A T Banda, K G D Priyantha & C L Tennakoon

Experiment 26.2: Studies on the resistance to water flow in coconut and intercrops. Bandirippuwa Estate, Lunuwila (1990).

Studies on the vascular system of root, stem, petiole and ekel of the coconut palm were continued. Differences in root axial resistances/conductances were observed in roots of Leaf Scorch Decline (LSD) palms. Studies on the nutrient translocation in stem and at leaf axils are in progress.

K S Jayasekara, C Jayasekara & S Periathamby

Experiment 26.3: Studies on water balance of coconut and intercrops. Ratmalagara Estate, Madampe (1991).

Differential irrigation treatments were given to intercrops (citrus, coffee, pepper and banana). Plant growth parameters were monitored. Water use by different intercrops under rain-fed and irrigated conditions will be monitored with the on-set of drought.

K S Jayasekara, H A J Gunathilake (Agronomy), D P Panditharatne & E M A T Banda

PROJECT 29: STUDIES ON FERTILIZER USE

Experiment 29.1: Efficiency of Differential Fertilizer Recommendations (DFR) based on leaf/soil nutrient and present/"potential/target" productivity of coconut.

Bandirippuwa Estate, Lunuwila (1989)
Ratmalagara Estate, Madampe (1989)
Pothukulama Research Station, Pallama (1989)
Isolated Seed Garden, Rajakadaluwa (1990)
Walpita Estate, Walpita (1990)
Makandura Seed Garden, Makandura (1990)
Maduru Oya Seed Garden, Maduru Oya (1990)

Differential fertilizer Recommendation (DFR) packages were applied in all seven estates of the CRI and Table 9 provides the average leaf nutrient levels with time.

Data show that the limiting nutrient to be Mg in most estates. Soils in the estates are acidic with pH is in the range of 4.8-5.8. Leaf sulphur levels also a low indicating the importance of early corrective measures with the use of gypsom, available locally from the salterns as a waste by-product at the rate of Rs 800/mt.

Magnesium deficiency that prevailed at Bandirippuwa Estate, Isolated Seed Garden, Pothukulama Research Station and Ratmalagara Estate have disappeared with the increased use of Dolomite under the DFR package.

However, after October-November monsoonal rains there was a re-emergence of Mg deficiency in few high ground coconut fields at Isolated Seed Garden (ISG). This sudden re-emergence of Mg deficiency would have been as a result of the temporary water stagnation for ~2-3 weeks during the heavy monsoonal rains. Stagnant water has been drained-off towards the valley (ie: tanks) by deep (~1 m) drainage canals. Hence most of soluble nutrients including Mg, may have been laterally drained away from the surface layers of soil.

Coconut palms at ISG did not show any visible sign of nutritional deficiency in October 1992. Under the DFR package, 3-4 kg of dolomite per palm were being applied annually from 1989. Hence by October 1992, incipient Mg deficiency symptoms that prevailed at ISG had disappeared with the application of ~10 kg of dolomite during 1989-1992.

Table 9. *Average leaf nutrient levels in coconut plantations belongs to CRI*

Estate Name / Sample date	Percentage									ppm			
	N	P	K	Mg	Ca	Na	Cl	S	B	Fe	Mn	Cu	Zn
Isolated Seed Garden, Rajakadaluwa													
1990-03-29	2.0	0.12	1.3	0.22	0.39	0.13	-	-	-	140	168	4	31
1991-03-18	1.9	0.10	1.2	0.25	0.26	0.13	0.57	0.14	16	-	-	-	-
1992-03-16	2.1	0.14	1.1	0.23	0.56	-	-	-	-	-	-	-	-
Bandirippuwa Estate, Lunuwila													
1989-01-30	2.3	0.16	1.3	0.16	0.22	-	-	-	-	162	135	5	22
1990-10-08	1.7	0.14	1.6	0.17	0.27	-	-	-	-	-	-	-	-
1991-08-26	1.8	0.13	1.3	0.19	0.42	-	0.53	0.18	11	-	-	-	-
Poththukulama Research Station, Pallama													
1988-01-28	2.1	0.15	1.2	0.29	0.46	-	-	-	-	-	-	-	-
Minneriya Farm, Minneriya													
1990-08-27	1.8	0.14	1.9	0.22	0.38	-	-	-	-	-	-	-	-
Maduru Oya Seed Garden, Maduru Oya													
1990-08-26	1.8	0.14	1.6	0.31	0.52	-	-	-	-	-	-	-	-
Makandura Seed Garden, Gonawila													
1989-04-28	2.2	0.14	1.3	0.15	0.42	0.06	-	-	-	106	602	5	29
1990-09-08	2.0	0.14	1.5	0.16	0.37	-	-	-	-	-	-	-	-
Walpita Estate, Walpita													
1990-08-25	1.9	0.16	1.5	0.18	0.37	-	-	-	-	-	-	-	-
1991-09-20	2.1	0.16	1.4	0.23	0.46	-	0.60	0.18	10	-	-	-	-
Ratmalagara Estate, Madampe													
1991-03-08	1.8	0.12	1.4	0.23	0.22	0.07	0.52	0.14	14	-	-	-	-

"Sufficient/adequate" nutrient ranges required in the 14th leaf for optimum growth and production of coconut are given below for comparison.

SRE	Percentage									ppm			
	N	P	K	Mg	Ca	Na	Cl	S	B	Fe	Mn	Cu	Zn
	1.9-2.1	0.11-0.13	1.2-1.4	0.25-0.35	0.35-0.50	0.4-	0.3-0.6	0.15-0.20	8-10	40-	60-	12-14	60-

(SRE = Sufficiency range established at CRISL in 1991)

However, with heavy rains during Oct-Nov 1992, most of the soluble Mg in the root zone may have been lost when stagnant water was allowed to drain out from the fields by deep (~ 1 m) drainage canals. This may have deprived the palms of soluble Mg in the soil, resulting in sudden re-emergence of Mg deficiency symptoms in these high ground fields. Please note that low ground fields close to tanks are not showing any deficiency symptoms, except in seedlings due to poor aeration.

An elaborate "anicut" type of cement structures constructed in the mid-1950's to regulate the water level in these fields at ISG was detected which allowed only the excess water to pass into the drainage canals. Unfortunately these anicuts have been abandoned and rain water is being drained-out, without allowing time to infiltrate into the impermeable soil layer that exist at ~1-2 m depth. If the drainage water had been regulated to keep the temporary stagnant water at ~0.3 m depth below the surface, at least part of the soluble nutrients (Mg, K, N) would have been trapped in the soil.

This showed the importance in rainfall water interception and regulation of any excess water in coconut plantations to avoid any adverse effect. Studies are in progress on the lateral and vertical movement of rain water in relation to nutrient dynamics. Further, it is envisaged to analyze the nutrient levels in wells and tanks to monitor the possible leaching/accumulation of applied fertilizer in the ground water aquifer, similar to that being conducted at Bandirippuwa Estate (Expt. 4.5).

Experiment at Poththukulama Research Station, Pallama on the application of relevant fertilizers based on the DFR programme to attain the potential productivity under non-limiting nutrient conditions was continued during the year.

K S Jayasekara, T W Fernando, A A Fernando & B C E Perera

Experiment 29.2: Studies on the localized application of fertilizer in coconut. Ratmalagara Estate, Madampe (1991).

Yield records were monitored regularly. Differential application of fertilizer was completed in October. Experiment is in progress.

K S Jayasekara, D N S Fernando (Agronomy) & B C E Perera

Experiment 29.3: "Axil Feeding" of fertilizers in coconut. Bandirippuwa Estate, Lunuwila (1991).

Plant growth parameters (leaf number and plant height) were measured. Differential fertilizer treatments were applied in May and November. Leaf samples were taken to study the nutrient translocation in relation to vascular system of coconut. Experiment is in progress.

Correction of Mg deficiency

Yellowing in Mg deficient palms at Pothukulama Research Station disappeared within seven months after the application of kieserite (at the rate of 0.5-1.0 kg/palm) to the cavities of leaf axils ("Axil feeding"). Yellowing symptoms

have disappeared in four palms out of five. Leaf samples were collected for detail analysis on nutrient translocation. Preliminary results indicate the benefit of axil application of fertilizer to correct the nutritional deficiencies in coconut. Trial is in progress.

K S Jayasekara, C Jayasekara, T W Fernando & A A Fernando

4. MISCELLANEOUS STUDIES

4.1 Studies on sulphur nutrition of coconut (1992)

Monitoring of the sulphur status of four research stations, Bandirippuwa, Ratmalagara, Poththukulama and Ambakelle was carried out during the year. The 14th leaf of the randomly selected palms was analyzed for sulphur and the results indicate that 'Zero-Sulphur' fertilization for more than a decade has no effect on reducing the sulphur status of the palms of these estates.

M N Fernandopulle (nee Dias)

4.2 Land suitability mapping project

Land suitability mapping project was commenced in 06 July. The objective of this project is to identify and classify different soil types according to their suitability for coconut and to prepare soil maps of coconut growing areas. From July to December, following 1" sheet areas have been surveyed: (1) Chilaw, (2) Battulu Oya, (3) Puttalam, (4) Kalpitiya and (5) Dandagamuwa.

Soil survey and the compilation of the map of Chilaw area was completed in August. Three great soil groups viz. latosols, regosols and red yellow podzolics were found in this area. Deep sandy loam textured latosols were divided into two series ; well drained Ratupasa series and moderately well drained to imperfectly drained Madampe series. These soils are classified as Class I based on their yield potential of 6000-8000 nut/ac/y. Deep sandy regosols were divided into three series; viz. Negombo, Weliketiya and Sudu. The Negombo series is moderately well drained beach sand and the Weliketiya series is also mostly beach sand but imperfectly drained. As the potential yield ranged from 4000-6000 nut/ac/y, Negombo and Weliketiya series were classified as Class II. Sudu series is found away from the beach but it is also deep sand and imperfect to poorly drained. Because of the poor physical characteristics, plants on that soil are drought sensitive. Its potential yield ranged from 3000-5000 nut/ac/y and hence classified as Class III. Red yellow podzolic in Chilaw area was divided into two series, viz. Andigama and Adipola. These soils have a moderately deep, sandy loam surface layer underlain by lateritic gravel. Andigama series is well drained while Adipola

series is imperfectly drained. The soils are classified as Class III. Alluvial soils were also extensively found close to the Chilaw town and were divided into a number of series based on their texture and the drainage.

In Battulu Oya area, alluvial soil is dominant. Those alluvials were divided into a number of series. Out of them, Welipellessa, Ambakelle and Palugaswewa are the most extensive. Coarse sandy textured, imperfectly drained Welipelessa series, fine textured moderately well drained to imperfectly drained Ambakelle series and sandy loam, imperfect to poorly drained Palugaswewa series are classified as Class I-II.

The yield potential in those soils ranged from 5000-7000 nuts/area/year. In addition, Andigama series was also found in Battulu-Oya 1" sheet area but the performance of coconut in that soil was very poor, mainly due to the moisture stress.

In puttalam area, the coconut plantations were mainly found on latosol and regosols. There was hardly any coconut found on reddish brown earth and red yellow podzolics. Moisture stress in these soils during the dry period appears to be the major problem. The latosols were divided into deep sandy loam well-drained Wilpattu series, deep sandy loam moderately well-drained to imperfectly drained Borupan series, sandy clay loam, well-drained Gembura series and sandy clay loam imperfectly drained Nagavillu series. All these soils are classified as Class I-II. In addition, regosols, including Negombo and Weliketiya series were also found on the coastal line. Clay loam poorly drained Puttalam series found near the lagoon was not suitable for coconut. However, sandy loam to sandy clay loam underlain by clay-loam imperfect poorly drained Udappu series was found to be more suitable for coconut and was classified into Class II.

Kalpitiya area is dominated by regosols. The presence of a 30-45 cm thick sandstone layer at a depth ranging from 1-3 m in most parts of the peninsula is a special feature in these regosols. Hence the Kalpitiya regosols were named as Kalpitiya series and classified as Class I-II. In addition to that, along the coastal line, Negombo and Weliketiya series were also found.

In the Dandagamuwa 1" sheet area, red yellow podzolic is dominant. However, alluvial soils of variable texture was also found in a considerable extent. The red yellow podzolic in this area was mainly divided into three series; viz. quartz dominant, well drained Kiriwana series, quartz, feldspar and iron stone gravel dominant Kurunegala series and iron-stone dominant Andigama series sub division of the Kurunegala series viz. Munamaldeniya series was found to be a better soils and falls into Class II with a potential yield of 5000-7000 nut/ac/y. Andigama series falls into Class III and Kiriwana series was found to be still inferior and falls into

Class IV. However, Kurunegala series is quite extensive in Dandagamuwa 1" sheet area. Some reddish brown latosolic which also appears to be a highly productive soil, was found around Polgahawela area.

Major part of the field work was completed by 30 November, with the commencement of monsoonal rains, which impede field work with soil pits. Transferring the soil boundaries from aerial photographs to the base map was carried out during December at the Land Use Division of the Irrigation Department in Colombo. Cartographic work on the preparation of soil maps also commenced in December.

(a) Bandirippuwa Estate (detailed soil survey)

Two great soil groups, latosol and red yellow podzolic were mainly found in Bandirippuwa Estate. Latosol were divided into Madampe and Sudu series, while red yellow podzolic was divided into Boralu series (moderately deep phase) and Boralu series (Shallow phase). In addition, alluvial-colluvial deposits were also found and they were further divided into Pallama and Lunuwila series. The soil map is attached.

(b) Ambakelle Isolated Seed Garden (detailed soil survey)

Ambakelle is located on the upper terrace of the Daduru Oya flood plain. The soils found here is alluvial. Welipalessa series is dominant in this estate and its yield potential range from 6000-9000 nut/ac/y. The soil map is attached.

(c) Pothukulama Estate (detailed soil survey)

Pothukulama Estate is also located on the upper terrace of the Daduru Oya flood plain and the soils are mainly alluvial. Soils were sub divided into seven soil series of which Ambakelle series and Welipelessa series were the dominant. The soil map is attached.

(d) Maduru Oya Seed Garden (detailed soil survey)

Reddish brown earth is dominant in Maduru Oya Seed Garden considering the texture, drainage, and the mineral content, the reddish brown earth in Maduru Oya was divided into six soil series and same of those series were sub divided based on the depth. Well drained Ulhitiya series and moderately well-drained Wilayaya series are dominant in the estate. The soil map is attached.

L L L W Somasiri, N Nagarajah, L Amarasinghe,
D S Wijetunga & K L Ranasinghe

4.3 Land suitability mapping project (soil physical aspects)

Mr L P VidhanaArachchi registered at the University of Sri Jayawardanapura, Nugegoda to undertake a Ph.D. programme titled "Characterization of physical properties of coconut soils and studies on development of coconut roots " to study the soil physical aspects under the land suitability project.

This study will evaluate the effect of varying physical and moisture stress of different coconut soils on root development of coconut seedlings.

Andigama soil series was selected to compare with Madampe soil series to identify the major physical barriers that affect root growth of coconut seedlings. Combined effect of moisture stress and physical stress on physiological aspects of coconut seedlings will be evaluated for this study.

Sites for the experiments have already been selected at Rathmalagara Estate and at Bandirippuwa Estate to represent Andigama and Madampe series, respectively. Description of soil profiles and some preliminary studies were completed.

L P VidhanaArachchi & K R E M Fernando

4.4 Diagnostic Survey

The second diagnostic survey under the Agricultural Research Project was commenced in September. The objectives of the survey are to study (1) the acceptability of CRI recommendations by the growers (2) the constraints, if any, for such acceptance and (3) feed-back from the growers on new areas requiring research.

The survey was carried out in major coconut growing districts viz. Puttalam, Kurunegala and Gampaha and also four coconut growing districts from Southern Province viz. Kalutara, Galle, Matara and Hambantota. Three Coconut Development Officer's (CDO) ranges were selected randomly per agro-ecological zone within teach of Gampaha, Kurunegala and Puttalam districts. Thus, three, nine and six CDO ranges were selected from those districts respectively. Only one CDO range per district was selected from each of Kalutara, Galle and Matara districts. Two CDO ranges were selected from Hambantota district. Thus the sampling procedure was purposive two stage simple random sampling.

Having pre-assumed that 400 growers would be interviewed for the survey, the number of growers from each district was primarily decided on the

based of the total extent of the coconut holdings of which individual extent was 2 acre or more. The sample size of each CDO range was subsequently decided by equally distributing the number of growers selected for each district among the CDO ranges selected for each district. Thus, the sample size per CDO range varied from 12-25 coconut growers. The growers from each CDO range was selected randomly.

Up to now the team has interviewed about 270 coconut growers from Kurunegala and Gampaha districts. The survey will be completed by the end of January 1993 and the report will be ready by the early March, 1993.

L L W Somasiri, T S G Peiris (Biometry Division), H A J Gunathilaka & M A T N Fernando (Agronomy Division) & J L J G Pinto (Information Division)

4.4 Sea water in irrigation of coconut (1988)

Differential sea water irrigation treatments were continued. Coconut seedlings were fertilized with 1 kg g of YPM (13-12-17) per seedling in June and december and i kg of dolomite/seedling in May. Plant growth parameters (leaf number and palm height) and leaf nutrient levels were monitored, as scheduled.

Seedlings irrigated with sea water performed better than others.

K S Jayasekara & D P Panditharatne

4.5 Nutrient culture (hydroponics) technique in coconut (1988)

Seedlings continued to grow satisfactorily and nutrient levels are being monitored.

K S Jayasekara & D P Panditharatne

4.6 Coir dust in manure circle of coconut (1989)

Soil and leaf samples were collected for nutrient analysis. Yield records are maintained. Study is in progress.

K S Jayasekara & E M A T Banda

4.7 Studies on nutritional deficiencies of coconut. Bandirippuwa Estate, Lunuwila (1991).

Differential fertilizer treatments were applied in November. Leaf samples were collected to monitor the nutrient levels with time.

K S Jayasekara & A A Fernando

5. CHEMICAL, PHYSICAL AND MICROBIOLOGICAL ANALYSIS

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

The division also participated in the Soil Sample Exchange Programme (SSEP) under the International Soil Analytical Exchange (ISE) organized by the University of Wageningen, The Netherlands. One soil sample was analyzed 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 NH_4OAC (Ca, K, Mg, Na).

Analysis of micro-nutrients were delayed and suspended in times due to the breakdown of the Varian (Model AA-475 purchased in 1980) Atomic Absorption Spectrophotometer (AAS). However, a new AAS (GBC Model 904AA) including the graphite furnace facility was received in October under the Agricultural Research Project.

5.2 Leaf, Soil, Fertilizer and Water Analysis

A total of 3567 leaf samples were analyzed for N, P, K, Ca and Mg. About 40% of these samples were analyzed for Cl, S, B, Fe, Mn, Cu, Zn and Mo.

One thousand three hundred and sixty (1360) soil samples were analyzed for pH and conductivity. About half of these samples were analyzed for total N, Exch. K, Exch. Mg, avail. P (Bray/Olsen) and total exchangeable bases (TEB). Thirty two (32) fertilizer (chemical and organic) and coir dust samples were analyzed for N, P, K, Mg and Organic-C.

Sixty four weed samples and 456 water samples were also analyzed for N, P, K, Mg, Cl, S, B, Fe, Mn, Cu, Zn and Mo.

A total of 568 soil samples were analyzed for several soil physical parameters such as bulk density, particle size, particle density, available water (at 1/10, 1/3, 15 bar using pressure plate) and gravimetric moisture.

6. SERVICES AND EXTENSION ACTIVITIES

6.1 Electronic Workshop

Several minor repairs and maintenance work were carried out for the Soils and Plant Nutrition and Plant Physiology.

6.2 Seminars/Field Days and Training Programmes

Mr K S Jayasekara, Dr M N Dias, and Dr L L W Somasiri functioned as resources person in training programmes conducted by the Coconut Research Institute, Coconut Development Training Center, Lunuwila and the National Institute of Plantation Management, Athurigiriya.

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

6.3 Advisory/Extension Work

Two hundred and fifteen coconut estates covering about 7100 ha were inspected for Differential Fertilizer Recommendations (DFR). Large number of requests to provide the DFR package by the coconut growers is an indication of its acceptability and benefits.

As the data from the analysis were to be used in experiments 7.7 and 7.13, the charges for chemical analysis were waived off. Transport and labour facilities were provided by the estates.

Staff assisted in the establishment of drip irrigation system in three private coconut estates. Nestle Lanka (Pvt) Ltd provided financial assistance to coconut growers to implement the drip irrigation system developed by the Soils and Plant Nutrition Division/CRI.

Field demonstrations on (magnesium deficiency and Fertilizer/Irrigation/Cultural practices) were well maintained and used in the field training programmes.

Divisional staff actively engaged in the organizational and the conduct of the "Coconut Day" held on 12 August. Mr K S Jayasekara functioned as the Chairman of the Organizing Committee for this event.

8. ACKNOWLEDGEMENTS

Encouragement and co-operation rendered by the Coconut Research Board are gratefully acknowledged. Thanks are due to Mr D T Mathes/Head of the Biometry Division for the assistance given in Biometry, to Dr (Mrs) C Jayasekara/Head, Plant Physiology Division for the assistance rendered in eco-physiological studies, Mr M Jeganathan, AKP-Project Coordinator for the assistance on CARP project and Dr M Rezania for valuable suggestions on the FAO Fertilizer Project. Assistance given by the Heads and staff of other research and services divisions of the Coconut Research Institute is sincerely appreciated. Services rendered by Mr Sunil Dimantha, Head/Land Use Division of the Irrigation Department under the CARP project (Expt 26.1) is gratefully acknowledge and express sympathy for his untimely death. Co-operation from Janatha Estate Development Board (JEDB), National Livestock Development Board (NLDB), Sri Lanka State Plantations Corporation (SPC) and Wayamba Plantations (Pvt) Ltd. in the conduct of the field experiments in their plantations and the encouraging response from the coconut growers/public are also acknowledged.

Contribution by former members of the division is duly recognized. All members in the division worked with dedication throughout the year to achieve the success of the research programme.

REPORT OF THE CROP PROTECTION DIVISION - 1992

Head - P A C R Perera, Ph D

1. GENERAL

The research programme of the Division progressed satisfactorily. The collaborative research project with the Universities of Peradeniya and Munster(Germany) was concluded. In these studies, the Dichloromethane extracts of the fruit/flesh of *Melia dubia* showed significant insecticidal activity against both the red weevil and the coconut caterpillar. In experiments on rat control, laboratory trials showed that a polythene band was as effective as a band of galvanized iron or aluminium when used as a barrier. Studies on termite control confirmed the suitability of Chlorpyrifos as an alternative to Chlordane/Aldrin. The Division also contributed to the multidisciplinary projects on premature decline of palms, immature nutfall and earthworms, results of which are reported elsewhere. Valuable assistance was provided to growers on the identification and control of pests and diseases.

2. RESEARCH PROJECTS

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

Experiment 8.2.2: Effect of nutrient status of plant on susceptibility to *Opisina arenosella* attack; Bandirippuwa (1984).

The experiment was carried out on a 5 ha, DxT plantation of 20 year old palms at Bandirippuwa Estate, Lunuwila. The differential application of fertilizers, initiated in 1989, was continued and leaf analyses for potassium and nitrogen content in the 14th leaf of experimental palms were carried out in September 1992. Significant ($P<0.001$) differences in percent dry weight of potassium were observed between palms with added potassium and no potassium. The means with LSD for the 4 treatments are presented in Table 1. Bioassay studies were initiated in November 1992 using *O arenosella* Instar 1 larvae. These studies are in progress.

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

Table 1. *Leaf analysis for percent dry weight of potassium : T tests (LSD) for variable K*

Treatment	N	Mean	T Grouping
K_2N_0	5	1.30	A
K_2N_2	5	1.10	B
K_0N_2	5	0.64	C
K_0N_0	5	0.56	C

LSD=0.14

(K_2N_0: Fertilizer mixture without Nitrogen and with 3.2 kg of Potassium Chloride/palm; K_2N_2: Fertilizer mixture with 3.2 kg of Potassium Chloride and 1.6 kg of Urea/palm; K_0N_2: Fertilizer mixture without Potassium and with 1.6 kg of Urea/palm; K_0N_0: Control)

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

Experiment 9.3: Pesticides from Sri Lankan plants for the control of coconut pests (collaborative project with the Universities of Peradeniya and Munster, Germany); Bandirippuwa (1990).

The collaborative Research Project on Coconut Pest Control with the Universities of Peradeniya and Munster (Germany) was concluded. During the project period, 64 plant extracts from 26 plants were tested for anti-feedant and lethal effects on two of the major pests of coconut namely, the coconut caterpillar *(Opisina arenosella)* and the red weevil *(Rhynchophorus ferrugineus)*. With the coconut caterpillar, insecticidal activity was related to measurements of weight gain, frass weight and leaf area consumed by the larvae feeding on the test leaves. With the red weevil, insecticidal activity was related to weight gain and mortality of larvae feeding on an artificial diet in which the insecticide extracts were incorporated.

In these studies, the dichloromethane extracts of the fruit/flesh of *Melia dubia* recorded significant insecticidal activity, while near significant insecticidal activity was observed with the methanol extracts of *Phyllanthus debilis*

(whole plant) and the dichloromethane extracts of *Swietenia mahogani* (twigs and leaves). The *M.dubia* extracts were fractionated and highly significant ($P < 0.001$) anti-feedant and lethal effects were recorded with an isolated fraction. The Research Contract ended in July, and the Project was therefore terminated.

V Kumar (University of Peradeniya), P A C R Perera, K S Hemachandra, Lalith Perera, and J Ranaweera

Experiment 9.4: Evaluation of four insecticides for the control of black beetle: Madampe (1992).

The objective of this experiment was to determine the effectiveness and persistence of the insecticides recommended for use in black beetle control.

The treatments consisted of the systemic insecticides Monocrotophos 60%, Methamidophos 60% and Carbofuran 3% granules and the controlled release formulation of Carbosulfan (Suscon) 10% granules with an untreated control.

The experimental design was, randomized complete blocks with 8 palms per plot and four replicates. The experiment was done at 2 locations viz. Kumbukwewa Estate, and Ratmalagara Estate, Madampe.

With Monocrotophos and Methamidophos, the insecticide was poured to the stem to cover the area around the first six leaf axils. The dilution rates were 5 ml in 250 ml water for palms with 10 leaves and less, and 10 ml in 500 ml water for palms with more than 10 leaves. The granular insecticides, Carbofuran and Carbosulfan were applied at the rates of 15 g for palms with 10 leaves and less , and 30 g for palms with more than 10 leaves. These were applied as small bags each containing 5 g of the insecticide and were placed in the first three or six leaf axils depending on the size of the palm.

Monthly records of (a) damage by black beetle and (b) rainfall were maintained.

This experiment is in progress.

P A C R Perera, I R Wickramananda, C N K Rajapakse and R Wijesekara

PROJECT 11: BIOLOGICAL CONTROL OF BLACK BEETLE

Experiment 11.3.2: Studies on the dispersal of *Baculovirus oryctes* and its effects on *Oryctes* (black beetle) populations; Pothukkulama (1992).

This experiment was undertaken to determine the survival and dispersion and hence effectiveness of *Baculovirus oryctes* under field conditions. Twenty artificial black beetle breeding sites (impregnation boxes) filled with the breeding medium (CRI Annual Report, 1991) were installed 75 m apart and radiating in North, South, East, and West directions from a central impregnation box. The central box was maintained as the source of virus inoculum and contained 30 virus infected larvae. Initially twenty healthy black beetle larvae were released to each impregnation box except the central box. At 14 day intervals, the larvae in each impregnation box were examined, the number infected by virus was recorded, and the larvae were replaced with 20 healthy black beetle larvae.

No direction-wise movement of the virus infection was observed. The infection rate was highest at the fourth week after introduction of virus, and thereafter the infectivity decreased rapidly (Figure 1). At the end of the eighth week the infection rate decreased to very low levels. These results indicate that the effectiveness of the virus could last for ca 4 to 6 weeks under field conditions.

P A C R Perera, C N K Rajapakse and D C L Pathirana

Experiment 11.5.2: Studies on the viability of *Baculovirus oryctes* under different field conditions; Pothukkulama (1991).

Healthy black beetle larvae were infected with *Baculovirus* by breeding them in virus contaminated breeding medium kept under different conditions in the field. Impregnation boxes were set up at random locations, in an area recently planted with coconut. Twenty laboratory cultured, virus infected black beetle larvae were added to each impregnation box and the medium maintained at different moisture levels. One kg of the breeding medium collected at 2 week intervals from each of the impregnation boxes and from untreated controls were bioassayed in the laboratory using healthy *Oryctes* larvae.

The results were inconclusive as many of the *Oryctes* larvae in the experimental cultures were infected by bacteria.

C N K Rajapakse, P A C R Perera and P H A P Siriwardena

MISCELLANEOUS INVESTIGATIONS

PROJECT: CONTROL OF MAMMALIAN PESTS

Experiment No.1: Control of rats in coconut plantations, Bandirippuwa, (1992).

The objective of this experiment was to find an effective and cheap method for rat control in coconut lands. The treatments consisted of barriers in the form of bands of G I sheet (present method) and polythene of different gauges (400, 500 and 700). With each material, different band widths (15 and 30 cm.) were tested.

A specially designed large circular cage, of diameter 3 feet and height 5 feet, with aluminium and wire mesh sides and with a coconut tree trunk fixed through the centre was used in these experiments. The polythene bands as per treatments were fixed to the centre of the coconut stem and a known number of rats were released at the base of the trap/cage. The number of rats which were able to cross the band and reach the upper part of the trap were counted. Tests without the barrier were used as controls. The experiment was replicated six times.

The results indicated very clearly that a G I band wider than 15 cm should be used to prevent rats from crossing the barrier. The results also indicated that in place of the expensive G I sheet a polythene band of gauge 500 and above and width 30 cm was as effective as the G I band.

P A C R Perera and M M Keerthi

Experiment No.2: The effect of planting method on susceptibility to termite attack; Bandirippuwa (1992).

The objectives of this experiment were, to determine whether termite attack in coconut nurseries could be prevented or reduced by adopting appropriate planting methodology.

The treatments were as follows: 1) horizontal planting with the nut completely covered with soil ie. flush with soil surface, 2) horizontal planting with the micropyle region flush with soil surface ie. only half the nut under soil, 3) horizontal planting with the micropyle region 2 cm above soil surface, 4) vertical planting with the nut completely covered with soil, 5) vertical planting with the micropyle region 2 cm above soil surface and 6) vertical planting with half the nut under soil.

Seednuts of uniform size and maturity were selected. The experimental area (seed-beds) was uniformly infested with termites. When the termites were well established nurseries were laid out as per treatments outlined above. The seed-beds were watered 2/3 times a week. Seedling mortality due to termite attack and seedling germination were recorded at 7 day intervals.

The results (Figure 2), indicated very clearly that termite attack was

heaviest when the seednut was completely covered by soil, and least with vertical planting when only half the seednut was covered with soil, the differences being highly significant ($P < 0.001$). No significant differences were observed between the percentage of germination in the different treatments.

P A C R Perera, R Wijesekera and K F G Perera

Experiment No.3: Methods of application of chlorpyrifos for termite control in coconut nurseries; Bandirippuwa (1992).

The objective of this experiment was to identify an effective method for the application of chlorpyrifos for termite control in coconut nurseries. The treatments consisted of two application methods described below and three concentration levels with each application method. The treatments were replicated three times. The two methods were: (a) dipping the seednut in the respective chlorpyrifos solution before planting in the nursery and (b) spraying (drenching) the nursery with the insecticide solution after planting.

With the dipping method, each seednut was dipped for 5 minutes in the insecticide solution, before planting in the nursery. The insecticide concentrations tested were; 0.60 g, a.i (3ml/l), 1.20 g, a.i.(6ml/l) and 1.80 g, a.i.(9ml/l). The spraying was carried out by applying 10 litres of the respective spray solutions per plot ($2m^2$) using 0.75 g, a.i (3.75 ml/l) , 1.50 g, a.i.(7.5ml/l)) and 2.25 g, a.i. (11.25ml/l). Mortality of seedlings due to termite attack was recorded weekly. The experiment is in progress.

C N K Rajapakse and I R Wickramananda

Experiment No.4: The residual activity of 4 concentrations of chlorpyrifos under field conditions.

The objective of this study was to determine the optimum concentration and optimum application frequency for use of Chlorpyrifos in termite control. Chlorpyrifos 20% EC was used for this experiment.

The spray solutions tested contained 0.4 g, a.i.(2ml/l), 0.6 g,a.i. (3ml/l), 0.8 g, a.i.(4ml/l), and 1.0 g, a.i.(5ml/l). One litre of the insecticide of the concentration relevant to each treatment was sprayed over a one m^2 area of sandy loam soil. Composite soil samples were taken immediately after spraying, one week after spraying, and two weeks after spraying at two depth levels (5 and 10 cm). Bioassays using 15 termites per sample were carried out on each soil sample. These

bioassays were conducted immediately after spraying and at intervals of 7 days, and 14 days after treatment.

With each bioassay termite mortality was recorded 24 hours after introduction of termites. All concentrations of chlorpyrifos tested gave over 95% mortality of termites (Table 2) with soil samples at 5 cm depth. However, at the 10 cm depth % mortality was low even at the highest concentration tested. All concentrations except 0.4 g,a.i. (2ml/l) gave high % mortality 7 days after treatment at the 5 cm depth of soil. The treatment with 1.0 g,a.i. (5ml/l) gave high % mortality even at 14 days after treatment although the lower concentrations gave considerably lesser percent mortality.

Table 2. *Percentage mortality of termites at different time intervals at different depths (cm) after treatment with Chlorpyrifos.*

	% mortality					
	24 hrs		7 days		14 days	
Depth	5cm	10cm	5cm	10cm	5cm	10cm
Concentration* (ml/l)						
2	98	12	77	10	69	16
3	100	21	87	16	81	18
4	96	17	97	5	66	29
5	100	21	95	8	85	13
control	0	0	0	0	0	10

(* Chlorpyrifos 20% (Pyrinex 20 EC)

C N K Rajapakse and P A C R Perera

Experiment 5: **Bioassay studies of Carbosulfan (suscon) and Carbofuran using termites under laboratory conditions, Bandirippuwa (1992).**

In this experiment 0.5 g each of carbosulfan and carbofuran were mixed with 200 g of soil separately. The soil samples were kept for 3 weeks in the laboratory under room temperature and bioassayed using termites. The results (Table 3) indicated that Carbosulfan was as effective as Carbofuran against termites. The

residual activity of both insecticides against termites was more than 3 weeks under laboratory conditions.

Table 3. *Percentage mortality of termites in soil at different time intervals after treatment with Carbosulfan and Carbofuran.*

Treatments	% mortality			
	24 hrs	7 days	14 days	21 days
carbosulfan	92	100	100	96
carbofuran	100	100	88	92
control	0	16	15	12

C N K Rajapakse and P A C R Perera

Experiment No. 6: Studies on the micro-organisms associated with decaying fibre dust.

The objective of this experiment was to identify and catalogue the micro-organisms associated with the decay of fibre dust.

Three tractor loads of fresh fibre dust were deposited at selected sites. Representative samples were collected from the fibre dust heaps at bimonthly intervals. The samples were assessed using different methods, such as Berlese's funnels, sedimentation, centrifugation and microscopic examination. The organisms present were identified.

The experiment is in progress.

P A C R Perera and D C L Pathirana

3. INCIDENCE OF PESTS AND DISEASES

Seventy five reports of pest and disease incidence (Table 4) received during the year were investigated and appropriate control measures recommended. Three reports of a *Xyleborus sp.* attacking coconut were received of which one was from an estate in the Wariyapola district, with a forest reservation as one boundary. In this estate, the pest was also found attacking a tree of the *Artocarpus sp.* growing in close proximity to the attacked coconut palms, indicating that the pest was an

incidental pest on coconut. However, four healthy 20 year old palms were destroyed by the pest.

Table 4. *Reported incidence of pests and diseases in different Provinces.*

Pest/Diseases	Number of reports	Province				
		WP	NWP	SP	CP	NCP
Black beetle	9	1	8	0	0	0
Red weevil	15	4	7	0	2	2
Coconut caterpillar	25	16	7	1	1	0
Coconut scale	3	0	2	1	0	0
Nettle grub	1	0	1	0	0	0
Leaf blight	3	1	1	0	1	0
Stem bleeding	1	0	0	0	1	0
Leaf scorch	7	1	6	0	0	0
Rat/bat	3	0	3	0	0	0
Others	8	2	4	0	2	0
Total	75	25	39	2	7	2

(WP: Western Province; NWP: North Western Province; SP: Southern Province; CP: Central Province; NCP: North Central Province)

During the year, the coconut caterpillar was observed to cause more damage in the Western Province as compared to the previous year.

A severe outbreak of the stem bleeding disease was recorded from an estate at Rambodagalla with over 100 palms being infected. The disease was controlled by the application of two concentration (5 and 10 ml /palm) of Baycor 200 EC, a systemic fungicide.

4. CROP PROTECTION SERVICE

4.1 Biological control

Insect Pests: Laboratory bred parasitoids for the control of the coconut caterpillar

were released in the infested areas (Table 5). However, in order to prevent possible major outbreaks chemical control was recommended in selected instances.

Table 5. *Parasitoid releases for coconut caterpillar control.*

Province	P_1	P_2	P_3	P_4	P_5	Total
Western	41,750	66,750	13,970	168,200	6,300	296,970
N. Western	10,250	20,500	2,900	103,500	3,200	140,350
Southern	5,250	5,000	1,150	9,000	2,700	23,100
Total	57,250	92,250	18,020	280,700	12,200	460,420

(P_1: *Goniozus nephantidis*; P_2: *Bracon hebetor*; P_3: *Eriborus trochanteratus*; P_4: *Trichospilus pupivora*; P_5: *Brachymeria nephantidis*)

Several consignments of the fungus *Metarhizium anisopliae* and the virus *Baculovirus oryctes* were issued as polythene packs to growers for the control of black beetle in the North Western and Western Provinces.

Weeds: The demand for the biological control agent (*Pareuchaetes pseudoinsulata*) used for the control of Podisinghomaran *(Chromolaena odorata)* continued during the year and a total of 14,750 larvae and 625 adults were issued/released in coconut plantations in the North Western and Western Provinces.

4.2 Chemical control

During the year a total of 5902 palms were treated with insecticides for the control of coconut caterpillar, 3387 being in the western province and 2515 in the North Western Province.

Trunk injections of systemic insecticides for the control of red weevil were done on 180 palms in the Western, North Western and the North Central Provinces.

5. EXTENSION ACTIVITIES

The following lectures/demonstrations were given.

Mrs C N K Rajapakse on "Action of pesticides and their toxicological effects" and " Classification of pesticides and the effects of pesticides on coconut pests and the pests of inter crops" to the Coconut Development Officers and Regional Managers of the C C B.

Mrs C N K Rajapakse on "Coconut pests and their control" to a group of middle-level management staff of coconut estates on 02 October.

Dr P A C R Perera on "Principles of Crop Protection" and "Diseases of coconut and their control" to a group of middle level management staff of coconut estates on 02 October,

Mr. K F G Perera, Mr K A S Chandrasiri, Miss D C L Pathirana, Mr A S M Premalal and Mr W E A Fernando; demonstrations on pests and diseases of coconut and their control to a group of middle-level management staff of coconut estates on 02 October.

Lectures and laboratory demonstrations on the work of the Division were given to several groups of students from schools and universities and to visiting scientists.

6. ACKNOWLEDGEMENTS

The cooperation and assistance of the staff of the Crop Protection Division in the conduct of research programme and in the preparation of this report is gratefully acknowledged. Thanks are also due to: the Head and the staff of the Biometry Division for assistance with design of experiments and analysis of data, the Soils and Plant Nutrition (SPN) Division for analysis of leaf samples, the staff of the Agronomy and SPN Divisions for assistance with the earthworm survey, and the Commonwealth Institutes of Entomology and Mycology for insect and fungal identifications respectively.

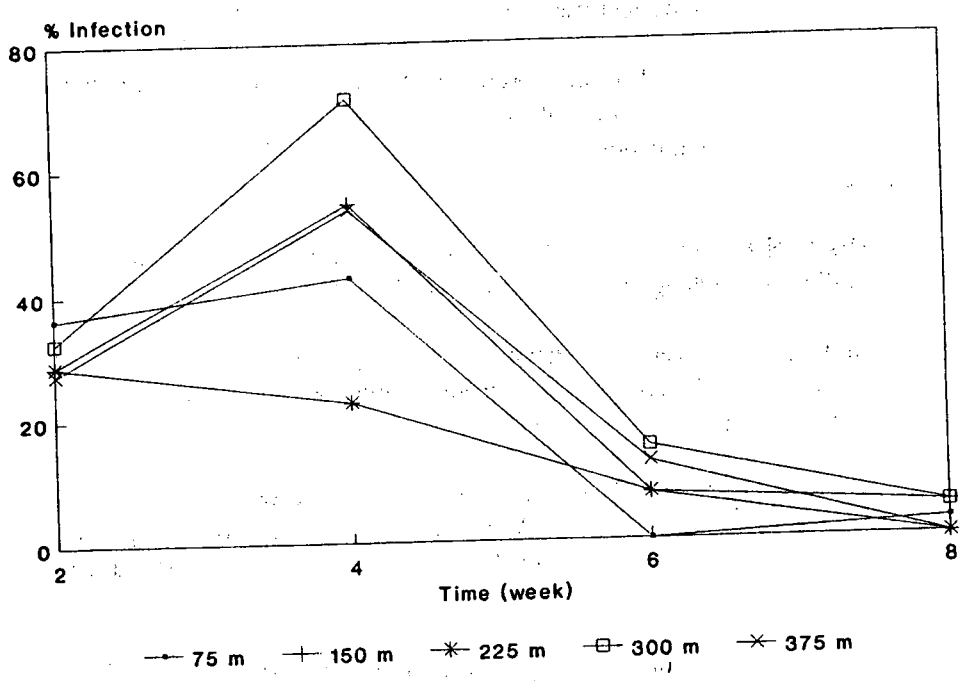


Figure 1. Dispersal and viability of *B. oryctes*.

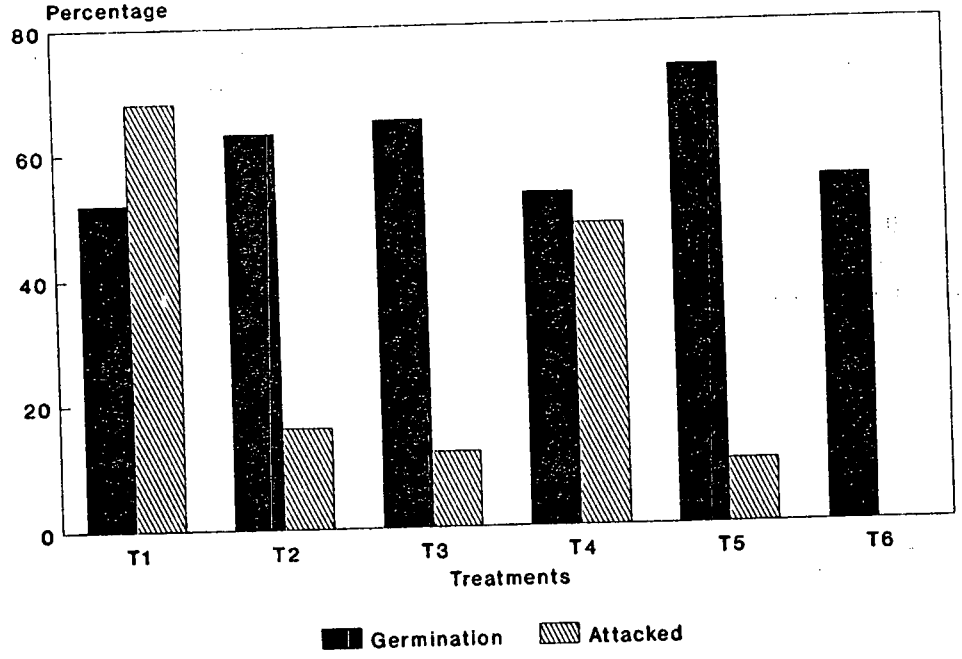


Figure 2. Effect of planting method on termite attack.

REPORT OF THE BIOMETRY DIVISION

Head - D.T. Mathes, FIS

1. GENERAL

Computerization: The computer facilities were further increased by increasing the hard disc capacity of the 386SX model to 80MB. In addition a Note-Book (lap-top type computer) with hard disc capacity 40MB and a NEC printer were purchased during the year.

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.

Special assistance was provided to Mr.T G L G Gunesekera and Mr. H P S Jayasundara in their Ph. D. projects. A number of undergraduates from different Universities too were provided with such assistance.

3. RESEARCH PROJECTS

PROJECT 19: APPLICATION OF BIOMETRY IN COCONUT RESEARCH.

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

The bimonthly recording of vegetative and yield characters were carried out without interruption. Variation of yield parameters between the six picks of 1991 and 1992 is given in Tables 1 and 2. The total number of bunches for the year showed an increase of 3.9% over 1991. A steady decline in number of nuts per palm was shown for the second pick onwards. The number of nuts per hectare too showed a similar pattern to nuts per palm. The recorded yield was 15083 nuts/ha compared to 16735 nuts/ha recorded in 1991. The year showed a decrease in yield by 9.9% over 1991. The copra yield per hectare was 2,877.2 Kg/ha which is a drop of 12.2% over 1991.

Table 1. *Average yield components in 1992 (Expt. 19.3).*

Pick number	Number of bunches/palm	Number of nuts/palm	Number of nuts/ha	Number of nuts/bunch
1	2.0 (2.3)	15.9 (17.5)	2509 (2765)	7.9 (7.5)
2	3.0 (2.0)	30.6 (19.4)	4841 (3060)	10.3 (9.8)
3	2.6 (2.1)	21.2 (24.3)	3357 (3848)	8.2 (11.7)
4	1.9 (2.1)	13.1 (18.2)	2064 (2878)	6.8 (8.5)
5	1.9 (2.1)	8.4 (11.6)	1334 (1833)	4.5 (5.5)
6	1.8 (2.1)	6.2 (14.9)	978 (2351)	3.4 (7.1)
Total	13.2 (12.7)	95.4 (105.9)	15083 (16735)	

(Figures in parenthesis are those recorded in 1991)

Table 2. *Average weight of husked nut and copra yield in 1992.*

Pick	Weight of husked nut (g)		Copra (Kg/ha)	
	1992	1991	1992	1991
1	684	673	549.17	595.47
2	627	580	971.30	567.94
3	611	551	656.36	678.48
4	556	609	367.23	560.86
5	444	669	189.53	392.41
6	459	640	143.65	481.48
Total/Ave.	592	612	2877.24	3276.64

(Copra Yield = husked nut weight x 0.32)

Two monthly vs. Bimonthly harvesting

Since the beginning of 1990 the palms in the calibration trial were divided into two groups of 50 palms each and harvesting was carried out at bimonthly intervals for one group and at monthly intervals for the other group. The number of nuts per 50 palms recorded prior to 1990 and after 1990 for the two

groups are shown in Tables 3 and 4. Preliminary analysis indicated an increased yield for monthly harvesting.

(The observations prior to 1990 shown in the table indicate the status of the two groups before the frequency of harvesting was identified).

Table 3. *Number of nuts per 50 palms.*

Frequency of harvesting	-- Prior to 1990 --				----- 1990 and Thereafter ----			
	Ave 1987-89	% setting	1989	% setting	1990	% setting	1991	% setting
Monthly	4689	34.3	5745	31.6	4976	29.1	5354	29.5
Bimonthly	4492	32.8	5617	31.2	4348	26.7	4910	28.7
Difference								
No	197		128		628		444	
%	4.4		2.3		14.4		9.0	

Table 4. *Number of bunches per 50 palms*

Frequency of harvesting	----- Prior to 1990 -------		1990 and thereafter	
	Ave. (1987-89)	1989	1990	1991
Monthly	639	642	711	630
Bimonthly	614	629	653	598
Difference				
No	25	13	58	32
%	4.1	2.1	8.9	5.4

D T Mathes, Ranjith Fernando, W M L G Fernando, Kingsley Herath & P Fernando.

4. MISCELLANEOUS STUDIES

4.1. Alternative methods for determination of optimum plot size in tree crops.

The plot sizes for field experiments on tree crops are determined by using data from uniformity trials. As conducting such trials are costly and time consuming, two alternative methods are developed here to determine the optimum plot size for the field experiments using already collected experimental data of long-term field experiments in tree crops.

In the first method, trees were numbered in the same sequence from one to n (n= number of trees per plot) within plots to maintain the plot shape identical and palms bearing same numbers were selected from each plot. All possible combination of palms were taken into consideration under different plot sizes of n, n-1, ...,1. The number of blocks and the number of treatments were kept same for all the cases. The coefficient of variation of experimental error, CV_{er} and cost ratio, C_r are computed in all cases and the intersection point of the mean values of CV_{er} and C_r could be considered as the optimum values of the plot size.

In the second method the block effect and treatment effect in the linear model of the experimental design (randomized complete block design) are removed from the yield of each tree and treated the ensuing yields as if it came from a usual uniformity trial and the analyses are carried out via Fairfield Smith's technique.

T S G Peiris and R O Thattil (University of Peradeniya) and Ananda Weerasooriya (University of Colombo).

4.2. Intensity of drought in 1992

A study was carried out in order to find the severity of drought as reflected from the available meteorological data. Using the raw data from 1958 - 1991, it was estimated that the monthly rainfall from January to March in 1992 of the three stations were less than 15% rainfall probability of the corresponding months. Only at Rathmalagara estate and Isolated Seed Garden, April rainfall is just above 50% rainfall probability but it was below 15% rainfall probability in Bandirippuwa estate. The length of the maximum dry run (MDR) for the period, 01 January to 30 April was derived in the three stations. (Note: In this analysis a rainy day of less than 5 mm followed by more than 14 dry days was ignored).

Table 5 gives the MDR of these stations for the last ten years along with the different probability values of dry spells.

Table 5. *Length of maximum dry run (MDR) for two periods at 3 estates: Rathmalagara (RE), Bandirippuwa (BE)and Isolated Seed Garden(ISG).*

Year	RE	BE	ISG
1982	77	86	65
1983	102	106	111
1984	16	15	16
1985	21	18	18
1986	30	30	29
1987	59	44	56
1988	59	68	34
1989	49	50	50
1990	23	32	64
1991	29	24	43
1992	113	117	100
Probability values of dry spells			
P_{90}	75	83	64
P_{75}	59	50	55
P_{50}	38	35	34
P_{25}	24	21	23
P_{15}	22	19	19

It shows length of the maximum dry spells in Rathmalagara estate and Bandirippuwa estate were higher in 1992 than 1983, whereas in Isolated Seed Garden the maximum dry spell in 1992 is ten days shorter than in 1983. However in both years, those values are much greater than the 90% probability values of dry spells. The distribution of the MDR between the four month in 1983 and 1992 is given in Table 6.

On the basis of the above, it shows that the drought in 1992 is similar to the drought of 1983 with respect of the distribution of rainfall and dry spells. It could be expected that the effect of drought to coconut in BE particularly for the first two picks would be more than in RE and ISG.

Table 6. *Distribution of MDR between months*

Station	Year	January	February	March	April
RE	1983	41	70	101	102
RE	1992	38	67	96	113
BE	1983	45	74	105	106
BE	1992	43	72	102	117
ISG	1983	37	65	96	111
ISG	1992	38	69	100	102

T S G Peiris

4.3 Analysis of rainfall data in different locations.

The analysis of rainfall of different areas in IL1, IL3, DL3 and DL1 was initiated to elucidate any discernible seasonal changes and to study the possible deterioration of climate in these areas during the last three decades.

a) The daily rainfall data from 1962 - 1991 in the following stations were subjected to probability analysis initially.

IL1 - Palugaswewa, Horakela, Katupotha, Kurunegala, Ratmalagara and Bandirippuwa.
IL3 - Mediyawa, Nikaweratiya, Ridibendiwela and Polonthalawa.

The monthly histograms of the 75% rainfall probability in the stations in IL1 and IL3 are given in Figures 1 and 2 respectively. These figures illustrate clearly the four rainy seasons: (i) North East monsoon period (December - March), (ii) first inter monsoon (Yala) period (April - May), (iii) South West monsoon period (June - September) and (iv) second inter monsoon (Maha) period (October - November). It is also clear that the Maha season rain is more reliable than the Maha season rains in all stations. On the basis of the estimated values of the probabilities of receiving minimum of 120 mm rainfall in October and November, the reliability of stations in IL1 and IL3 can be ranked as follow.

IL1: Kurunegala > Katupotha > Bandirippuwa > Palugaswea > Ratmalgara > Horakela.

IL3: Polonthalawa > Ridibendiwela > Polonthalawa > Mediyawa.

Further investigations are being carried out about the length of rain, length of dry spells and weekly rainfall probabilities in these four seasons.

T S G Peiris

b) Trend analysis of the rainfall variation

Trend analysis was carried out by regressing five year moving total(y) against time(x) for the total rainfall and monthly rainfall of different stations. The stations used were Puttalam(DL3), Mahauswewa(DL1), Anamaduwa(DL1), Nikaweratiya(IL3), Kurunegala(IL1), Rathmalagara(IL1), and Bandirippuwa(IL1). The objective was to see whether there are any significant trend in the rainfall pattern over the last three decades. The regression coefficients (a and b) and the correlation coefficients (r) are as given;

Total Rainfall (for the year)

Location	a	b(time)	r
Puttalam	5382	22.50	0.3228
Mahauswewa	-622	105.02***	0.6417
Anamaduwa	6204	-49.71	0.4088
Nikaweratiya	7756	-71.44***	0.9147
Kurunegala	11367	-63.44**	0.6027
Rathmalagara	8089	-21.75	0.3739
Bandirippuwa	10383	-71.61***	0.8004

For the overall rainfall of the year, Mahauswewa showed a significant increasing trend while the stations Nikaweratiya,Kurunegala and Bandirippuwa showed a significant declining trend. No such significant trend was shown by the rest of the stations.

Rainfall for January

Location	a	b(time)	r
Puttalam	-86.49	16.29***	0.7906
Mahauswewa	-32.21	4.97**	0.5771
Anamaduwa	142.19	-3.22	0.2729
Nikaweratiya	210.19	-0.73	0.0539
Kurunegala	151.33	10.49*	0.4123
Rathmalagara	135.32	1.10	0.0995
Bandirippuwa	287.24	-5.22	0.2524

The rainfall for the month of January for the stations Puttalam,

Mahauswewa, and Kurunegala showed a significant increasing trend. The rest of the stations however did not indicate a significant trend.

Rainfall for February

Location	a	b(time)	r
Puttalam	-81.74	17.34***	0.7624
Mahauswewa	-15.37	2.82***	0.6810
Anamaduwa	234.48	-5.67	0.4395
Nikaweratiya	215.71	7.59*	0.4146
Kurunegala	548.04	-4.37	0.1649
Rathmalagara	207.61	2.87	0.2458
Bandirippuwa	350.38	-3.71	0.3426

Puttalam, Mahauswewa and Nikaweratiya showed significant increasing trend, while no such significant trends were shown by other stations

Rainfall for March

Location	a	b(time)	r
Puttalam	322.53	0.88	0.0608
Mahauswewa	-68.57	10.27***	0.6583
Anamaduwa	358.25	1.99	0.1063
Nikaweratiya	461.94	-0.33	0.0361
Kurunegala	677.54	2.43	0.1261
Rathmalagara	441.32	-0.81	0.0557
Bandirippuwa	587.81	-3.58	0.2291

Mahauswewa showed a significant increasing trend with rest of the stations showing no such trends

Rainfall for April

Location	a	b(time)	r
Puttalam	695.16	13.71*	0.4736
Mahauswewa	-125.87	19.69***	0.6597
Anamaduwa	721.74	5.83	0.1752
Nikaweratiya	1201.11	-13.70*	0.4025
Kurunegala	1659.56	-25.72***	0.6704
Rathmalagara	919.39	5.20	0.1338
Bandirippuwa	981.62	-1.03	0.0400

Significant increasing trends were shown for stations Puttalam and

Mahauswewa, while decreasing trends were evident for stations Nikaweratiya and Kurunegala.

Rainfall for May

Location	a	b(time)	r
Puttalam	409.60	3.83	0.2243
Mahauswewa	-13.13	6.16**	0.6027
Anamaduwa	711.53	-16.25**	0.5419
Nikaweratiya	772.72	-15.19***	0.5375
Kurunegala	941.31	0.71	0.0283
Rathmalagara	1032.68	-1.74	0.0436
Bandirippuwa	1555.98	-11.27	0.2900

Significant increasing trend was shown for the station Mahauswewa while decreasing trends were shown for Anamaduwa and Nikaweratiya.

Rainfall for June

Location	a	b(time)	r
Puttalam	219.10	-3.66	0.3621
Mahauswewa	-36.45	5.13**	0.6057
Anamaduwa	224.23	-5.70*.	0.4420
Nikaweratiya	327.74	-2.10	0.2186
Kurunegala	731.41	3.21	0.2045
Rathmalagara	508.92	-0.05	0.0000
Bandirippuwa	794.95	0.77	0.0400

The stations Mahauswewa showed a significant increasing trend and Anamaduwa showed a decreasing trend.

Rainfall for July

Location	a	b(time)	r
Puttalam	76.42	-0.25	0.0520
Mahauswewa	-8.52	1.73*	0.5006
Anamaduwa	156.58	-3.93.	0.3170
Nikaweratiya	293.44	-5.11**	0.5192
Kurunegala	598.33	-3.10	0.2629
Rathmalagara	414.68	-8.48***	0.6247
Bandirippuwa	588.71	-11.68**	0.5562

The three stations Nikaweratiya, Rathmalagara and Bandirippuwa showed a significant decline while a significant increase was shown for Mahauswewa.

Rainfall for August

Location	a	b(time)	r
Puttalam	111.87	-2.71***	0.6113
Mahauswewa	-30.37	4.34*	0.5916
Anamaduwa	132.70	-3.20	0.3688
Nikaweratiya	244.28	-6.12***	0.6120
Kurunegala	537.91	-5.00*	0.4415
Rathmalagara	112.39	9.84***	0.8289
Bandirippuwa	399.71	-0.95	0.0529

The three stations Puttalam, Nikaweratiya and Kurunegala showed a significant decline while a significant increase was shown for Rathmalagara.

Rainfall for September

Location	a	b(time)	r
Puttalam	144.88	13.07***	0.6344
Mahauswewa	-53.27	7.96***	0.6228
Anamaduwa	255.08	3.87	0.2522
Nikaweratiya	547.61	-7.07*	0.4589
Kurunegala	849.96	-3.82	0.2258
Rathmalagara	592.59	-2.78	0.1828
Bandirippuwa	798.84	3.06	0.1212

Stations Puttalam and Mahauswewa showed a significant increasing trend while Nikaweratiya showed a significant decreasing trend.

Rainfall for October

Location	a	b(time)	r
Puttalam	1520	-27.35***	0.8183
Mahauswewa	-81	16.16***	0.6419
Anamaduwa	1399	-12.65	0.3142
Nikaweratiya	1796	-30.51***	0.7423
Kurunegala	2058	-22.66***	0.6470
Rathmalagara	1906	-35.63***	0.7503
Bandirippuwa	2076	-37.27***	0.7513

Five stations showed a significant decline while Mahauswewa a significant increase was evident.

Rainfall for November

Location	a	b(time)	r
Puttalam	1046	14.74	0.3497
Mahauswewa	109	18.82***	0.6304
Anamaduwa	997	10.29	0.3441
Nikaweratiya	750	24.92***	0.7162
Kurunegala	1617	2.87	0.0608
Rathmalagara	1111	16.72*	0.4009
Bandirippuwa	1203	13.16	0.2972

The three stations Mahauswewa, Nikaweratiya and Rathmalagara showed a significant increasing trend while the rest of the stations showing no such trend.

Rainfall for December

Location	a	b(time)	r
Puttalam	1002	-23.19***	0.8016
Mahauswewa	-31.31	6.96**	0.5852
Anamaduwa	873	-21.22***	0.7917
Nikaweratiya	934	-22.88***	0.7785
Kurunegala	995	-18.34**	0.5855
Rathmalagara	707	-8.00*	0.4680
Bandirippuwa	759	-14.00**	0.6022

All the months showed a significant declining trend except however Mahauswewa showing a significant increasing trend.

D T Mathes

5. COMPUTER FACILITY

(a) Group training programmes were conducted separately for Executive and Clerical staff of Establishment, Estate Management and Publication. The following areas were covered in these programmes:

* Introduction to computers and operating systems(DOS)
* Introduction to Spread Sheet Packages

* Introduction to DBASE
* General usage of WORD Processing Package (WP 5.1)

H P De Zoysa

(b) computerization of the data collected from the experiments continuedthroughout the year.

W E R C Fernando, K Herath and D T Mathes

(c) Computerization of the meteorological data and providing such informations weekly to Meteorology Department and other Institutions continued throughout the year.

Protus Fernando, H P De Zoysa and D T Mathes

(d) A basic training on the use and application of, some statistical methodologies, SAS and Word Processing packages were provided on an individual basis, to the research officers who went abroad on post-graduate training.

D T Mathes and H P De Zoysa

(e) Assistance was provided quite often to all Research Divisions on the use/application of data base packages and statistical packages.

H P De Zoysa and D T Mathes

(f) The division continued to assist in computerizing information of the Medical Aid Scheme.

T S G Peiris and W E R C Fernando

(g) Assistance was provided in compiling the Management Information System and Programme Budgeting in respect of the CRI, for the Council for Agricultural Research Policy (CARP).

T S G Peiris & H P De Zoysa

(h) Assistance was provided to CARP in preparation of the report on Management Information System and Programme Budgeting System of Agricultural Institutions under CARP.

T S G Peiris

(i) Participated as a resource person for the Local workshop on Management Information System and Programme Budgeting System (MIS/PBS) organised by the CARP

T S G Peiris

(j) Assistance to other Divisions in maintenance of computers.
Following services were provided through-out the year to all Research Divisions, Establishment, Estate Management and the Library.

* Installation of new application packages
* Maintenance of hardware and software.

H P De Zoysa

(k) Some technical assistance in computer software was provided to Regional Agricultural Research Centre, Makandura.

H P De Zoysa

6. YIELD RECORDING

The recording of yield data of experiments conducted by the Research Divisions at the following estates was continued satisfactorily.

I	Bandirippuwa	V	Pothukulama
II	Ratmalagara	VI	Saddhatissa
III	Margaret Estate	VII	Walpita
IV	Sirikandura	VIII	Marandawila

7. EXTENSION ACTIVITIES

Lectures were provided to trainees attending courses conducted by the Coconut Research Institute and National Institute of Plantation Management.

Trainees from the National Apprentice Board were given training from time to time.

Visitors and students from Universities were briefed on the work of the division.

8. AGRO-METEOROLOGY

The three meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained satisfactorily. Daily recordings were taken throughout the year on rainfall,temperature, evaporation, humidity and soil temperature.

8.1 Bandirippuwa Estate

(a) Rainfall: The month January recorded a rainfall of 5.3 mm while no rainfall was recorded for the months February and March. Heavy rainfall was recorded for months September, October and November with a total of 1124.2 as against 2053.7 the total for the year. (see Table 7).

(b) Temperature: The monthly maximum temperature ranged from 29.4 to 33.1 °C as against 29.8 to 32.4 °C in 1991. The monthly minimum temperature ranged from 20.1 to 25.4 °C. On the whole, the temperature during the year was slightly higher compared to 1991. (see Table 8).

(c) Sunshine: Longer sunshine hours were observed during the early latter part of the year. The average for the year was 7.0 h. (see Table 8).

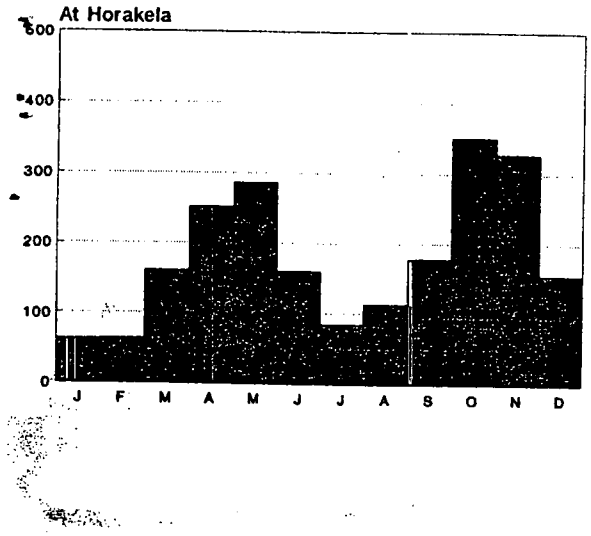
(d) Soil Temperature: The average temperatures recorded at depths 5,10,20,30,60 and 120 cm during the morning were 28.0, 28.2, 28.7, 29.4, 30.3, 30.3 °C while those for the afternoon were 34.0, 33.0, 30.9, 30.2, 30.2, 30.3 °C respectively. (see Table 9).

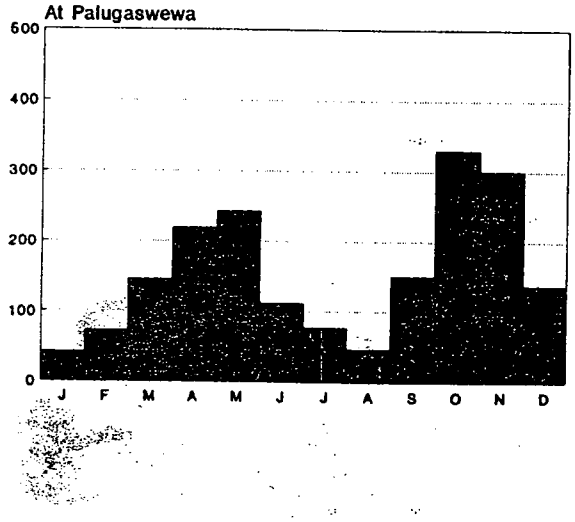
8.2 Ratmalagara Estate

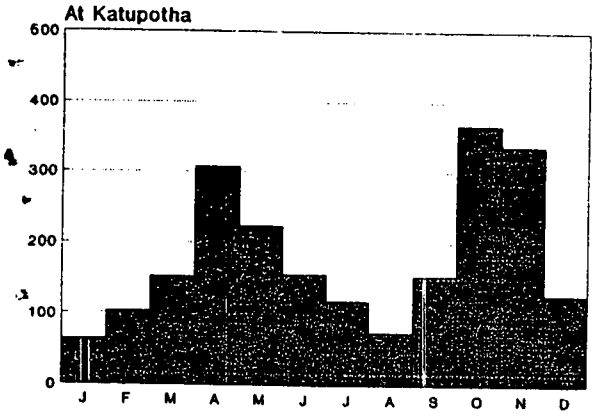
There was no rainfall recorded for the three months January, February and March. The total rainfall recorded for the year was 1867.9 mm. This is the highest since 1985. The three months September, October and November recorded a total rainfall of 1025.2. (see Table 10).

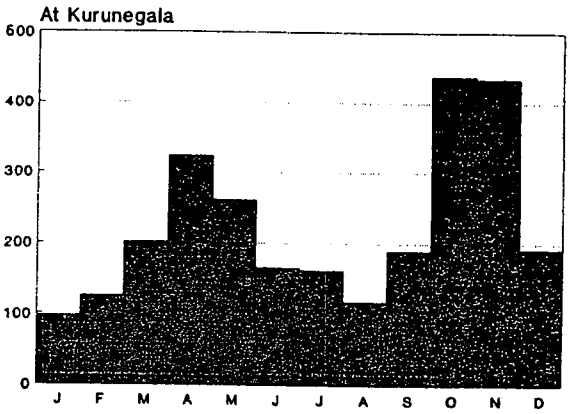
8.3 Isolated Seed Garden

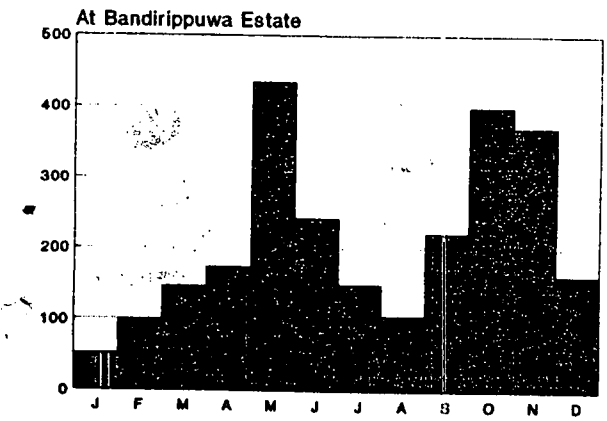
The three months January, February and March recorded no rainfall. The total rainfall for the year was 1696 mm which is the highest since 1985. The months April, May, June and July observed good rain. Except for the first three months there was fairly a good distribution of rainfall during the year. (see Table 11).











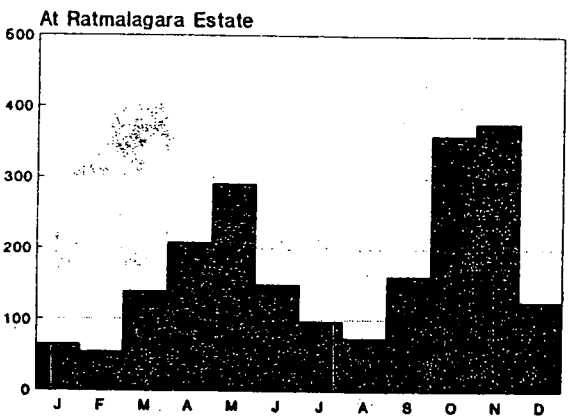
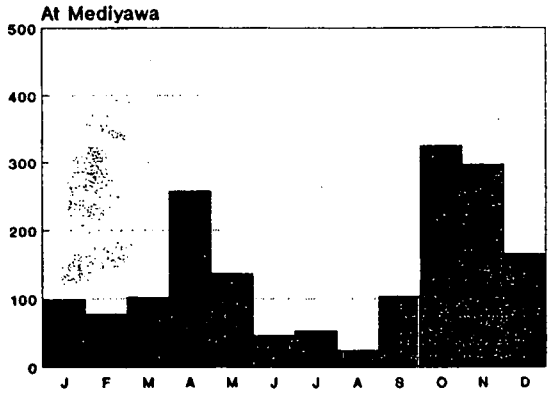
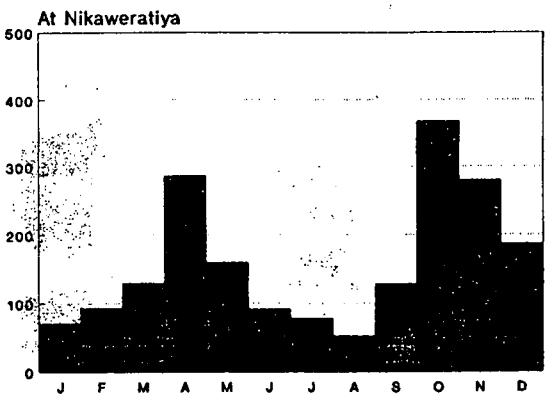
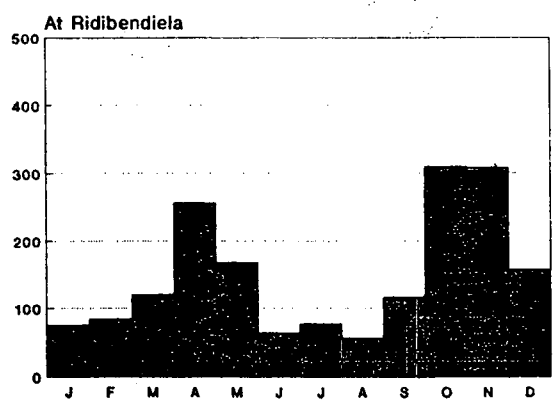


Figure 1. Monthly histograms of 75% rainfall probability for the six locations in IL1 (in mm)







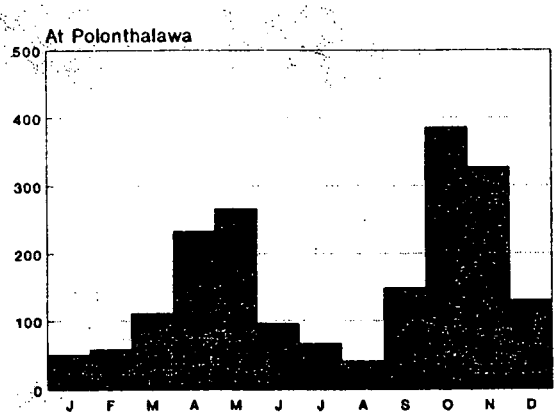


Figure 2. Monthly histograms of 75% rainfall probability for the four locations in IL3 (in mm)

Table 7. *Rainfall(mm) for the last 10 years and in 1992 (Bandirippuwa Estate)*

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Ave. (82-91)	1992
January	0.0	0.0	197.9	13.0	61.7	31.2	0.0	25.4	201.8	37.7	56.9	5.3
February	0.0	0.0	106.9	189.0	35.0	0.0	111.4	0.0	16.8	12.2	47.1	0.0
March	144.3	0.0	145.5	228.9	62.0	118.3	87.4	65.7	84.3	97.5	103.4	0.0
April	125.2	219.7	425.2	103.9	60.2	237.6	283.0	234.9	74.8	90.3	185.5	54.5
May	232.9	322.1	297.7	275.3	284.7	187.2	109.9	52.3	227.7	481.5	247.1	413.5
June	328.4	138.4	115.1	291.3	44.7	61.6	255.8	153.4	29.0	269.4	168.7	260.2
July	152.1	79.7	111.0	14.5	33.5	6.4	151.8	99.0	156.3	105.8	91.0	78.0
August	188.9	120.6	0.5	139.9	77.2	156.5	105.2	20.4	0.3	22.6	83.2	57.3
September	185.2	242.1	129.3	168.4	94.7	410.7	303.4	222.1	11.9	59.3	182.7	362.6
October	235.7	50.0	121.9	195.6	224.3	579.3	88.8	395.9	395.1	309.2	259.6	443.7
November	244.6	159.0	239.8	306.3	149.4	194.7	370.7	379.4	623.3	161.4	282.9	317.9
December	57.7	141.0	83.0	63.7	63.5	79.9	19.1	50.3	90.2	29.1	67.7	60.7
Total	1895.0	1472.6	1973.8	1989.8	1190.9	2063.4	1886.5	1698.8	1911.5	1676.0	1775.8	2053.7

Table 8. *Summary of meteorological observation in 1991 (Bandirippuwa Estate)*

Month	Temperature (°C) max	min	Evaporation (mm) per day	Relative Humidity (%)	Sunshine (hrs) a.m.	p.m.
January	31.4	21.6	4.7	76	56	7.9
February	32.9	20.1	5.1	76	58	9.6
March	33.1	22.0	5.7	76	63	9.2
April	33.3	23.5	5.5	75	65	8.2
May	31.3	24.8	3.8	84	79	6.4
June	30.0	25.4	..0	83	78	6.2
July	29.4	24.9	3.7	84	79	5.6
August	29.4	25.4	4.0	81	76	6.1
September	29.6	24.5	3.6	84	75	6.2
October	29.6	23.5	4.0	84	77	6.5
November	30.3	23.0	4.1	85	78	5.1
December	29.9	21.9	3.8	80	69	6.7
Average	30.8	23.4	4.3	81	71	7.0

Table 9. *Soil temperature (°C) at different depths (Bandirippuwa Estate)*

Months	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	26.2	26.6	27.5	28.4	29.2	29.2	32.5	31.8	30.0	29.4	29.2	29.2
February	27.2	27.7	29.1	30.0	31.0	30.5	39.5	37.2	32.6	31.5	30.9	30.5
March	29.5	29.9	31.4	32.4	33.0	32.1	42.9	39.9	34.3	33.1	32.8	32.1
April	31.2	31.4	32.3	33.4	34.2	33.4	42.1	40.0	35.3	34.2	34.0	33.5
May	29.0	28.9	29.2	29.8	31.0	31.2	33.9	33.1	31.4	30.7	30.9	31.2
June	28.2	28.2	28.3	28.8	29.8	30.0	32.5	31.8	30.5	29.9	29.8	30.0
July	28.1	28.1	28.3	28.9	29.8	29.9	31.7	31.0	29.9	29.4	29.7	29.9
August	28.0	28.1	28.3	28.9	29.7	29.8	32.3	31.6	30.3	29.8	29.7	29.8
September	27.9	28.1	28.3	28.8	29.8	30.0	31.6	31.3	30.3	29.7	29.7	30.0
October	27.4	27.6	27.7	28.0	28.8	28.9	30.7	30.3	29.2	28.7	28.8	28.9
November	27.1	27.3	27.6	28.0	29.0	29.1	30.1	29.6	29.0	28.5	28.9	29.0
December	26.0	26.3	26.6	27.1	28.2	28.7	28.8	28.3	27.8	27.5	28.2	28.6
Average	28.0	28.2	28.7	29.4	30.3	30.3	34.0	33.0	30.9	30.2	30.2	30.3

Table 10. *Rainfall(mm) for the last 10 years and in 1992 (Ratmalagara Estate)*

Month	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Ave. (82-91)	1992
January	0.0	0.0	32.9	16.6	64.8	13.6	0.0	77.7	185.5	36.2	52.7	0.0
February	0.0	0.0	166.2	122.1	54.3	0.0	101.3	0.0	8.3	12.2	46.4	0.0
March	118.8	0.0	168.6	158.3	74.7	72.0	53.3	117.4	96.2	88.8	94.8	0.0
April	112.2	109.2	703.6	208.3	143.4	120.4	231.4	204.2	37.7	104.4	197.5	236.9
May	196.8	145.3	282.4	82.3	246.1	141.5	68.0	54.2	114.6	375.7	170.7	275.2
June	190.8	80.9	39.1	126.0	50.9	65.1	221.9	126.5	12.6	264.2	117.8	191.2
July	35.6	55.6	88.6	39.1	22.6	16.9	57.9	124.2	92.7	38.1	57.1	71.5
August	155.2	74.9	2.0	13.3	85.9	139.5	158.1	10.0	0.0	16.1	65.5	11.5
September	36.6	109.9	132.8	84.2	26.4	190.0	259.7	161.4	17.4	43.0	106.1	192.8
October	272.8	79.5	109.3	209.9	153.0	502.8	58.0	238.9	389.2	211.3	222.5	326.9
November	200.8	163.6	472.8	319.0	228.4	195.9	230.1	298.7	434.6	175.8	272.0	505.5
December	118.7	216.3	95.9	104.4	95.9	53.2	88.8	24.4	76.7	82.2	95.7	56.4
Total	1438.3	1035.2	2394.2	1483.5	1246.4	1510.9	1528.5	1437.6	1465.5	1448.0	1498.8	1867.9

Table 11. *Rainfall(mm) for the last 10 years and in 1992 (Isolated Seed Garden)*

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Ave. (82-91)	1992
January	0.0	0.0	96.9	38.3	59.1	5.9	3.3	58.4	221.6	44.0	52.7	0.0
February	0.0	2.1	228.9	113.4	65.8	0.0	135.0	0.0	0.0	0.0	54.5	0.0
March	176.3	1.6	279.7	94.6	55.3	21.7	77.4	29.5	34.0	116.0	88.6	0.0
April	61.7	52.8	821.4	100.0	104.9	141.1	233.3	81.7	38.8	147.9	178.4	217.8
May	281.8	248.8	155.5	171.4	121.9	100.2	71.7	16.0	145.6	182.5	149.5	207.3
June	110.7	73.4	29.7	88.8	74.5	49.8	129.7	112.2	8.4	236.5	91.4	239.5
July	32.1	26.4	117.0	17.9	4.2	4.5	91.4	72.1	67.7	29.2	46.3	116.9
August	91.6	78.0	3.8	10.7	47.4	48.1	60.1	1.7	0.0	17.1	35.8	28.4
September	35.6	89.4	164.7	107.4	37.4	270.8	272.2	34.0	9.5	25.8	104.7	62.3
October	199.9	105.7	227.3	108.7	199.9	467.6	61.3	221.9	288.6	221.6	210.2	342.3
November	152.7	199.3	210.6	334.8	236.1	143.2	319.5	214.7	306.7	208.1	232.6	406.0
December	93.4	331.4	53.6	118.6	7.6	49.5	64.8	8.0	59.2	151.5	93.8	75.9
Total	1235.8	1208.9	2389.1	1304.6	1014.1	1302.4	1519.7	850.2	1180.1	1380.2	1338.5	1696.4

REPORT OF THE TISSUE CULTURE DIVISION

Research Officer-in-Charge - R R A Peries, Ph D

1. GENERAL

During the year, emphasis was placed on improving the conditions of formation, germination and further development of somatic embryos from immature zygotic embryos and leaf explants of coconut.

As a result of the review of tissue culture research undertaken last year, a panel of scientists were appointed for the periodic evaluation of the progress in coconut tissue culture.

2. RESEARCH PROJECTS

PROJECT 18: Studies on the vegetative propagation of coconut.

Experiment 18.1: *In-vitro* culture of embryos of local varieties and forms of coconut (1986)

The effect of incorporating salt (NaCl) and coconut water into the normal embryo culture medium on improved rooting of embryo cultured plants was studied. Results of preliminary investigation showed a beneficial effect of NaCl on rooting *in-vitro*.

The addition of coconut water at 10% into the normal embryo culture medium caused no difference in the percentage of germinated embryos. However, an increase in the percentage of germinated embryos with a well developed root was apparent. It is necessary to investigate further whether this increase can be consistently obtained.

Investigations were also commenced to evaluate the performance of embryo cultured plants which were raised using fertilizer grade KCl and household sugar instead of analar grade KCl and sucrose.

Attempts were also made to reduce the contamination rate of embryo cultures by incorporating a fungicide (Benlate 10 mg/l) into the culture medium. Results indicated that the concentration of fungicide should be increased further to reduce contamination.

A programme was launched to raise embryo cultured seedlings of *dikiri pol* (Makapuno type). Three visits were made to the South where *dikiri* is commonly found to collect *dikiri nuts*. Nuts were collected with the help of the farmers in the area. In appearance, *dikiri* nuts are not different from the other nuts in the same bunch. In a bunch of *dikiri* nuts only one or two nuts are generally found to be true *dikiri*. *Dikiri* nuts do not give the splashing sound of coconut water like other nuts due to the presence of a gelatinous endosperm. Some nuts are heavier than others. Parameters for the selection of true *dikiri* based on appearance are often inconsistent from tree to tree. *Dikiri* nuts give a distinct sound when tapped on the dehusked nut compared to other nuts. However, since collection of dehusked nuts may cause increased contamination, only nuts with husks were collected. In doing so there is a chance that some nuts collected are not true *dikiri*. Table 1 shows the success in collection and germination of true *dikiri* during the year.

Table 1. *The progress in selection of true dikiri and their germination during the year.*

Month	Total number of nuts collected	Number of true *dikiri* nuts		Number of germinated *dikiri* embryos	
July	28	16	(57%)	9	(56%)
September	52	40	(77%)	30	(75%)
November	49	24	(49%)	19	(79%)

S C Fernando, V Kodikaraarachci, C Gamage and S Santha

Experiment 18.1.1: Application of embryo culture technology to select drought tolerant coconut germplasm (1986).

A comparative study on the response of Ambakelle Special and their progeny to water deficit using the embryo culture technique was commenced. NaCl was used to induce water deficit conditions.

Four out of five embryo cultured seedlings that survived the stress condition caused by 200 mM NaCl and one that survived at 180 mM NaCl and

planted in the germplasm conservation block at PRS for the evaluation of their performance under field conditions, (i.e five seedlings in all) are growing satisfactorily. The single control seedling died due to natural causes.

V Kodikaraarachchi, S C Fernando, R R A Peries and S Santha

Experiment 18.1.2: *In-vitro* culture of immature zygotic embryos of local varieties of coconut (1986).

Investigations on development of a technique for clonal propagation of improved cultivar, *Tall X Tall* were continued using immature embryo explants. Consistent callogenesis from embryos , somatic embryogenesis and shoot formation were accomplished. Occasionally complete plants were obtained. However, further development of shoots and complete plant formation were found to be inconsistent.

Different batches of activated charcoal used in the culture media responded differently in callogenesis of immature zygotic embryos. Successful results were obtained only in the presence of particular brands of activated charcoal in the medium. However, within a single brand too, there was often inconsistency in behavior among different batches.

Therefore, attempts were made to find a substitute for activated charcoal. Polyvinyl pyrrolidone (PVP), Ascorbic acid and different brands of activated charcoal pre-treated in the laboratory were tested on callogenesis. When immature embryos were dipped in the pre-sterilized solutions of PVP (0.5%) or Ascorbic acid (0.5%) or pre-treated activated charcoal (0.5%) and cultured in media free of any of these components, immature embryos did not form callus. But immature embryos dipped in Ascorbic acid solution did not show browning whereas all embryos dipped in the solutions of either PVP or pre-treated activated charcoal showed browning indicating cessation of growth.

When immature embryos were cultured in the presence of either PVP or Ascorbic acid at 1% in the media, all embryos showed browning and no callus formed.

S C Fernando and C Gamage

Experiment 18.3: Culture of vegetative tissues of coconut *in-vitro* (1983)

18.3.1: Culture of shoot explants.

Investigations on optimized rhysogenesis of clonal shoots were continued using shoot tip cultures. Shoot tips were excised from embryo cultured

seedlings and cultured in a medium developed by the laboratory for shoot tip cultures. One shoot tip gave rise to one complete shoot and they were used for treatments.

Results of preliminary investigations conducted using salt and hormone stress showed a beneficial effect of salt stress. Further experiments were undertaken to determine whether the method of exposure to salt stress and lighting conditions (radiation) affect the rhysogenesis of shoots. When the shoot tips were cultured in the medium developed for immature zygotic embryo cultures, shoot tips produced embryogenic callus which in turn formed small shoots.

S C Fernando

18.3.2: Culture of leaf explants

Investigations were conducted using a particular leaf of a seedling. This leaf was observed to be morphogenetically active in earlier experiments (Karunaratne *et al.*, 1991). Increased somatic embryogenesis was observed. However, further development of somatic embryos showed only a rapid root development. Attempts were made to initiate germination of somatic embryos by using different proportions of Auxin and cytokinin.

S C Fernando and S Santha

18.3.3: Culture of root explants

Preliminary investigations on root culture were undertaken. Three culture media developed in the laboratory were tested on callogenesis of root explants.

V Kodikaraarachchi

3. MISCELLANEOUS

Ms. S C Fernando and Dr. R R A Peries participated in the Biotechnology group meetings held in Colombo on 24th February and 31st July.

4. ACKNOWLEDGEMENTS

The assistance and cooperation of the staff of Tissue Culture Division in compiling this report is gratefully acknowledged.

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REPORT OF THE PLANT PHYSIOLOGY DIVISION

Head - C Jayasekara, Ph D

1. GENERAL

The research programme of the division is focussed on examining how coconut palm acquire atmospheric carbon from the external environment and use it for efficient growth processes. Much emphasis was placed on how maximum productivity and yield is achieved with optimal use of water and major nutrients as well as to seek the effect of environmental factors on this growth processes.

During the year drought screening and water-use efficiency studies of coconut genotypes were carried out with good progress. With a view to develop more accurate and easy technique to screen coconut palms for high water-use efficiency, stable carbon isotope discrimination of coconut was investigated with the assistance from the International Atomic Energy Agency, Vienna. Considerable progress was made this year on CO_2 assimilation, water relations and water-use efficiency studies of coconut.

The division participated in two multi-disciplinary research projects namely Immature nutfall and premature decline of the coconut palm. Experiments so far conducted on Immature nutfall of coconut gave a clear picture on CO_2 assimilation characteristics and source-sink relationship of the coconut palm. Shortage of staff and adverse weather conditions prevailed during the year affected on leaf scorch decline studies of the coconut palm.

The project funded by the Canadian International Development Agency (CIDA/87/27) was terminated this year and 1.8 million rupees worth of equipment received under this project were permanently transferred to the institute.

2. RESEARCH PROJECTS

PROJECT 16: STUDIES ON THE PHYSIOLOGY OF THE COCONUT PALM

Experiment 16.6: Studies on the effect of N,K,Cl and abscisic acid on drought tolerant characteristics of coconut, glass house study (1988).

Data collected under this project were statistically analysed and the final report was submitted to the Natural Resources Energy and Science Authority of Sri Lanka (NARESA)

Two experiments conducted with open pollinated tall (OP) and *Tall x Tall* seedlings showed that increasing Cl to excessive levels caused cessation of apparent photosynthesis suggesting that higher levels of Cl inhibitory to growth performance of coconut seedlings. In both types of coconut seedlings maintenance of leaf water potential under water deficit conditions was achieved through osmotic adjustment. In the presence of adequate or higher levels of nitrogen three fold increase in proline concentration was observed, whereas, when K and Cl nutrients were adequately available, these nutrients acted as osmotica to maintain the osmotic potential of tissues as given in Table 1.

Table 1. *Effect of N, K, and Cl on accumulation of nutrients, carbohydrates, and proline in leaves of TxT coconut seedlings during the dry period.*

Nutrient level	Total sugar (mg/g dw)	Reducing sugars (mg/g dw)	Starch content (mg/g dw)	Proline (mg/g dw)	Nitrogen (%)	Potassium (%)	Chlorine (%)
Nitrogen (mM)							
0	44.4	4.7	24.4	323	0.8	1.3	0.9
6	51.3	5.4	24.8	467	1.1	1.4	0.7
12	55.8	6.0	23.3	519	1.2	1.2	0.7
Significance	***	**	ns	**	**	ns	**
Potassium (mM)							
0	55.7	6.3	25.3	444	0.9	0.7	0.8
6	48.3	5.1	23.8	386	1.1	1.3	0.8
12	47.5	4.7	23.4	479	1.1	1.8	0.8
Significance	***	**	ns	ns	***	***	ns
Chlorine (mM)							
0	50.5	5.5	22.5	509	1.2	1.5	0.6
3	50.7	5.3	24.1	411	1.1	1.2	0.8
6	50.3	5.2	26.0	389	0.9	1.1	1.0
Significance	ns	ns	***	ns	***	***	***

Results of this study revealed that adequate supply of nitrogen to coconut seedlings significantly increased the apparent photosynthesis, leaf chlorophyll content and total soluble sugars in leaves as well as rate of transpiration.

High potassium treatments exerbate the photosynthetic rate significantly in coconut seedlings. As reported in previous Annual Reports potassium has no direct influence on chlorophyll synthesis or chlorophyll content of leaves. It was integruing to note that there was a linear relationship between apparent photosynthesis, stomatal conductance and leaf water potential with increase

in soil potassium level. This observation suggest that augmentation of apparent photosynthesis with potassium treatments achieved through maintenance of leaf water potential at higher levels and increasing stomatal conductance for gaseous exchange. Further, fresh and dry mass of shoots as well as roots were increased with increasing the potassium levels. Significant increase in shoot and root dry masses were not observed with nitrogen and chlorine treatments as given in Table 2.

Table 2. *Fresh and dry mass of shoots and roots of open pollinated coconut seedlings with different treatment levels of nitrogen, potassium and chlorine.*

Nutrient level	Fresh mass of shoots (g)	Dry mass of shoots (g)	Fresh mass of roots (g)	Dry mass of roots (g)	Shoot/Root
Nitrogen (mM)					
0	136	47	86	29	1.56
6	160	57	95	28	1.68
12	160	55	84	29	1.90
Significance	ns	*	ns	ns	
Potassium (mM)					
0	126	44	69	24	1.82
6	161	56	83	31	1.93
12	168	59	93	33	1.80
Chlorine (mM)					
0	150	54	82	29	1.86
6	154	55	83	30	1.83
12	151	50	81	28	1.78

Results also revealed the deleterious effects of high chlorine levels in coconut leaf, where it reduced CO_2 assimilation and growth of coconut seedlings.

C Jayasekara, G V Athukorala, and C S Ranasinghe

Experiment 16.3: Identification of physiological and biochemical characters of putative drought tolerant tall (Ambakelle Special) palms, Isolated Seed Garden, Ambakelle (1987).

As reported in the Annual Report for 1991 physiological measurements of newly selected forty two Ambakelle Special palms in the field No 2 were continued until end of October, 1992 at monthly intervals. Collected data has to be analysed to determine the genotypic stability to environmental changes.

Further collection of physiological measurements of Ambakelle special palms was temporarily suspended at the end of the year until new palms are selected from other fields.

C Jayasekara, A Nainanayaka, R D N Premasiri, and L R S Silva

Experiment 16.4: Studies on heritability of drought tolerant characters into open pollinated seedlings from selected drought tolerant palms. (Glass house study - 1987)

New pot experiment commenced with open pollinated seedlings raised from the selected drought tolerant adult coconut palms was continued. Photosynthesis and water relations measurements at field capacity conditions were continued for nearly 12 months. During the dry weather prevailed at the first quarter of the year two drying cycles were imposed. Photosynthesis and water relations measurements were taken at weekly intervals during the drying cycles followed by rewatering. High atmospheric temperature and exposure of seedlings to direct sunlight posed major difficulties on data collection. Seedlings used for this study were planted at the BE old nursery. Lack of plant house facilities created a major set back on these studies. All plant house experiments were suspended until it is renovated.

C Jayasekara, C S Ranasinghe and R D N Premasiri

Experiment 16.7: Studies on physiology and biochemistry of different varieties and forms of coconut (1989)

This experiment was temporarily suspended until suitable planting material are raised and necessary chemicals are obtained for biochemical studies.

C S Ranasinghe, C Jayasekara and P S A De Saram

Experiment 16.9: Studies on vegetative growth and physiology of Ambakelle special seedlings grown under field conditions (1990)

Vegetative growth measurements viz. number of leaves produced, seedling height and girth of the collar were taken at quarterly intervals. Height and girth measurements of those seedlings were suspended as seedlings are bigger now and leaf area measurements were continued at six-monthly intervals. Table 3 summarizes the vegetative growth pattern of putative drought tolerant" Ambakelle special" and *Tall x Tall* seedlings. Collected data show that both varieties of seedlings have similar vegetative growth pattern.

Photosynthetic and water relations measurements were carried out

at monthly intervals, however some routine measurements were suspended during the peak of the drought prevailed at the first quarter of the year.

Experiment is progressing satisfactorily.

Table 3. *Vegetative growth performance of putative drought tolerant and open pollinated Ambakelle seedlings planted at Bandiruppuwa Estate (Avenue Plantation).*

Variety	Ave. girth (cm)	Ave. height (cm)	Ave. leaf production
Ambakelle Special	112.77	457.30	8.7
Tall x Tall	110.22	474.83	8.7
Significance	ns	ns	ns

A Nainanayake, C S Ranasinghe, P S A De Saram and R D N Premasiri

Experiment 16.10: Studies on the effect of canopy and root modification on yield of coconut (1990).

Recording of button nut numbers, fruit numbers and tagging of newly opened inflorescences were continued at bimonthly intervals. Canopy sizes of different treatments were maintained by pruning lower leaves depending upon the number of leaves produced during a two month period.

Root volume was maintained by not allowing to regenerate new roots in the pruned area. Experiment is being continued.

C Jayasekara, A Nainanayake, and L R S Silva

Experiment 16.11: Evaluation of field performance of embryo-cultured seedling (1987).

Growth measurements of embryo-cultured seedlings were continued as reported in the previous years. One open pollinated seedling set into flower during this year.

During the drought period three open pollinated seedlings were lost

due to drought damages and porcupine attacks. All the seedlings received 2 kg of YPM mixture in two split applications and the recommended cultural practices.

C Jayasekara and R D N Premasiri

Experiment 16.12: Studies on assimilate partitioning pattern of seedlings and bearing young coconut palms with the use of $^{14}CO_2$.

Labelling of a young active frond of a seven-year-old bearing coconut palm at Bandiruppuwa Estate was carried out during the IAEA expert mission of Dr D G Bowen in December 1991. Large number of samples collected from this palm were analysed for ^{14}C activity during the first quarter of the year 1992.

This study gave some inspiring results on the assimilate partitioning and "source-sink" relationship of the coconut palm for current assimilate. As shown in Figure 1 large proportion of labelled assimilate partitioned into the developing nuts in the fourth bunch compared to the young developing bunches of 1, 2, and 3. Fourth bunch was at the rapid endosperm cavity expanding and kernel filling stage. Thus it explains that the demand/partitioning of assimilated carbon largely determined by the activeness of the developing sinks. These observations give impetus to studies on assimilate partitioning into developing nuts under different environmental constrains.

Distribution of ^{14}C activity into the root system of the labelled coconut palm was carried out in collaboration with the Soil and Plant Nutrition Division. Soil core samples were obtained along four transects at distances 0.5,0.75,1.0, and 1.5, 2.0 and 2.5 m away from the coconut bole and up to a depth of 1 m. Root samples in soil cores were separated into primary, secondary, tertiary and fine roots. Distribution pattern of roots up to a distance of 2.5 m is given in Figure 2. Distribution of ^{14}C activity revealed that more activity is confined to the fine roots in 1-1.5 m away from the bole and this area will be the active root zone (Table 4).

This study was temporarily suspended during the period Dr Jayasekara was out of the island on IAEA Fellowship.

C Jayasekara, K S Jayasekara, and A Nainanayake

Table 4. *Distribution pattern of 14C activity in the root system of the coconut palm (four days after labelling).*

Distance from the bole (m)	Range of 14C activity in roots (DPM/g dw) Primary	Secondary	Tertiary	Fine
0.5	0.57-0.59	1.13-3.88	1.58-2.02	1.54-5.32
0.75	0.57-1.76	2.11-7.5	0.49-2.91	4.07-11.79
1.00	1.05-2.62	24.86	16.05	7.05
1.5	0.60-0.94	15.31	1.27-1.97	5.17-20.15
2.0	0.80	-	7.07	5.52
2.5	1.57	8.27	10.88	7.5

Experiment 16.13: Studies on water-use efficiency of different ecotypes of coconut in relation to the stable carbon isotope discrimination (1992).

It has been proved by Farquhar *et al.* (1982) that the ratio of carbon gain by photosynthesis to water loss by leaves (transpiration efficiency) is negatively related to the discrimination against the naturally occurring, stable carbon isotope ^{13}C during CO_2 fixation by C_3 leaves. This relationship is widely used today to screen crop species for high transpiration efficiency.

Different ecotypes planted at the Pothukulama Research Station for multi-locational cultivar evaluation trial conducted by the Genetics and Plant Breeding Division was used for the preliminary studies. In situ net CO_2 assimilation of coconut seedlings, leaf area and fresh weights were determined in the field itself. Carbon isotope composition of the leaf samples were analysed at the Research School of Biological Science, Australian National University, Canberra.

Leaf carbon isotope composition provides information on integrated discrimination over different ratios of intercellular to atmospheric partial pressure of CO_2 over the whole duration of growth. Experimental results revealed that sampling of middle leaflets in young coconut fronds is most suitable for carbon discrimination studies. The relationship between carbon isotope discrimination of different ecotypes of coconut grown under same experimental conditions and the ratio of intercellular to ambient partial pressure of CO_2 (P_i/P_a) is given in Fig. 3. The positive relationship observed between these two parameters suggest that this

technique could be applicable for coconut to select them for high transpiration efficiency. Theory established on carbon discrimination studies of plants have shown that transpiration efficiency has positive correlation with $(1-P_i/P_a)$. Percentage variation in $(1-P_i/P_a)$ of coconut ecotypes was found to be about 36%. This large variation in $(1-P_i/P_a)$ and the relationship between carbon isotope discrimination (Δ) observed in this study prove that this technique could be used to select coconut palms for high transpiration efficiency.

Further studies are continuing to determine genotypic variation in carbon isotope discrimination and stability of Δ of similar genotypes at different locations.

C Jayasekara

PROJECT 25: ESTABLISHMENT AND FURTHER GROWTH OF AMPUTATED POLY-BAGGED SEEDLINGS

Experiment 25.4: Field performance of amputated poly-bagged seedling (1989).

Vegetative growth measurements viz. girth, height and rate of leaf production were recorded at quarter yearly intervals. Vegetative growth data were statistically analysed and the results revealed that amputated seedlings have the ability to grow fast and attain similar vigor as ordinary seedlings, once they established in the field. As given in Table 5 height growth of amputated seedlings have not shown significant difference, 14-16 months after field planting.

Table 5. *Girth and height increase and leaf production of amputated polybagged seedlings and nursery raised seedlings planted at Bandiruppuwa Estate.*

Both types of seedlings were received YPM mixture as a split applications. Experiment is progressing satisfactorily.

C Jayasekara, A Nainanayake and L R S Silva

Table 5. *Girth and height increase and leaf production of amputated polybagged seedlings and nursery raised seedlings planted at Bandiruppuwa Estate.*

Variable	Month	Ordinary seedling	Amputated seedling	Significance
Girth (cm)	Jan	20.0	17.3	*
	Apr	24.0	19.9	**
	Jul	28.0	22.6	*
	Oct	32.3	26.1	*
Height (cm)	Jan	140.0	114.1	**
	Apr	151.5	132.2	**
	Jul	163.6	142.0	ns
	Oct	176.4	159.0	ns
No. of leaves (cm)	Jan	1.0	1.0	ns
	Apr	1.0	1.0	ns
	Jul	1.0	0.6	ns
	Oct	1.0	1.0	ns

ns = not significant; * (**) - significant at the 5% (1%) levels.

4. EXTENSION ACTIVITIES

Plant Physiology Division actively participated in Coconut Day activities. Estate owners and middle level management staff of coconut estates were briefed on activities and research findings of the division.

5. ACKNOWLEDGEMENTS

The assistance of the staff of the Plant Physiology Division in conducting experiments and the preparation of this report is gratefully acknowledged. Thanks are due to Mr K S Jayasekara, Officer-in-Charge of the Soil and Plant Nutrition Division and Soil Physics staff for routine neutron probe measurements, soil core sampling and to Mr D T Mathes and staff for analysis of data.

6. REFERENCES

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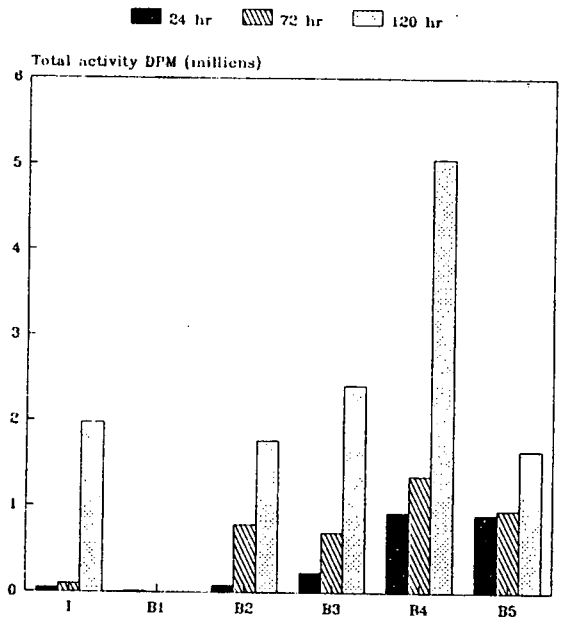

Figure 1. Accumulation pattern of 14C labelled assimilate into opened inflorescence (I) & developing bunches (B) with time

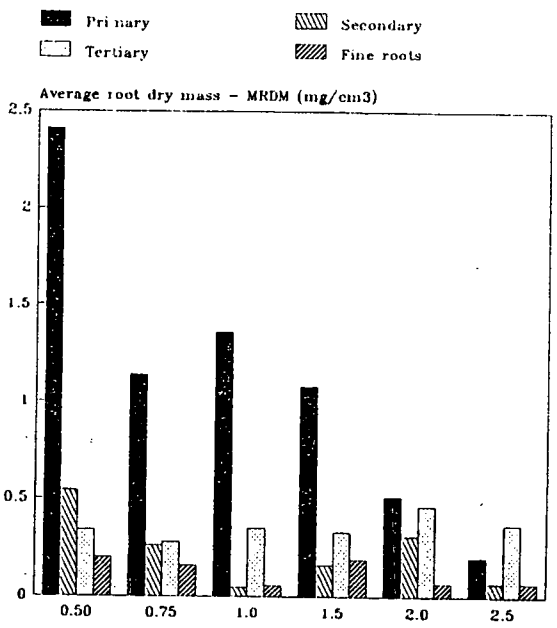

Figure 2. MRDM in surface 1m depth soil layer at different away from the bole of a 12 yr old coconut palm.

MULTI- DISCIPLINARY PROJECTS

PROJECT 17: PREMATURE DECLINE OF PALMS

(Project Leader - C Jayasekara, Ph D)

Participating Divisions: Plant Physiology Division
Agronomy Division
Soil and Plant Nutrition Division
Crop Protection Division

General Remarks

Experiments conducted to determine possible cause/s for Leaf Scorch Decline (LSD) were continued. Inconsistent results obtained in CO_2 assimilation and analytical studies of secondary metabolites explain the necessity to investigate more replicate palms. Lack of sufficient number of palms within the same category of severity of symptoms has become one of the major limitations for these studies.

Experiment 17.1: Studies on internal water relations of Leaf Scorch Decline (LSD) palms (1987).

Water relations studies of LSD palms were continued at Walpita Estate. Water uptake studies of healthy and LSD affected roots were not continued during this year due to heavy work load and shortage of research staff to engage in this study continuously.

C Jayasekara and N P A D Nainanayake

Experiment 17.2: Studies on the root system of Leaf Scorch Decline palms (1987).

Root densities of healthy and LSD palms at different severity stages were measured taking soil core samples at different distances away from the bole and down to a depth of 2 m, in collaboration with the Soils and Plant Nutrition Division. Compare to the healthy palms, number of active live roots in LSD palms are lower, as well as increasing the severity of symptoms.

Same soil cores will be investigated after 6-9 months to determine the root generation pattern of healthy and LSD affected palms.

Assuming that palms with poor root systems may not producing

sufficient growth hormones, it was attempted to inject 100-200 ml of 100 ppm cytokinin solution into healthy and LSD palm stems and to monitor the visual changes in palm canopies. Very small quantity of cytokinins were taken up through the coconut stems and this study will be repeated with some refinements.

N P A D Nainanayake, C Jayasekara and L R S Silva

Experiment 17.3: Determination of net assimilation rate, foliar organic and inorganic nutrients in LSD palms (1987).

CO_2 assimilation studies of LSD affected palms were continued. Nevertheless, palm to palm variations within the same category of symptoms were found to be high. Lack of sufficient palms within a population has become one of the major limitations for these studies. Attempts will be made to continue this study with more replicates.

Presence of higher levels of total polyphenolic compounds have been observed in LSD affected palms. Withered leaves in the lower whorls gave higher levels of polyphenolic compounds as given in Table 1. Flavanol group poly phenols were high in upper whorls with healthy leaves. However, conclusive results were not been able to obtain in this study.

Table 1. *Seasonal variation in stomatal conductance, rate of transpiration in relation to the vapour pressure deficit (VPD) between leaf and the atmosphere and leaf water potential (LWP) of a fronds within a same palm.*

Month	Frond No	Stomatal conductance (mol/m²/s)	Stomatal resistance (s/cm)	Rate of Transpiration (Ug/cm²/s)	VPD (mb)	LWP (mb)
Jan	7	0.303	6.86	0.75	32.88	105
Feb	6	0.046	46.75	0.61	33.74	8.5
Mar	9	0.122	16.90	1.84	41.35	105
May	6	0.616	5.43	2.88	25.53	110
Jun	6	0.158	1.38	3.62	36.67	125
July	7	0.203	2.77	3.37	30.49	100
Sep	6	0.319	2.44	3.08	30.69	7.0

These experiments are being continued.

C Jayasekara, N P A D Nainanayake, C S Ranasinghe and W P K K Fernando

Experiment 17.4: Studies on the effect of root pruning and incorporation of organic manure on LSD palms (1989).

During the year yield records were maintained and data on size and shape of nuts were also collected at alternative picks. Pits of 30 x 30 cm to the depth of 60 cm were opened in the treated area of palms to count new roots formed. The length and volume of new roots were also measured. Results are being analysed.

Experiment is in progress.

D N S Fernando, M Bastian and A Nainanayake

PROJECT 27: STUDIES ON EARTHWORMS IN COCONUT CULTIVATION

(Project Leader - P A C R Perera, Ph D)

Participating Divisions: Crop Protection Division
Agronomy Division
Soils and Plant Nutrition Division

General remarks

The importance of earthworms in improving the fertility of agricultural soils is widely accepted. A survey to map the distribution of the earthworms within the coconut triangle has been carried out (Ann. Rpt. 1991). Information on the biology of Sri Lankan earthworms is meager and hence the foregoing study was undertaken.

Experiment 27.2: Studies on the biology of Sri Lankan earthworms (1991).

The objective of this experiment was to identify the most favourable soil type and the humus and moisture requirements for the development and reproduction of earthworms. In this study earthworms were bred in earthenware pots from egg to maturity and eventual death. The soil types tested were clay, loam, sand and gravel, with variation of humus content from 10 - 40 % and moisture content from 9 - 28%.

These studies showed that under favourable conditions earthworms lived for over 2 years and that clay soils with humus content of 20% and a moisture

content of 28% was the most favourable of the media tested, where mean mortality was only 3.1%. The reproductive phase of earthworms was more pronounced when they were ca 180 days old and the number of offspring produced was significantly ($P < 0.001$) greater in gravel soils than in the other soil types under all conditions of humus and moisture content.

P A C R Perera and P H A P Siriwardena

PROJECT 28: IMMATURE NUTFALL

(Project Leader - C Jayasekara, Ph D)

Participating Divisions: Soils and Plant Nutrition Division
Crop Protection Division
Plant Physiology Division

General Remarks

Research programme carried out under this project focussed on examining how coconut palm acquire organic carbon from the external environment and how efficiently assimilated carbon is utilized for growth processes with much emphasis on partitioning of assimilate into developing nuts. Further, influence of climatic factors on economy of carbon gain and water loss, associated intrinsic biochemical and physiological changes, and effect of biotic factors on nut setting are investigated with a long term goal to improve productivity/nut yield of coconut palms.

Experiments conducted under this project were continued with a good progress. Routine net canopy photosynthesis, canopy transpiration, soil water extraction studies, and light-use measurements in combination with extreme weather conditions prevailed during the year reflected the major constrains underlying photosynthetic productivity of coconut palms and responses of palms to changing weather.

Experiment 28.2: studies on nutrient and water relations in immature nutfall of coconut (1990)

Studies on water extraction pattern of coconut roots with the use of neutron probe was continued. Measurements were not been able to take during the

heavy rainy period of May to September. Water relations studies of coconut palm canopy continued at monthly intervals. Collected data during the year show that coconut canopy transpiration largely depend on the soil water availability and the vapour pressure deficit of the atmosphere. Table-1 summarize the transpiration rate and stomatal conductance of a coconut frond at different vapour pressure deficits of the atmosphere. Transpiration measurements during dry weather conditions revealed that stomata tend to close and stomatal conductance reduce to very minimal levels when leaf to air vapour pressure deficit exceeds 40-50 m bar.

C Jayasekara, K S Jayasekara, C S Ranasinghe, R D N Premasiri and L R S Silva

Experiment 28.3: Studies on insects associated with the coconut inflorescence, their relative abundance and seasonal distribution within the coconut triangle, (1991).

This experiment was undertaken to identify the different species and orders of insects visiting the coconut inflorescence in the different climatic zones during the different seasons and their influence if any on coconut yields.

Insect collections were made using sticky traps fixed to the recently opened inflorescence. The insect collections in respect of three seasons were completed and the insects have been placed in their respective orders (Table 2).

These results confirm the observations made from the data analysis of the first two seasons that the major insect order visiting the coconut inflorescence is the diptera and their numbers are significantly ($p < 0.001$) greater than those for the other orders.

P A C R Perera, M M Keerthi, D C L Pathirana and K F G Perera

Table 2. *The insects visiting the coconut inflorescence; classed under major representative orders Mean insects caught/palm/24hr.*

Order	Agro-ecological region	Mean insects caught/palm/24hrs		
		S1	S2	S3
1	IL_1	5.6	4.7	5.5
1	IL_3	3.9	2.6	6.2
1	WL_1	4.9	4.9	5.5
1	WL_2	3.3	6.1	7.7
1	WL_3	3.6	4.9	7.2
1	WL_4	14.3	11.4	12.3
1	DL_1	3.6	6.1	6.9
1	DL_3	1.9	9.6	1.9
2	IL_1	23.0	12.8	22.1
2	IL_3	22.4	14.1	21.6
2	WL_1	16.4	16.7	44.8
2	WL_2	11.5	22.5	29.0
2	WL_3	15.7	19.0	19.3
2	WL_4	34.6	35.9	26.0
2	DL_1	8.4	30.1	44.5
2	DL_3	9.8	42.1	27.8
3	IL_1	1.1	0.6	1.7
3	IL_3	0.9	4.8	1.8
3	WL_1	0.5	0.4	2.0
3	WL_2	0.6	0.6	0.4
3	WL_3	0.8	1.0	0.9
3	WL_4	0.6	0.7	0.8
3	DL_1	0.5	1.9	1.0
3	DL_3	0.8	1.3	2.6
4	IL1	12.9	16.7	13.2
4	IL3	6.9	7.8	8.0
4	WL1	8.3	9.0	9.9
4	WL2	9.8	7.5	9.4
4	WL3	5.7	9.3	11.5
4	WL4	16.2	10.1	11.6
4	DL1	10.4	7.6	7.7
4	DL3	3.6	10.4	3.9

(Significance: Between seasons - NS, Between zones - NS, Between orders - S ($P<0.001$).
Orders: 1-Coleoptera;2-Diptera;3-Homoptera;4-Hymenoptera&
IL - Intermediate low country; WL - Wet low country)

Experiment 28.3.1: Preliminary studies on immature nutfall in relation to damage by pests and diseases; Bandiruppuwa (1992).

The objective of this experiment was to identify, categorize and evaluate the causes of immature nutfall in coconut with special reference to pests and diseases. Nineteen healthy palms were selected for the study and one inflorescence

was chosen per palm. Soon after the opening of inflorescence a net basket was hung just below the opened inflorescence. Fallen nuts were collected at weekly intervals over a six month period. Each nut was carefully examined and categorized as nuts damaged due to (a) insect attack, pest other than insects and (c) diseased.

Three major factors, viz. disease, pest damage and mechanical causes were identified as predominant causal agents for nut shedding. Diseased nuts were identified by the light brown to dark brown patches on the epicarp, mainly in the perianth region. Isolation were performed mainly on discolored tissues of diseased nuts. Only *Fusarium sp.* were recorded in the diseased nuts. Insect attacks were identified by their feeding signs, larval tunnels, webbing and scraping marks under the perianth regions. Insects feeding on the nuts were identified as mealy bugs, scale insects, mites, *Merdolus sp.* and *Cyclodes omma.* Insect damage was comparatively high in the first four months after fruit set. Mature nuts (five to six) months) were mainly shed due to rat and bat damage.

Nuts shed due to physiological factors (Mechanical causes) such as drought, high female flower production etc. were identified by their healthy appearance and the characteristic uniform browning of the nuts.

The results (Table 3) indicate significant differences (P 0.001) in % nut shed due to the three causes. The % nut shed due to pest damage is low when compared with that due to mechanical reasons. The results also indicate that shed due to diseases is an important factor in immature nut fall of coconut. The results also revealed an association between time and nut shedding; (χ^2 = 86.96).

Table 3. *Mean % nut shed due to the three reasons during the 6 month study period.*

Causal agents	Mean % nut shed	SD
Diseases	33.51	20.14
Pest Damage	13.52	14.94
Mechanical reasons	52.48	22.60
L.S.D	12.68	
C.V.	58.75%	

Experiment 28.4: Dry matter production in leaves and specific mass transfer into developing bunches (1990).

In situ measurement of net photosynthesis of individual fronds were continued at monthly intervals. Variations in rate of apparent photosynthesis and total chlorophyll content with the maturity of fronds are given in Figure 1. As shown in the figure total chlorophyll content do not vary significantly with the age of fronds, but large variation in rate of net photosynthesis may be attributable to the variation in incident quantum radiation at different strata of canopy in addition to the intrinsic biochemical and physiological changes associated with age.

Coconut palm has a "pleonanthic" pattern of flowering where lateral inflorescences are produced from axils of leaves concurrently once they attain reproductive maturity. Thus, it is possible to hypothesis that nut production depends on the current photosynthate stored in a transient stage in leaves. To test this hypothesis dry matter accumulation during nut development and dry matter partitioning when artificial sink is created in the form of bleeding inflorescence were studied for six similar age palms grown under same environmental conditions for a period of six months. The total amount of dry matter (dm) withdrawn from one or two inflorescences of a single palm accounted to approximately 150-170 g dm d^{-1}, whereas developing all the bunches in the crown also accumulated approximately similar quantities of assimilate within a day as given in Table 4.

Table 4. *Total dry matter accumulation during tapping and nut development of 12 yr. old DxT coconut palms (g/palm/d).*

	Oct 90	Nov 90	Dec 90	Feb 91	Mar91
Tapping	156.80	139.48	170.96	-	-
Nut development	194.17	256.31	140.04	148.3	156.35

(Palms were grown under same field conditions. Each data point is an average of 3 palms)

Total canopy dm production of those palms is about 1500 g canopy $^{-1}$ d^{-1}. Thus it reflects that about one tenth of the total assimilated dry matter is available for nut development or sap production within a day. Further this observation give foregoing answer to heavy nut setting within first 2, 3 months after discontinuation of toddy tapping.

Total net canopy photosynthesis from January to December, rainfall and relative humidity of the atmosphere are given in Figures 2.a and 2.b. In March 1992, when heat and drought stress were at the peak, total net canopy dry matter production decreased down to 350-400 g dm canopy^{-1} day^{-1}. If we make an assumption that regardless of seasonal climatic variation, same trend of assimilate partitioning is followed through-out the year, there will be a severe shortage of assimilate for developing bunches during the inter-monsoon rain-free periods.

Efficiency of conversion of solar radiation was estimated for a twelve-year-old coconut plantation using measured average net canopy photosynthesis as 1500 g dm canopy^{-1} d^{-1} for *DxT* coconut palms and average daily solar radiation in wet tropics as 17.2 M: m^{-2} d^{-1} (Loomis & Williams, 1963). Conversion efficiency of solar radiation of such coconut palms is about 2.4% which is about 50-60% less than that of C_3 annual crop species.

At the later part of the year, it was commenced to investigate the activity of the major photosynthetic enzyme - Ribulose bisphophate carboxylase oxygenase (Rubisco) with the maturity of fronds. These studies are being continued with satisfactory progress.

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Experiment 28.5: Development of nuts in relation to climatic factors.

As reported previously our aim of this study is to determine the intrinsic biochemical changes within nuts in relation to external environmental stress conditions. Nut development studies were abandoned during the second quarter of the year due to heavy immature nutfall during the drought and subsequent rat damages. Nut setting of those selected palms was improved, after nearly six months lag period and nut development studies were recommenced at the last quarter of the year.

Determination of sugar and amino acid composition of nut water during wet and dry months were continued through out the year. Palm to palm variation in amino acid composition of nut water was observed. During wet and dry seasons concentrations of some amino acids in nut water were changed, where high concentrations were observed during dry months. Analytical results of amino acids revealed marked increase in proline and lysine content during dry season as given in Table 5. Poor yielding palms also showed higher concentration of proline during dry season. Glucose and fructose concentrations were also increased during dry season.

Table 5. *Amino acid content in nut water during wet and dry period of the year (Concentrations are given as g l^{-1} * 10^{-4})*

Amino acid	Dry season			Wet seasons		
	Bunch no. 4	Bunch no. 5	Bunch no. 6	Bunch no. 4	Bunch no. 5	Bunch no. 6
Aspartic acid	8.84	9.45	12.00	7.00	7.15	9.50
Glutamic acid	9.00	13.53	14.40	6.65	14.00	16.20
Serine	6.41	12.36	9.35	5.12	8.41	16.27
Glycine	3.60	10.73	8.81	2.21	16.58	13.83
Threonine	3.01	6.34	9.04	2.62	4.72	8.16
Alanine	12.75	11.87	12.81	10.61	14.79	12.42
Proline	13.93	52.30	55.00	6.46	13.65	10.77
Tyrosine	2.27	3.44	6.41	3.00	8.19	7.86
Valine	3.47	13.76	17.00	2.86	9.46	10.60
Lysine	96.07	86.68	82.22	3.56	1.61	0.88
Phenylalanine	3.69	6.29	6.32	3.34	13.64	12.46

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Loomis, R. S. and Williams, W. A.(1963). Maximum crop productivity: an estimate. *J. Crop Sci.* **3: 67.**

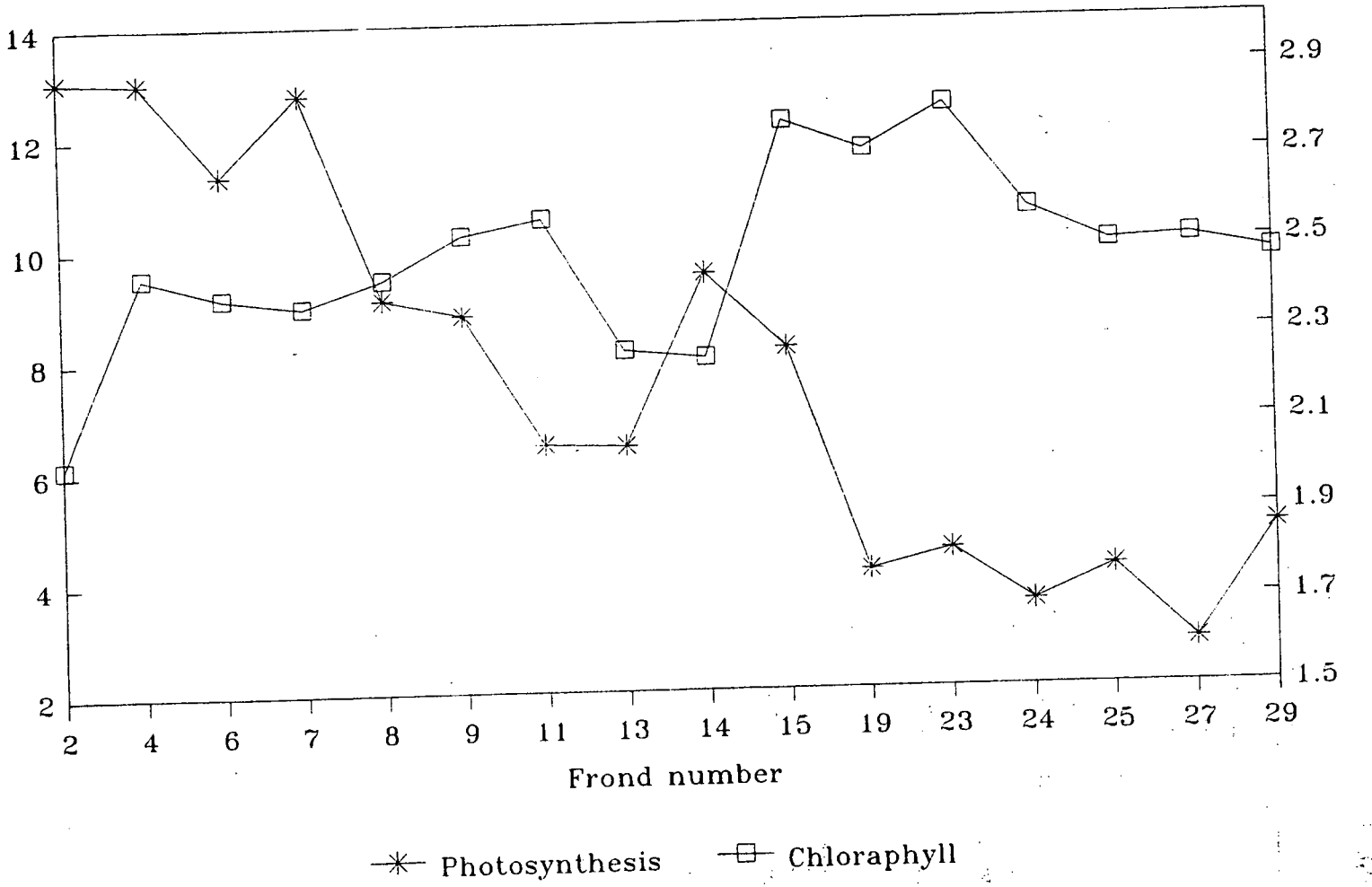

Figure 1. Variation in rate of photosynthesis and total chlorophyll content with maturity of fronds.

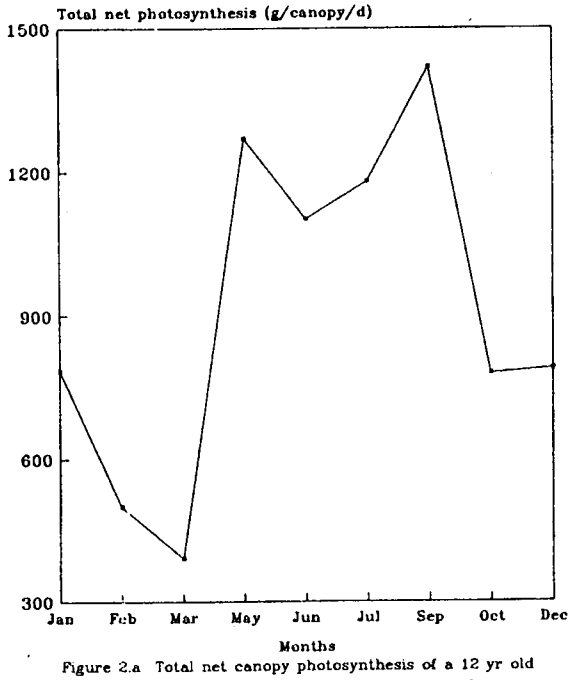

Figure 2.a Total net canopy photosynthesis of a 12 yr old TxD hybrid coconut palm at BE in 1992

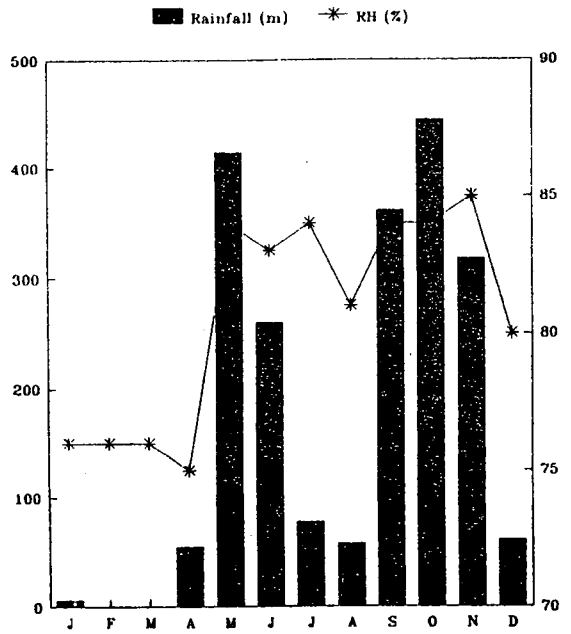

Figure 2 (b). Monthly rainfall and relative humidity (RH) at Bandirippuwa Estate in 1992

REPORT OF THE INFORMATION SERVICES DIVISION

Officer-in-Charge - P A H NIMAL APPUHAMY, M Sc

1. GENERAL

The work of the Division continued satisfactorily during the year. Requests for technical advisory assistance were received from both estates and small holding sectors. Inspection and necessary advice were afforded to coconut growers. Training programmes and other related activities were continued.

2. PUBLICATIONS

2.1 Technical Publications

Annual Report for 1990 was printed and made available.

2.2 Extension Publications

Pol Pawath	-	Volume 13 Nos. 1/2
Coconut Bulletin	-	Volume 7 Nos. 1/2

Sinhala version of the Book on Coconut Cultivation.

The English version of the Book on Coconut Cultivation was reprinted due to heavy demand.

2.3 Advisory Circulars

The following Advisory Circulars (Sinhala) were reprinted after revision.

i. A1 - Planting of Coconut Seedlings
B1 - *Promecotheca cumingii*
B2 - The Coconut Caterpillar and its control
B3 - The Red Weevil and its control
B4 - The Black Beetle and its control
B5 - The Coconut Scale and its control
B9 - Bud Rot Disease and its control
B10 - Stem Bleeding and its control
B11 - Leaf Blight Disease and its control
B12 - Tapering of Palms and Leaf Scorch Decline

ii. Advisory Circular No. A4 was under revision.

3. ADVISORY ACTIVITIES

The Division continued to assist the coconut growers in various ways with the dissemination of information on the latest recommendations of the Coconut Research Institute. There was a heavy demand for advisory visits not only from the Estate Sector but from the small holders as well. Every effort was made to accommodate such requests. Advisory circulars had to be revised and reprinted as the demand for such literature increased with many requests from General Certificate (Ordinary Level) and (Advanced Level) students who offer agriculture as a subject.

4. TRAINING PROGRAMMES AND STUDY TOURS

4.1 Training Programmes

The following training programmes were conducted during the year.

(a) Attachment training for 04 students from the National Apprenticeship Board for durations ranging from 06 January to 31 December.

(b) A training programme was arranged for Mr. Liadi B Ojikutu, Head, Seed Production and Adaptive Research Department, Lagos State Agricultural Development Project, Nigeria on 'Coconut hybridization and production technique at the CRI' from 17 August to 16 September.

(c) A programme was conducted for a batch of 24 Middle Level Estate Management staff from 28 September to 06 October. The trainees were awarded a certificate of participation at the end of the programme.

On visits made subsequently to estates managed by those who received training, it was observed that new technology introduced by the CRI was being put into practice by them very effectively.

(d) Some students from universities and colleges of higher education were assisted to collect data on coconut for compilation of their reports.

4.2 Study Tours

Study tours were organized for the following:

(a) A group of students from the Sri Jayawardenapura University Nugegoda on 17 June.

(b) A group of 38 students from the Sri Lanka School of Agriculture Angunakolapalessa on 30 July.

(c) A group of students from the Aquinas College of Higher Studies Colombo on 21 September.

(d) A group of 28 second year students from Sri Lanka School of Agriculture, Pelwehera, Dambulla on 20 October.

(e) A group of 25 Agriculture Officers from the Department of Agriculture, North East Provinces, on 2 December.

(f) Two groups of students from the School of Agriculture, Kundasale on 7 and 17 December.

5. SEMINARS/LECTURES/FIELD DAYS/EXHIBITIONS

5.1 Coconut Day

The Coconut Research Institute for the second time organized and successfully conducted the Coconut Day on 12 August. This was held at Bandirippuwa Estate in the Crop Museum. The theme of this coconut day was "More Profits from Coconut Lands". This provided a forum for the coconut growers to interact with Research, Extension, and the Trade to increase the productivity from coconut lands and thereby higher profits. The CRI had demonstrations on relevant recommendations. A tour of CRI laboratories and other field experiments at Bandirippuwa Estate was arranged. The Coconut Day was well attended with over 3000 persons visiting the CRI.

5.2 Research Discussions

A series of informal discussions amongst research divisions on new recommendations and research highlights was organized. Prof. M K V Carr and Dr (Mrs) Susan Carr addressed the CRI Research Staff on "Practical Conservation" and on "Scientific Writing" respectively on 13 February. This visit was sponsored by the British Council.

5.3 Field Days

A field day was conducted at Rathmalagara Estate Madampe for the Extension Staff of the Kurunegala Regional Office of the Coconut Cultivation Board on 06 February.

5.4 Workshops

CRI sponsored the 1st Workshop on Problems of weeds. It was organized by the Weed Science Society of Sri Lanka and held on 18 December at the CRI Auditorium on the subject "Control/management in coconut plantations".

5.5 Exhibitions

The Institute assisted in the following exhibitions.

Cambrian Exhibition, Prince of Wales College, Moratuwa from (04-11), April.

The Institute participated in the "Gam Udawa" Exhibition 1992 at Buttala 23 June- 03 July and in the Environlank 92 Exhibition at BMICH 10-12 December.

6. PHOTOGRAPHY

Transparencies and photographs required for Research Divisions were prepared and supplied. Audio visual aids were also supplied for lectures and training programmes.

7. MUSEUM

The Museum was maintained satisfactorily with more additions. This also included illuminating museum boxes.

8. AUDITORIUM

A new auditorium with a seating capacity of 100 was constructed. Modern temperature controlling equipment was fitted. Audio visual and recording system were also installed during the year under review.

REPORT OF THE LIBRARY AND COCONUT INFORMATION CENTRE

Head - Library Services/Project Leader - M J C Perera, ALA

1. GENERAL

The library resumed its normal functioning after a period of nearly 18 months due to refurbishing activities. However, a considerable time of the staff had to be spent during the year on rearrangement of journals and books after removing obsolete and irrelevant material.

The Coconut Information Centre (CIC) activities continued smoothly during the year.

2. ACQUISITIONS

Eighty new books were accessed to the collection during the year bringing up the total to 4800 books as at 31-12-92. An order has been placed for another 23 new books during the last quarter of the year.

Unndred periodical titles and 13 annual reports were received. 27 titles received were on subscription while the rest was on exchange and on complimentary basis.

For the CIC database 263 new items on coconut were processed. 382 references on 'Farming Systems' were processed from the CIC database for compilation of the retrospective bibliography on 'Farming Systems' for Asian and Pacific Coconut Community (APCC)/International Development and Research Centre (IDRC) Integrated Coconut Information Project. On requests made for 45 items from various sources for literature on coconut 28 items were received during the year. 254 items of literature from the CIC database were microfiched.

3. SERVICES

3.1 Routine Services

Lending and inter-library loan services, processing of new material acquisitioned were carried out satisfactorily. Alert services and new books announcement services were provided regularly to the research staff. Literature search services for information requested were provided for the institute staff as well as outsiders, both local and foreign. Current awareness services from coconut

literature were provided regularly for APCC newsletter.

Regular up-dating of the CIC database and the International Directory of Coconut Research Workers were carried out with new information collected.

3.2 External Services: APCC/IDRC Integrated Coconut Information Project

In accordance with the responsibilities entrusted to the CIC for the above project, the following bibliographies were compiled for the APCC.

(a) Bibliographical Series on Coconut (1989-90). 594 references with abstracts.

(b) Retrospective bibliography on 'Farming Systems' on coconut (1970-90). 382 references with abstracts.

Agricultural Information Network (AGRINET)

The Library continued to function as the Coordinating Centre for the above network system in the country. Four meetings of the member libraries were organised and conducted during the year.

Selective Dissemination of Contents Page Services (SDCP) were satisfactorily carried out by providing 481 contents pages from 43 journal titles assigned to the library for the users of member libraries and 174 contents pages from 30 journal titles were received for the users of this Institute. Out of 78 requests for interlibrary loans received 69 were satisfactorily responded.

A residential training programme on "Agricultural Information Management" was organised and conducted at the Institute for the staff managing the AGRINET member libraries from 09-13 July. 15 participants from 15 member libraries participated at this programme.

A User Seminar for the AGRINET member institutions' staff in Southern region was conducted at the Agriculture Faculty, University of Ruhuna, Matara on 28 November, to create awareness among agricultural scientists, extension personnel and educationists on the agricultural information resources available in Sri Lanka.

Two issues of the AGRINET newsletter were published and

distributed among the member institutions and users.

7. PRINTING AND BINDING

Six hundred and fifty copies of the AGRINET newsletter were printed and 10 publications were bound during the year.

REPORT OF THE ESTATES MANAGEMENT DIVISION

Manager (Estates) - P S Liyanagama, B Sc

1. General

The following nine units were administered by the Division:

1. Bandirippuwa Estate (BE), Lunuwila
2. Rathmalagara Estate (RE), Madampe
3. Poththukulama Research Station (PRS), Pallama
4. Walpita Estate (WE), Walpita
5. Isolated Seed Garden (ISG), Ambakelle
6. Makandura Seed Garden (MK), Gonawila
7. Maduru Oya Seed Garden (MO), Bogaswewa, Dimbulagala
8. Minneriya Research and Demonstration Farm (MIN), Minneriya
9. Passekudah Research and Demonstration Farm (PAS), Kalkudah

Of the above nine units, Passekudah Research and Demonstration Farm was not functioning since June 17, 1990 due to the escalation of terrorists' violence in the region. Staff of the Farm are redeployed at the Head Office.

The rest of the units were maintained in good order. The recommended cultural practices were carried out. Ground conditions were satisfactorily maintained keeping noxious weeds under control. Success in ground maintenance could be attributed to the expansion of cover crops with mechanized weeding plus use of herbicides another contributory factor.

Emphasis had always been placed on soil and moisture conservation practices, especially in the vicinity of palm bases. Basin preparation and extension of mulching circles up to 8 ft from the palm were carried out with success. The entire quantity of husks available on the properties were buried in pits supplemented with coir dust. Signs are such that action taken on moisture conservation is paying dividends with sustained yields.

Rainfall during the first quarter of the year was very disappointing with prolonged droughts up to even three months at some stations. All available resources had to be mobilized to combat the situation. The worst affected was the Makandura Seed Garden with casualties of 24 bearing palms and 62 seedlings and reducing the crop by half the estimate. The soil in Makandura being high in clay content, the effect of drought is more pronounced. Rest of the stations did not suffer so much and there were no casualties due to the drought. During the rest of the year, the rainfall was satisfactory with good distribution. However, the set-back

due to the drought will be manifested in next years' yields at Makandura Seed Garden but not so pronounced at other stations. Heavy rains towards the latter part of the year caused water stagnation and 121 newly planted seedlings succumbed to water logging at ISG, Ambakalle in December.

The performance of Minneriya Farm continued to decline for want of an assured supply of water for irrigation. But at Maduru Oya Seed Garden it is the opposite with irrigation water available regularly.

The general performance of the units are given in Table 1.

2. BANDIRIPPUWA ESTATE, LUNUWILA

(Superintendent - Mr M R L A Perera)

District	:	Puttalma
Electorate	:	Wennappuwa
Agro-climatic Zone	:	Semi-wet Intermediate

Only 58% of the planted area is in production whilst the balance (51.9 ha) is young plantations (Table 1).

2.1 Rainfall: The total rainfall (2053.7 mm) indicates an increase of 22.5% over that of 1991. However, the number of wet-days had decreased from 129 to 114 confirming the poor distribution (Table 2).

2.2 Nut Yields: The total nut yield for the year (412 956) did not indicate any significant improvement over the previous year (Table 1) and reached a level close to the estimated crop.

2.3 Disposal of Crops: The first five crops of the estate were disposed mainly through brokers as husked nuts for processing. The last crop was sold as curry nuts at a concessionary price through the co-operative unions in Colombo by arrangement of the Commissioner of Co-operative Development in an attempt to relieve the Colombo consumers of a soaring price hike of curry coconuts.

2.4 Field Operations

2.4.1. Manuring: All bearing palms (6624) were manured during 'Maha' season with the DFR at Urea 1.2 Kg, ERP - 0.5 Kg; SP-0.2 Kg; MP-1.8 Kg and Dolomite-5.0 Kg. No organic manuring was done during the year.

Table 1. *General Performance of the Estates, Seed Gardens etc.*

	BE	RE	PRS	WE	ISG	MK	MO	MIN	PAS	TOTAL
1. Coconut Extent (ha)										
Mature	72.0	49.9	66.4	16.2	91.3	-	2.0	4.1	-	301.9
Immature	51.9	48.5	15.1	-	48.2	53.9	55.5	8.1	-	281.2
Total	123.9	98.4	81.5	16.2	139.5	53.9	57.5	12.2	-	583.1
Nursery	1.6	-	-	-	1.0	-	1.0		-	3.6
Other crops	-	4.1	1.8	-	-	-	-	-	-	5.9
Vacant land	-	2.8	-	-	1.0	-	22.5	38.0	-	64.3
Reservoir	-	-	-	-	2.0	2.4	-	-	-	4.4
Jungle	-	3.2	-	-	309.8	-	-	-	-	313.0
Roads & Buildings	22.3	2.0	2.5	1.6	3.0	2.0	4.0	0.4	-	38.1
Total	148.1	110.5	85.8	17.8	456.3	58.3	85.0	50.6	47.4	1059.8
2. Cencus of Palms										
Bearing palms	8893	7060	6800	2097	14451	8482	500	443	-	48726
Young Palms	6242	7304	2605	269	4845	590	5300	789	-	272343
Seedlings	2060	-	1258	-	999	-	3000	1219	-	8536
Dud palms	58	57	113	88	215	117	-	-	-	648
Vacancies	748	109	1003	72	6515	978	3200	678	-	13339
Total	18037	14530	11779	2526	27025	10167	12000	2418	-	98482
3. Pick-wise crop yield										
pick 1	67225	31033	73709	31460	123985	19177	774	1330	-	348693
pick 2	87826	67394	120487	50305	254460	51693	813	1615	-	634593
pick 3	99229	67816	187437	33023	234640	45708	2275	2079	-	672207
pick 4	65233	62520	84963	17481	244565	26048	4187	2547	-	507544
pick 5	53126	59288	70058	14921	162206	20421	2649	574	-	383243

Table 1 (Contd.)

	BE	RE	PRS	WE	ISG	MK	MO	MIN	PAS	TOTAL
3. Pick-wise crop yield										
pick 6	40317	47011	77221	9052	160604	5736	2229	105	-	342275
Total-1992	421956	335062	613875	156242	1180460	168783	129270	8250	-	2888555
Total-1991	408894	242772	239248	190230	393950	94322	1075	18580	-	1589071
Diff. + %	+1	+38	+157	-18	+200	-	-	-	-	+82
Est. - 1992	400000	300000	350000	200000	700000	150000	3300	17000	-	2120300
Ave.	396187	504869	499722	162548	760221	-	-	-	-	-
Nuts/palm 1991		49.7	38.2	35.4	85.9	27.8	-	-	-	-
1992		50.2	47.0	90.9	74.5	81.7	-	-	-	-
Yield/ha 1991		5679	5005	4313	11743	4315	-	-	-	-
1992		5735	6712	[illegible]	9645	12930	-	-	-	-
4. Crop disposal										
Sold	346803	226227	550350	108993	3180	-	-	2391	-	1237944
For copra	8581	23299	30631	6820	110648	37797	-	3396	-	221172
Research	515	14282	-	13039	8140	-	-	-	-	35976
Seednuts	2293	-	615	-	965639	114056	10581	-	-	1093184
Staff issues	31866	11368	5544	1316	15705	4500	1287	1470	-	73056
Rejections	14676	10572	26735	4717	27452	12430	1059	953	-	98594
Sale	7480	49314	-	21357	49628	-	-	35	-	127814
Total	412956	335062	613875	156242	1180460	168783	12927	8250	-	2888555
5. COP	1998	1560	1106	2170	1429	-	-	-	-	
6. NSA	4677	4945	4535	4720	6994	-	-	-	-	

(COP and NSA are in Rs. for 1000 nuts; Est.: Estimated; Ave.: Previous 5 years mean)

Table 2. *Monthly total rainfall (mm) with number of wet days in parenthesis*

Month	Bandirippuwa Estate		Rathmalagara Estate		Pothukulama Estate		Walpita Estate	
	1991	1992	1991	1992	1991	1992	1991	1992
January	37.7 (6)	5.3 (2)	36.2 (3)	0 (0)	124.5 (5)	5.0 (2)	79.6 (5)	0 (0)
February	12.2 (2)	0 (0)	12.2 (0)	0 (0)	0 (0)	0 (0)	48.0 (3)	9.0 (0)
March	97.7 (9)	0 (0)	88.8 (7)	0 (0)	98.5 (9)	0 (0)	173.9 (9)	9.0 (0)
April	90.3 (10)	54.5 (7)	104.4 (10)	236.9 (6)	111.4 (8)	156.8 (8)	137.6 (7)	116.0 (8)
May	481.5 (14)	413.5 (9)	375.7 (9)	275.2 (16)	124.1 (6)	226.9 (8)	443.7 (10)	246.7 (14)
June	269.4 (22)	260.2 (12)	274.7 (23)	191.2 (9)	246.9 (11)	175.9 (3)	428.5 (20)	287.5 (12)
July	105.2 (9)	78.0 (15)	38.1 (5)	71.5 (7)	38.7 (2)	116.6 (2)	164.3 (9)	164.4 (10)
August	22.6 (8)	57.3 (11)	16.1 (3)	11.5 (3)	16.2 (2)	62.2 (3)	54.9 (6)	67.4 (6)
September	59.3 (8)	362.6 (14)	42.0 (5)	192.8 (9)	21.4 (4)	80.8 (5)	91.0 (2)	348.3 (11)
October	309.2 (21)	443.7 (13)	213.4 (21)	326.9 (10)	281.1 (18)	277.1 (8)	401.1 (12)	546.2 (15)
November	161.4 (13)	317.9 (22)	175.8 (10)	505.5 (22)	178.1 (11)	366.5 (13)	144.5 (12)	331.9 (14)
December	29.1 (7)	60.7 (9)	82.2 (5)	56.4 (4)	96.4 (5)	32.1 (5)	65.2 (4)	81.4 (8)
Total	1676.2 (129)	2053.7 (114)	1460.6 (102)	1867.9 (86)	1337.3 (81)	1498.9 (57)	2235.3 (99)	2189.8 (98)

Table 2 **(Contd.)**

Month	ISG	Ambakelle	Makandura Seed Garden		Maduru Oya Seed Garden		Minneriya Farm	
	1991	1992	1991	1992	1991	1992	1991	1992
January	44.0 (5)	0.0 (0)	44.0 (4)	9.1 (2)	290.5 (9)	70.9 (5)	138.9 (9)	27.3 (2)
February	0.0 (0)	0.0 (0)	14.5 (1)	0.0 (0)	30.3 (3)	0.0 (0)	2.9 (1)	0.0 (0)
March	116.0 (9)	0.0 (0)	188.4 (9)	0.0 (0)	200.0 (5)	0.0 (0)	96.5 (6)	0.0 (0)
April	147.9 (10)	217.8 (9)	112.9 (12)	84.0 (9)	27.8 (3)	53.1 (3)	26.9 (2)	123.6 (7)
May	182.5 (8)	207.3 (11)	616.9 (12)	308.6 (16)	21.0 (4)	66.8 (4)	24.8 (3)	114.8 (4)
June	236.5 (17)	239.5 (8)	438.9 (23)	264.7 (11)	10.5 (5)	0.0 (0)	5.4 (1)	0.0 (0)
Jull	29.2 (6)	116.9 (7)	[illegible] (9)	113.2 (13)	1.5 (1)	38.1 (2)	4.9 (1)	2.5 (1)
August	17.1 (8)	28.4 (5)	41.6 (7)	69.7 (8)	80.0 (2)	1.8 (1)	25.0 (2)	4.5 (1)
September	25.8 (4)	62.3 (7)	110.0 (7)	366.1 (16)	114.8 (4)	85.6 (8)	72.1 (3)	234.9 (5)
October	221.6 (21)	342.3 (10)	313.0 (14)	481.3 (14)	173.8 (10)	76.2 (5)	290.8 (7)	45.4 (30)
November	208.9 (14)	406.0 (22)	116.5 (12)	410.6 (15)	358.0 (16)	546.6 (21)	237.0 (12)	452.7 (14)
December	151.5 (8)	75.9 (8)	26.3 (4)	36.5 (4)	581.3 (14)	580.1 (16)	325.6 (9)	284.6 (10)
Total	1380.2 (107)	1696 (87)	2160.8 (114)	2143.8 (108)	1889.5 (76)	1519.2 (65)	1250.8 (56)	1290.3 (47)

5753 young palms were manured, as recommended, with the same DFR dosage as above. 1286 newly planted (1992) seedlings were manured with YPM 1.0 kg and Dolomite 1.0 kg each.

780 young palms of one of the Genetics & Plant Breeding trials were manured with APM but no Dolomite was applied in this block.

2.4.2 Weed Control: Ground conditions were maintained in good order mainly by using the rotoslasher in three rounds. Cover cropped areas were manually weeded. Manure circles were kept free of weeds using herbicides. Noxious weeds such as "Atora" "Mana" and a small patch of "Illuk" had to be contained by the use of Glyphosate.

2.4.3 Soil and Moisture Conservation: Contour drains and drainage canals were desilted and reconditioned in all the fields. No new drains were opened. Manure circles were regularly mulched with the available material. A temporary husk mulch was applied during dry weather and the husks later buryied in pits. Seedlings in gravelly areas were provided with an additional mulch of coir dust. Existing cover crops were well maintained.

2.4.4 Replantating Improvements: 1091 polybagged seedlings of CRIC 60 raised in the estate nursery were used in planting vacant patches and field vacancies in fields No. 1, 2, 4, 7 and 8 in Maha Season. Low lying areas were provided with drainage facilities to prevent water-logging.

All young plantations were well looked after and they were watered during the drought. 100 palms of the old stand in field No. 9 were uprooted and removed. 108 dud palms were removed in fields No. 3, 5 6 and 7.

2.4.5 Tree Planting: A nursery was established and the following seedlings were raised in polybags:

Acacia	-	14000
Margosa	-	525
Gliricidia	-	510
Pihimbia	-	100
Total	-	15135

2.4.6 Dairy: The herd strength by end of the year was

Cows	25
Heifers	22
Bulls	02
Bull calves	14
Total	63

The total production of milk during the year was 27 913.2 litres, disposal of which was mainly to the Institute staff at concessionary rates and the surplus was sold to the milk collecting centre. Disposal figures are given below.

Sold to the staff	16,036.0 l
Sold to collecting centre	11,438.2 l
Sold to CRI Canteen	439.0 l
Total Production	27 913.2 l

2.4.7 Costs and Returns: The Cost of Production (COP) for the year was Rs. 1998.00 per 1000 nuts produced and the Net Sales Average (NSA) was Rs. 4677/- per 1000 nuts.

3. RATHMALAGARA ESTATE, MADAMPE

(Superintendent - Mr L J C Perera)

District	:	Puttalam
Electorate	:	Chilaw
Agro-climatic zone	:	Semi-Dry Intermediate Zone

The entire plantable land of the estate excepting 3.2 ha of reserved jungle is planted to coconut. Of this 49% under immature coconut (Table 1).

3.1 Rainfall: The total rainfall for the year was 28% more than that of previous year and slightly exceeds the estimated crop (Table 1). However, this is far below the previous five years' average yield.

3.2 Disposal of crops: Crop was disposed mainly through brokers as husked nuts for processing.

3.3 Field Operations

3.3.1 Manuring: All adult palms (7060) were manured as per the DFR providing 3.5 kg of NPK ingredients and 3.0 kg of dolomite per palm. All four ingredients were applied together during wet weather in one surface application and lightly forked in and mulched thoroughly. Seedlings were manured with YPM as recommended.

No organic manure was applied during the year.

3.3.2 Weed Control: Weeds were kept well under control. Mainly the rotaslasher was used where necessary followed by manual weeding of left-over sections. Herbicides were used to control noxious weeds and to maintain manure circles free of weeds.

3.3.3 Soil and Moisture Conservation: Extended maintenance circles were mulched well and weeds coming through the mulch were killed in two rounds using herbicides. Inter-row mulching with coir dust was done in sections of fields No 4 and 8 and was ploughed in during Maha rains. Husk burying was done only in 155 pits of 1.5 m x 0.9 m x 0.9 m. The balance available husks were used up by a trial on new techniques of moisture conservation using husks conducted by SPND.

Cover crops were encouraged and well maintained. Harvesting of cover-crop seeds was restricted as indiscriminate collection of seeds was found to be detrimental to the rejuvenation of the crop after a drought.

3.3.4 Plantation Improvements: Dwarf Palm Block (2.5 ha) in field No. 7 was scheduled to be replanted with CRIC-60 during the year. Out of 480 planting points only 370 (2 ha) would be planted owing to the unprecedented delay in tender procedure for removal of old stand. Other young plantations were well managed.

3.3.5 Nursery: The following number of seednuts were laid in polybags during the year:

CRCI 60	: 15,800
CRIC 65	: 2,000
Dwarf Red	: 419
King coconut	: 1,313
Total	: 19,812

Sales (number of seedlings) during the year are:

CRCI 60	: 6,058
CRIC 65	: 430
Dwarf Red	: 187
King coconut	: 289
Total	: 6 964

Revenue @ Rs. 30 = Rs. 208,920.00.

3.3.6 Costs and Returns: The Cost of Production and Net Sales Average were Rs. 1560/- and Rs. 4945/- per 1000 nuts respectively.

4. POTUTHUKULAMA RESEARCH STATION, PALLAMA

(Superintendent: Mr D M Pathirage)

District	:	Puttalam
Electorate	:	Anamaduwa
Agro-climatic zone	:	Semi-dry Intermediate Zone

Out of the total planted extent of 81.5 ha 18.5% is immature. Leaving out the land reserved for future planting by research, no further land is available for planting (Table 1).

4.1 Rainfall: An increase of 12% was observed in total rainfall over that of previous year. However, the distribution of the same had been very poor with 57 wet days compared to 81 wet days in 1991. An intense drought was experienced during the first quarter of the year but there were no casualties. (Table 2).

Effect of drought on mature palms was negligible perhaps due to the measures taken on moisture conservation. Seedlings were irrigated employing tractor bowsers during the drought.

4.2 Nut Yields: The total crop for the year indicates a 157% increase over that of the previous year and it is 23% more than the estimated crop a well as the previous five years' average yield (Table 1).

4.3 Disposal of Crops: The first five crops were disposed through brokers mainly as nuts for processing. Similarly to in Bandirippuwa Estate the last crop was sold to the Colombo Co-operative Unions under the same arrangement (Table 1).

4.4 Field Operations

4.4.1 Manuring: The mature palms were manured as per the DFR consisting 1.4 kg Urea, 0.8 kg ERP, 0.3 K SP, 2.2 Kg MP and 3.8 Kg Dolomite per palm per annum.

Seedlings were manured as recommended and no organic manuring was done during the year.

4.4.2 Weed Control: Weeds are generally kept under control but there were instances where it went out of hand. The mode of control was by the rotaslasher and the noxious weeds were controlled using Glyphosate.

4.4.3 Soil and Moisture Conservation: The available husks were buried in field No. 8 in pits of 1.5 m x 0.9 x 0.9 m at one pit per each palm. The rest of the husks were used as a mulch for seedlings. Existing cover crops in about 20 ha were maintained well but no new covers were planted.

4.4.4 Plantation Improvements: 524 seedlings were newly planted in field No. 14 germplasm collection conducted by G & P B Division. 1992 planting holes were opened in the scrub jungle deared (one ha in extent) in field No. 15. Of this 69 were planted with CRIC 60. Balance 23 and another 149 pits opened in field

No. 13 could not be planted due to the high water table prevailing during the planting season. 64 vacancies were infilled in the fire damaged area in No. 15.

4.4.5 Intercropping: The banana intercrop in field No.6 was maintained in well. A harvest of 1000.75 kg of 'ambul' and 701.5 kg of 'kolikuttu' bunches were collected realising an income of Rs. 23195.50 where expenditure has been Rs. 17 000/-.

The paddy field left fallow during Yala season was given on lease for cultivation during Maha season. The problem of soil salinity has increased and no much harvest is anticipated.

4.4.6 Costs and Returns: The Cost of Production for the year was Rs. 1106/- per 1000 nuts whilst the Net Sales Average was 4543.25 per 1000 nuts.

5. WALPITA ESTATE, WALPITA

(Officer-in-charge - Mr N Gamage)

District	:	Gampaha
Electorate	:	Divulapitiya
Agro-climatic Zone	:	Semi-wet Intermediate Zone

This is a small property of about 18 ha in extent established in 1948 as Progeny Trial. About half of the extent is intercropped as trials or demonstrations (Table 1). Area under intercrops is given in Table 3.

Table 3. *Area under intercrops (ha) in Walpita.*

Intercrop	Bearing	Non-bearing	Total
Cocoa	2.02	-	2.02
Coffee	0.80	-	0.80
Pepper	0.20	0.93	1.13
Cinnamon	0.18	-	0.18
Banana	1.64	-	1.64
Ginger	0.10	-	0.20
Mixed	0.20	-	0.20
Total	5.14	0.93	6.07

5.1 Rainfall: The total rainfall is more or less similar to that of 1991 but with a poor distribution. The first quarter of the year had no rains whilst the plantation experienced an intense drought (Table 2). However, there were no casualties due to drought either in coconut or in intercrops as the measures taken in general moisture conservation supplemented by irrigation were effective. Although the plant were saved, yields of intercrops were badly affected and coconut yields will manifest it in the following year.

5.2 Nut Yields: Walpita is the only station that recorded a decrease (-18%) in yield compared to last year's crop (Table 1). It is also lower than the previous five years' average yield.

5.3 Disposal of Crops: Coconuts were disposed through brokers mainly as husked nuts for processing. Intercrop produce too were sold through brokers.

5.4 Field Operations

5.4.1 Manuring: Mature palms (2097) were manured during Maha season as per the DFR at 1.2 Urea, 0.6 ERP, 0.2 SP, 1.8 MP and 5.0 Kg Dolomite per palm. The infills (269) were manured with YMP as recommended in two split doses.

5.4.2 Weed Control: Weeds were under control owing to well established cover crops. Only occasional cheddy weeding was required to maintain ground conditions. A patch of 'Illuk' about 0.1 ha was removed by manual uprooting. Manure circles were maintained using Gramoxone in three rounds.

5.4.3 Intercropping: Areas intercropped are given in Table 3. 0.81 ha of Banana/Pepper intercrop was established during the year. Projected revenue could not be realised on pepper and coffee due to poor market prices prevailed.

5.4.4 Costs and Returns: Cost of production of coconuts was Rs. 2170/- per 1000 nuts and the Net Sales Average was Rs. 3681/- per 1000 nuts. Returns on intercropping is given in Table 4.

Total expenditure on intercropping was Rs. 43,350/- realising a profit of Rs. 24,567.07.

Table 4. *Returns on intercropping.*

Produce	Quantity	Revenue (Rs.)
Cocoa (dry beans)	470 kg	27197.28
Cinnamon (peelings)	17 kg	3423.04
Coffee (dry beans)	74 kg	2960.00
Pepper (dry seeds)	312 kg	19647.75
Pepper (seedlings)	2150 nos.	10750.00
Banana		3936.00
Total revenue		67914.07

6. ISOLATED SEED GARDEN, AMBAKELLE

(Superintendent - Mr S M Wijeratne Banda)

District	:	Puttalam
Electorate	:	Chilaw
Agro climatic zone	:	Semi-Dry Intermediate Zone

(**Note:** Further information on the ISG appears in the report of the Genetics and Plant Breeding Division.)

6.1 Rainfall: Although an increase of 23% was recorded in total rainfall over that of the previous year the distribution of rainfall was very poor with over three months of drought at the beginning of the year (Table 2). However, the plantation did not appear to have suffered the drought as supplementary irrigation was provided. Extension measures taken in soil moisture conservation and improvement of ground water table due to the renovation of two reservoirs could be contributory factors in alleviating the drought.

Nevertheless, the rainfall towards the end of the year was quite intense and there was standing water that could not be drained out in many sections in the field causing 121 casualties of newly planted seedlings due to water-logging in December.

6.2 Nut Yields: Total nut production for the year was three times that of the previous year (+ 200%). This is 55% more than the previous five years' average production, whilst last year it was 50% less (Table 1). Breakdown of the total nut production by the two varieties is given in Table 5.

Table 5. *Breakdown of the Production 1991 and 1992 - Isolated Seed Garden, Ambakelle.*

	1991			1992		
Pick	CRIC 60	CRIC 65	Total	CRIC 60	CRIC 65	Total
1	57546	3466	61012	101377	22608	123985
2	69339	5398	74737	219274	35786	254460
3	54274	16390	70664	197158	37482	234640
4	51973	13083	65056	184865	59700	244565
5	40754	10720	51474	120027	42179	162206
6	51771	19236	71007	119758	40846	160604
Total	325657	68293	393950	942459	238001	1180460
BP	11135	3044	14179	11527	292	414451
NPP	29	22	28	82	81	82

(BP: Bearing palms; NPP: Nuts per palm)

6.3 Seednut Production: A corresponding increasing to nut yields (+ 365%) is observed in seednut production and its breakdown is given in Table 6.

Table 6. *Seednut Production.*

Pick	CRIC 60	CRIC 65	Total	CRIC 60	CRIC 65	Total
1	34059	845	34904	77331	21000	98331
2	46579	1100	47679	189765	31322	221087
3	15969	9120	25089	168061	33582	201643
4	27394	6475	33869	160912	54655	215567
5	25830	4824	30654	100194	37885	138079
6	31475	11951	43426	91666	36489	128155
Total	181306	34315	215621	787929	214933	1002862

6.4 Disposal of Crops: Crop was disposed mainly as seednuts and the breakdown is given in Table 1.

6.5 Field Operations

6.5.1 Manuring: All mature palms (15336) were manured as per the DFR @ Urea 1.6 kg, ERP 0.6 kg, SP 0.6 kg, MP 2.8 kg and Dolomite 3.8 kg per palm. All ingredients were applied together during rainy season. Fields No. 1, 2, 3, 4, 7, 10A and 10B were manured in May-June season and the rest of the fields in Oct. - Nove. season. As Mg - deficiency symptoms were more pronounced in certain fields Kieserite was applied in addition to the DFR @ 1 kg/palm to field No. 10A and @ 0.5 kg/palm to field No. 10B.

Young plantations were manured with YPM twice the year at recommended dosages. Dolomite was applied @ 2 kg per seedling along with the second dose of YPM.

Organic manure (cow dung) was applied to fields No. 8, 10A and 14 @ 15 kg/palm.

6.5.2 Weed Control: Ground conditions were maintained in good order throughout the year. 3 to 4 rounds of weeding had been done in all the fields employing mostly the rotoslasher. Left out sections after rotoslashing and cover-cropped areas were weeded manually as required.

Chemical control was resorted to maintain manure circles, free of weeds. Noxious weed such as 'Illuk' and 'Atora' were kept under control using Glyphosate mainly in fields No. 4, 8, 9, 10A, 11A, 11B, 13 and 14.

6.5..3 Soil and Moisture Conservation: The cover crop *Puereria* was established in 50 ha in fields No. 9, 10A, 10B, 11B, 12 and 14. Old cover-cropped sections were lightly harrowed during rainy season and this was found to be successful in expanding the covers.

Regular mulching was continued using fallen fronds and weed trash. A 5 cm thick layer of coir dust was used in greater mulching circle up to 60 cm beyond the standard mulching circle. This was commenced in early January in fields No 4, 5, 8, 10A, 10B, 11A, 11B and 12. This seemed to have contributed in going through the drought successfully.

Although progrmmed for 4000 pits, only 810 coir dust pits of 1.5 m x 0.9 m x 0.9 , could be completed in fields No. 11B and 12, due to shortage of coir dust supply.

The bunds of the two reservoirs in fields No. 10B and No. 7 were renovated and water storage was improved. With over 7 m of water in each

reservoir both were spilling over with Maha rains in the latter part of the year. Renovations of the reservoirs seemed to have improved the ground water table in the main sections of the seed garden.

6.5.4 Irrigation: Bowser irrigation, commenced in mid-January, was continued till end of the drought in mid-April. Young plantations and infills were watered at 45 l every 10 days and mature palms fields No. 4, 5, 10A, 10B, 11A, 11B, 12 and 13 at 45 l per palm every 10 days. There had not been any casualties due to drought.

6.5.5 Replanting: 10 acres of the dwarf plantation in field No. 14 were replanted with "Ambakelle Special" variety on 25 feet triangular system in August. Out of the 800 seedlings planted, 121 died of wet-feet due to heavy rains experienced during the latter part of the year. Casualties were infilled after the water table was receded.

One new push-cycle and a water-pump with a deep-well kit were received during the year.

6.5.6 Tree Planting: A nursery of 20,000 seedlings with 18500 *Acasias* and 1500 *Gliricidias* was raised. Of these 13000 plants of *Acasias* and 1000 plants *Gliricidias* were planted in the Seed Garden. The balance could not be planted due to stagnant water in several sections towards the end of the year.

6.5.7 Costs and Returns: Cost of production was Rs. 1429.12 per 1000 nuts and the Net Sales Average was Rs. 6994/- per 1000 nuts.

7. MAKANDURA SEED GARDEN, GONAWILA

(Officer-in-Charge - Mr D L J Neththasinghe)

District	:	Kurunegala
Electorate	:	Katugampola
Agro-climatic Zone	:	Semi-Wet Intermediate zone

This seed garden was established in 1984 with the financial assistance of the Asian Development Bank. The entire plantable area of the seed garden was brought under coconut to produce CRIC - 60 and Ambakelle Special varieties. (Report for 1988 gives planting details.)

7.1 Rainfall: The total rainfall for the year was more or less the same as that of the previous year but the distribution was very poor with a rainless period of about 3 months at the beginning of the year (Table 2). The reservoir as well as

the trench in it ran dry during this drought and water for irrigation had to be drawn by bowsers from the river Ma-oya, at an exorbitant cost. Nevertheless the plantation suffered 24 casualties of bearing palms and 62 of seedlings.

7.2 Nut Yields: By the end of the year 8863 palms out of the total of 10167 had come into flower producing a harvest of 168733 nuts for the year. This was in keeping with the estimated crop of 150000 nuts (Table 1).

7.3 Seednut Production: Out of the total crop of 168783 nuts 114056 (68%) had been issued as seednuts.

7.4 Disposal of Crops: Crop was disposed mainly as seednuts and its breakdown is given in Table 1.

7.5 Field Operations

7.5.1 Manuring: All young seedlings (811) were manured with YPM in two 6 monthly doses at recommended quantities. Dolomite was supplied at 1 1/2 kg per seedling per year.

Mature Palms (8487) were manured as per the DFR with Urea 1.1 kg, ERP 0.5 kg, SP 0.21 kg, MP 2.0 kg and Dolomite 3.0 kg per palm. The two easily soluble ingredients, Urea and MP were split into two doses and the rest in one dose were applied from June to October.

7.5.2 Weed Control: Weeds were slashed down using rotoslasher in two rounds for the year. Cover cropped areas and left out sections were weeded manually.

The creeping cover *Puereria* existed in a large extent did not rejuvenate after the drought making the Seed Garden virtually devoid of ground covers. Weeds on manure circles were kept under control using herbicides.

7.5.3 Soil and Moisture Conservation: 283 coir dust pits of 150 x 90 x 90 cm were done in No. 3 barrier during the May/June monsoon season. Regular mulching with fallen fronds and cut grass was done in five rounds in the year.

No work could be done in re-establishing the cover crops that got wiped out with the drought.

7.5.4 Drains: 1475 m of drainage canal in the barriers of field No 2,3 and 4 were desilted and cleaned once during the year.

7.5.5 Infilling: 300 vacancies in fields No. 1, 2 and 4 were infilled with polybagged seedlings of CRIC 60 obtained from Rathmalagara Nursery. They were planted in freshly prepared planting holes of 120 x 120 x 90 (deep) cm in size.

7.5.6 Pests and Diseases: After the drought the plantation was plagued with Black Beetle and Red Weevil infestations. This was brought under control by chemical treatment and improved crop sanitation. However, 20 palms succumbed to the infestations.

7.5.7 Propping: Drooping of bunches was aggravated due to the drought conditions. 8500 props brought in from ISG, Ambakelle were used along with butt-ends to prop up drooping bunches. However, the immature nut-fall was extensive.

7.5.8 Removal of Weak Palms: Uprooted and removed 170 weak palms as per evaluation and recommendation made by the G & P B Division.

7.5.9 Drains: 532 m of drainage canals in fields No. 1 and 2 were cleared desilted and reconditioned twice during the year to facilitate draining out surplus water.

7.5.10 Tree Planting: Around 1000 timber plants were established along the perimeter and roadsides during the year.

7.5.11 Census: A census was taken and the entire palm population in the estate was numbered with 10 cm digits on their stem.

7.5.11 NFT planting: 8500 *Acasia* seedlings were planted along the perimeter and the barrier boundary.

7.6 General: Thr set-back caused by the drought prevailed at the beginning of the year had assumed alarming propositions. Future nut production will severely be affected and the production target would not be achieved. If favourable weather continues full recovery could be expected by 1994.

8. MADURU OYA SEED GARDEN, BOGASWEWA

(Superintendent - Mr G Vithanage)

District:	:	Polonnaruwa
Electorate	:	Polonnaruwa
Agro-climatic Zone	:	Dry Zone

This seed garden was established in 1985 under the East Coast

Rehabilitation Project of the Coconut Development Authority financed by the European Economic Community.

8.1 Rainfall: The Seed Garden received a rainfall of 1519.2 mm which is 26% less than that of the previous year. However, the effect of rainfall variations is minimal as there is an assured supply of irrigation water from the Mahaweli Project.

8.2 Harvest: Regular harvesting continued for the second year yielding 12324 nuts compared to the first year's yield of 1075 nuts. 10491 out of this year's production had been selected and issued as seednuts.

8.3 Field Operation

8.3.1 Manuring: The entire seed garden was manured as per the DFR provided by the SPND.

8.3.2 Weed Control: Ground conditions were satisfactorily maintained. The noxious weed "Illuk" (*Imperata cylindrica*) was effectively controlled at a cost using herbicide Glyphosate. A well established cover crop assisted in keeping the grassy weed down. The rest of the areas were maintained employing the rotoslasher regularly. Manure circles were kept free of weeds using Paraquot.

8.3.3 Soil and Moisture Conservation: Seedling bases were mulched using paddy straw col ected from nearby paddy fields. Sun-hemp was planted on the periphery of manure circles in field No. 5 as a green manure crop. Leguminous creeping covers, mostly *Puereria* were quite well established in many sections of the seed garden. Husk/coir dust burying could not be practiced for want of such material in the region.

8.3.4 Pests and Diseases: Intermittent attacks of Red Weevil were observed in the plantation. Pesticide Monochrotophos was used intensively to bring the infestation under control. However, by end of the year 35 palms had succumbed to red weevil damage.

Wild elephant damage continued but at a lesser intensity but the damage caused by wild boar was unabated. Partly constructed elephant trench was found to be effective in keeping these beasts away but the project was abandoned, to construct an electric fence as an alternative.

No other incidents of pest damage or diseases were reported.

8.3.5 In-filling: Priority was given for filling vacancies over new planting during the year. All vacancies except the ones in field No. 4 were infilled.

8.3.6 Irrigation: Although irrigation water was made available since last year in the field canal provided for the seed garden by the Mahaweli Authority, there was no proper system of irrigation for watering the palms. Assistance was sought from the Mahaweli Engineering and Construction Agency (MECA) to design a suitable system of irrigation. Until then an interim arrangement was made, introducing several branch canals to irrigate the seed garden with satisfactory results. Recommendations from MECA are awaited to construct the appropriate irrigation network.

8.3.7 Drainage: Three drained sections were identified and necessary drainage canals were opened out to take away surplus water. However, the blockage of drainage canals by illicit paddy cultivators in drainage reservations in the vicinity has caused a serious drainage problem in to the lower reaches of the seed garden. The Mahaweli Authorities were requested to solve out this problem.

8.3.8 Soil Survey: A detailed soil survey of the seed garden was carried out and various soil types were identified. This became very useful in planning and designing all operations.

8.4 General: Work at the seed garden has shown a satisfactory progress during the year.

9. RESEARCH AND DEMONSTRATION FARM, MINNERIYA

(Officer in Charge - Mr A N Ekneligoda)

District	:	Polonnaruwa
Electorate	:	Minneriya
Agro-climatic Zone	:	Dry Zone

Minneriya Research and Demonstration Farm was established in 1982 under the East Coast Rehabilitation Project of the Coconut Development Authority.

9.1 Rainfall: The Farm received a rainfall of 1290.3 mm distributed in 47 days which records a marginal increase (+ 3%) over that of the previous year (Table 2).

9.2 Nut yield: The total crop for the year was dropped by 56% compared to that of the previous year. This could mainly be attributed to the lack of seepage

water from the main delivery canal running by the Farm boundary which was virtually dry for the last two years.

9.3 Field Operations

9.3.1 Manuring: 262 young palms below 3 years of age were manured with YPM as per recommendations. Others over 3 years (1479) were manured only with 3 ingredients P, K and Mg as per the DFR during the dry weather awaiting for N application with rains but it was abandoned in view of the monsoon failure.

9.3.2 Weed Control: Weeds in general were under control as the rotoslasher was effectively utilised throughout. Dry weather which prevailed during most part of the year was an added advantage in keeping the weeds down. Two round of cheddy weeding were done manually. Herbicides too were used in maintaining ground conditions.

9.3.3 Soil and Moisture Conservation: Mulching of manure circles was intensified owing to the dry weather prevailed. Paddy straw, paddy husk, weed trash etc. were used as mulching material. The legume cover *Puereria* which provided an effective mulch to conserve soil as well as moisture died as a result of the prolonged drought.

9.3.4 Other field operations: The boundary fence was frequently damaged by wild elephants. Yet the fence was kept in a satisfactory states with damage repaired in time.

Internal roads and paths were kept in good order and new field tracks were introduced for better supervision. No serious incidents of pests and diseases were recorded.

About 1000 good quality polybagged seedlings of *CRIC 60* were raised for future planting programme. Under the NFT planting programme 10,000 *Acasia* and 750 *Gliricidia* seedlings were raised in polybags. Of these, 540 *Acasias* and 80 *Gliricidias* were planted along the perimeter and roadsides.

Buildings, machinery and equipment, implements etc were maintained well.

9.4 General: Agricultural condition of the Farm deteriorated on account of continued dry spells.

10. RESEARCH AND DEMONSTRATION FARM, PASSEKUDAH,KALKUDAH

(Officer in Charge - Mr A Thavaratnarajah)

District	:	Batticaloa
Electorate	:	Kalkudah
Agro-climatic Zone	:	Dry Zone

10.1 Activities: The OIC and the staff of the Farm continued to work at the head quarters as the civil administration in the region did not sufficiently improve to revive the farm activities.

REPORT OF THE AGRICULTURAL RESEARCH PROJECT

Project Co-ordinator - M Jeganathan, M Phil

1. ACTIVITIES

1.1 Manpower Development Programme

1.1.1 Long Term Training (Foreign)

Ms W M U Fernando, Assistant Botanist, returned to the island on 19 July, after successfully completing the Ph.D programme from the University of Birmingham, U.K.

Mr T G L G Gunasekera and Mr H P S Jayasundara, Assistant Agronomists, continued with their field studies in Sri Lanka, under the split training programme.

Mr N A Tennakoon, Assistant Soil Scientist and Ms L K Weerakoon, Research Assistant (Tissue Culture) continued with their Ph D programmes in U K and U S A respectively.

Two officers left the Island for post graduate studies (M Phil) during the year,

Mr K B Dassanayake, Assistant Agronomist in Crop Ecology, University of Aberdeen, U.K. and Ms C S Ranasinghe, Assistant Plant Physiologist, in Plant Physiology, University of Sussex, U.K.

Mr J M D T Everard, Assistant Geneticist/Plant Breeder, was awarded a fellowship to undertake M Phil studies at the University of Sterling, U.K. and is scheduled to take up the training in January, 1993.

1.1.2 Long Term Training (Local)

Ms D M D I Wijebandara continued with her postgraduate studies (M Phil) at the Post Graduate Institute of Agriculture, Peradeniya.

The following officers have been awarded fellowships for post graduate studies:

Mr T S G Peiris, Senior Biometrician in Agrimeteorology at the University of Colombo, Ph D; Mr P V A Lal, Assistant Soil Scientist in Agronomy at the University of Jayawardenepura, M Phil.

1.1.3 Short Term Training (Local)

Ms M Fernandopulle, Soil Scientist and Mr A Nainanayake, Assistant Physiologist undertook a course of training in the use of SPSS statistical package from 24 February to 6 March in Colombo.

1.2 Council for Agricultural Research Policy(CARP): Special Programme - Research Management

The Institute has been selected for the Project on the Research Prioritization and the Development of Research Management Capability conducted by CARP/GTZ. Dr Hans-Joachim Holler and Dr D T Wettasinghe of the GTZ visited the Institute on 11 December, for a preliminary discussion with the research staff.

Mr V Abeywardene, Consultant appointed by the CARP to report to an *ad hoc* committee for the formulation of a training policy for agricultural research scientists, visited the Institute on 27 May for discussion with the research staff and collect data.

1.3 Strengthening of Research Station Facilities

Laboratory/Field Equipment and Spares: The undermentioned items were received.

Laboratory	-	Atomic Absorption Spectrophotometer
Equipment Spares	-	spares for spectrophotometers
		15 voltage stabilizers (1000W and 2000W)
Office Equipment	-	Two air conditioners
		Phqtocopiers
Vehicles	-	a 15 seater van(Nissan Urvan) and a diesel motor car
	-	one tractor drawn bowser and one tractor-trailer
Furniture	-	three wooden cupboards and a laboratory work table

Procurements of Books and Periodicals: 15 books were received.

1.4 Civil Works

All civil works undertaken at the Head Office have now been completed and handed over. This includes improvement to the library auditorium (with furniture), guest house, and the construction of the service building, screenhouse and six quarters.

1.5 Field Days, Workshops and Seminars

Coconut Day: A very successful "Coconut Day" was held on 12 August at the Institute for coconut growers on the theme 'Increase Profitability from Coconut Lands'. About 2000 growers participated.

Land Suitability Field Workshop: A successful 'Land Suitability Field Workshop' was held on 26 August, covering the main coconut growing areas in the North Western Province. Thirty scientific staff of the Institute and the extension staff of the Coconut Cultivation Board attended the workshop.

1.6 Diagnostic Team (Research & Extension Linkage)

The Diagnostic Team presently consists of Dr L L W Somasiri, Soil Scientist; Mr T S G Peiris, Senior Biometrician; Dr H A J Gunatilake, Agronomist; ; Mr M T N Fernando, Assistant Agricultural Economist and Mr J G L Pinto, Assistant Information Officer.

The Diagnostic Team has undertaken a comprehensive diagnostic survey, with a view to obtain information on the farmers problems and constrains.

The team has now completed survey of 325 farm holdings and interviewed the farmers/owners, of the 450 holdings selected, covering six districts. The final report of the findings is expected by end March 1993.

1.7 Management Information System and Programme Budgeting System (MIS/PBS)

The MIS/PBS package is now in place, and the information is being used to allocate funds for prioritized research programmes. Also this information has been used to re-allocate funds based on the priorities indicated.

1.8 World Bank Mission

Mr Ivor Serejski visited the Institute on 10 October to review the progress of the ARP, under the October/November) 1992 Supervision Mission.

2 CONTRACT RESEARCH PROGRAMME [CARP AWARDS]

2.1 Inter Institutional Research Programme (IIRP) - Coconut Intercropping (Project No.12/1/1 and 12/18/13)

The tenth, eleventh, twelth, and thirteenth meetings of the IIRP were held on 24 January, 30 March, 20 July, and 30 October, to monitor the progress of the IIRP.

The half-yearly progress report of the programme ending December 1991 and June 1992 were submitted to the CARP om 1 March and 29 September repectively.

2.2 Studies on Water Balance of Coconut Under Different Soil Landscapes, Agroclimates and Management Practices (12/104/89)

The award was made on 6 February and the field work commenced during the second quarter of the year. The first half-yearly report was submitted on 10 November, 1992.

2.3 Adaptive Research Trials on Coconut Based Cropping/Farming Systems (12/121/92)

The award was granted on 6 February and the first half-yearly report was submitted on 13 October, 1992.

2.4 Intercropping of Coconut with Selected Medicinal Plants(12/167/136)

The award was made on 14 December.

REPORT OF THE ADMINISTRATION DIVISION

Deputy Director (Adm. & Fin.) - D G Manamudali, B A

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, 1992 was as follows:

Grade	Unclassified	Special Class	Class I	II	III	IV	Total
Executive	2	-	6	10	22	9	49
Technical	-	11	19	28	-	-	58
Intermediate	-	1	2	4	-	-	7
Clerical	-	15	9	18	-	-	42
Operative	-	16	12	28	-	-	56
Minor	-	52	30	41	-	-	123
Ungraded							
Drivers	-	08	10	15	-	-	33
Watchers (12hr)	13	-	-	-	-	-	13
Total	15	103	88	144	22	9	381

Appointments, retirements, resignations, deaths of officers, and internal promotions, etc. are reported separately.

Administration: The general administrative functions were continued.

The total expenditure during the year was Rs. 5.7 million comprising Rs. 1.3 million as capital expenditure and Rs. 4.4 million as recurrent expenditure. The revenue during the year was Rs. 18.2 million.

2. WELFARE

2.1 Finance Aid

Provident Fund: The loans from the Provident Fund to employees amounted to Rs. 2,376,200.00.

Distress Loans: Distress loans to employees amounted to Rs. 1,328,294.00.

Transport Loans: Transport loans to employees amounted to Rs. 908,000.00.

Loans to Relieve Indebtedness: Loans to relieve indebtedness to employees amounted to Rs. 52,500.00.

Refrigerator Loans: Refrigerator loans to employees amounted to Rs. 1,440,000.00.

Medical Aid:
(a) A sum of Rs. 616,869.00 was reimbursed by the Medical Aid Scheme to its members.
(b) A sum of Rs. 56,147.00 was granted by the Medical Aid Scheme to buy Mosquito Nets to its members.

2.2 Other Facilities to Employees

(a) Financial assistance were granted to the Multi Purpose Co-operative Society, Recreation Club and the Art Circle to promote their activities during the year.

(b) The Medical Aid Scheme organized a dental clinic for the benefit of the staff and their families.

3. OTHER ACTIVITIES OF THE ADMINISTRATION DIVISION

3.1 Transport Section

The Transport Section administered the drivers and maintained the following fleet of vehicles.

Cars	08	Busses	03	Jeeps/Double Cabs	15
Vans	06	Lorries	02	Three Wheeler	01

The following vehicles were disposed of during the year 1992.
Jeeps 03 Lorries 01.

3.2 Accounts Unit

The usual accounting functions were satisfactorily carried out during the year.

3.3 Engineering Unit

The Engineering Unit continued to provide maintenance services for electricity, water supply, refrigerators, air conditioners, telecommunication system, machineries, vehicles, official quarters and office buildings in the institutes' head office and Estates. There was a considerable saving incurred on vehicle servicing at the Engineering Unit Service Centre. It was also possible to attend to some repairs to the Institutes' vehicles at the Engineering Unit workshop.

STAFF MATTERS

1. Appointments

Mr P Premaratne Fernando as Supplies Officer on 06 January.
Mr H P de Soyza as Analyst/Programmer on 14 January.
Ms H D Mangalika as Chief Clerk on 14 January.
Mr N B Ruwan Bandara as Guest House Keeper on 01 April.
Mr K L Ranasinghe as Lab/Field Assistant on 15 June.
Mr K R E M Fernando as Lab/Field Assistant on 15 June.
Mr W Gunasena as Lab/Field Assistant on 15 June.
Mr P A D M Appuhamy as Lab/Field Assistant on 15 June.
Mr I A N Hemasiri as Lab/Field Assistant on 15 June.
Mr F H A J R Silva as Lab/Field Assistant on 15 June.
Mr M H Dhanasena as Lab/Field Assistant on 15 June.
Mr H P Asoka Kumara as Lab/Field Assistant on 15 June.
Mr M A Hemachandra as Lab/Field Assistant on 15 June.
Ms V R M Kodikaraarachchi as Assistant Botanist on 03 August.
Mr I R Wickramananda as Assistant Crop Protection Officer on 03 August.
Mr H T R Wijesekara as Assistant Crop Protection Officer on 03 August.
Mr R D Sumanasiri as Book Keeper on 01 October.
Mr N H R Saratchchandra as Book Keeper on 01 October.
Mr S M Sirisoma as Book Keeper on 01 October.
Mr R A Swarnatilaka as Supervisor on 10 November.
Mr A G B G Silva as Supervisor on 10 November.
Mr M A Sunil Fernando as Supervisor on 10 November.
Mr W M P Weerasekara as Supervisor on 10 November.
Mr W M U Ratnayake as Field Officer on 10 November.
Ms J A N Thushara as Clerk/Typist on 10 November.
Mr R M S G Ratnayake as Motor Mechanic on 16 November.
Mr P Daluwatta as Administrative Officer on 23 November.
Ms H P Lakshmi as Clerk/Typist on 01 December.

2. Retirements

Mr B Somapala, Guest House Keeper on 06 February.
Mr K S L Fernando, Watcher on 10 February.
Mr J S Roberts, Lab/Field Assistant on 15 June.
Mr M Jeganathan, Senior Research Officer on 23 June.
Mr D T Fernandopulle, Lab/Field Assistant on 22 September.
Mr P M E Andrew, Driver on 02 November.

Mr M Francis Fernando, Motor Mechanic on 23 November.
Mr A Wilson, Lab/Field Assistant on 07 December.

3. Resignations

Mr W L D Fernando, Tractor Driver on 10 January.
Mr M A J Livera, Driver on 01 February.
Ms R A D G Subashini, Technical Assistant on 07 February.
Mr M M Keerthi, Research Assistant on 31 March.
Mr A Jayasinghe, Watcher on 27 May.
Mr K Velupille, Labourer on 01 June.
Mr D B Jayasinghe, Documentation Assistant on 30 June.
Ms H S G Kularatne, Technical Assistant on 01 July.
Mr N K Douglas, Office Attendant on 31 July.
Mr B Raymond Fernando, Clerk/Typist on 01 August.
Mr A M U Wijeratne, Technical Assistant on 01 August.
Mr K L L Appuhamy, Watcher on 01 September.

4. Vacation of Post

Mr R A J R Perera, Research Assistant on 03 January.
Mr B K Dissanayake, Supervisor on 01 April.

5. Deaths

Mr K D Jathiratne, Clerk/Typist on 09 January.
Mr C B B P Fernando, CLerk/Typist on 16 July.

6. Promotions

Executive Grade

Dr M de S Liyanage, Agronomist to Class I on 22 January.
Mr P A H N Appuhamy, Assistant Information Officer to Class II on 12 December.

The effective date of the following promotions was 01 January, 1992.

Technical Grade Class I to Special Class

Mr S M Wijeratne Banda, Superintendent
Mr C K A Gamage, Technical Assistant
Ms W B S Fernando, Technical Assistant

Mr M H L Padmasiri, Technical assistant
Mr K F G Perera, Technical assistant
Ms D M D I Wijebandara, Technical Assistant
Ms K M A Nonis, Book Keeper

Intermediate Grade Class I to Special Class

Ms T I I Peries, Library Assistant

Clerical & Allied Grade Class I to Special Class

Ms C M B I Salwatura, Clerk/Typist
Ms W P R Fernando, Clerk/Typist
Mr H H J E Appuhamy, Clerk/Typist
Mr W G L Rodrigo, Printing Machine Operator

Operative Grade Class I to Special Class

Mr W E Antony Fernando, Field Assistant
Mr A S M Premalal, Field Assistant
Mr M Murugaiya, Field Assistant
Mr W M K Kingsly Herath, Field Assistant
Mr A Jayathilaka, Field Assistant

Drivers Grade Class I to Special Class

Mr T M Ariyadasa, Driver
Mr H M Tikiri Banda, Driver

Minor Grade Class I to Special Class

Mr M M Padmasena, Lab/Field Attendant
Mr H Bandula Perera, Lab/Field Attendant
Mr J K C W N Perera, Office Attendant
Mr W A L Raj Fernando, Office Attendant
Mr M A Vahid, Pollination Labourer
Mr M A Sugathadasa, Pollination Labourer
Mr I M Thilakaratne, Electrician
Mr H M Thilakaratne, Mechanic Helper
Mr K T J W N Perera, Office Labourer
Ms T M Ghanawathie, Garden Labourer

Technical Grade Class II to Class I

Mr A H Norman, Technical Assistant
Mr R Marasinghe, Technical Assistant
Ms R M S Rathnayake, Draughtsman
Mr Newton Gamage, Field Officer

Clerical & Allied Grade Class II to Class I

Ms W J M D M A Fernando, Internal Audit/Typist
Mr I H Nelson, Record Keeper
Ms I N Jayawardane, Clerk/Typist

Operative Grade Class II to Class I

Mr W B Protus Fernando, Field Assistant
Mr D W J Jayakody, Electrician

Minor Grade Class II to Class I

Mr G D Benjamin, Cattle Keeper
Mr M A Percy Rohitha Fernando, Lorry Cleaner

7. Transfers

Mr A N Ekneligoda (Superintendent) from Maduro Oya Seed Garden to Minneriya Farm on 22 January.

Mr G Vithanage (Superintendent) from Ratmalagara Estate to Maduro Oya Seed Garden on 22 January.

Mr L J C Perera (Superintendent) from Makandura Seed Garden to Ratmalagara Estate on 22 January.

Mr H M Thilakasiri (Watcher) from Ratmalagara Estate to Bandirippuwa Estate on 22 January.

Mr W M U Ratnayake (Supervisor) from Ratmalagara Estate to Ambakella Seed Garden on 22 January.

Mr D L J Neththasingha (Field Officer) from to Ambakella Seed Garden to Makandura Seed Garden on 22 January.

Mr K Parisadan (Driver) from to Bandirippuwa Estate to Head Office on 10 February.

Mr I A N Hemasiri (Lab/Field Assistant) from to Ratmalagara Estate to Makandura Seed Garden to 12 February.

Mr E M Gunaratne Banda (Lab/Field Assistant) from Ratmalagara Estate to Bandirippuwa Estate on 20 February.

Mr R Marasinghe (Technical Assistant) from Agronomy Division to Ratmalagara Estate on 20 February.

Mr H M Kirihamy (Driver) from to Pothukulam Research Station to Ambakella Seed Garden on 25 February.

Mr M Sisira Fernando (Supervisor) from Ratmalagara Estate to Bandirippuwa Estate on 15 July.

Mr M P W Fernando (Supervisor) from Bandirippuwa Estate to Ratmalagara Estate on 15 July.

Mr L K Nimalaratne (Tractor Driver) from Pothukulam Research Station to Maduru Oya Seed Garden on 15 July.

Mr E A Jayathilaka (Tractor Driver) from Ambakella Seed Garden to Pothukulam Research Station 01 October.

Mr S Marasingha (Pollination Labourer) from Ambakella Seed Garden to Pothukulam Research Station 04 November.

Mr W Sirisena (Lab/Field Attendant) from Makandura Seed Garden to Walpita Estate 26 November.

8. Overseas leave on no-pay

Mr A Jayatilaka, Lab & Field Assistant (Middle East)

9. Training and Visits

9.1 Training in Sri Lanka

Mr D T Mathes, Head,Biometry Division and Dr D N S Fernando, Agronomist, participated in a Workshop on Multivariate Analysis held at the Faculty of Agriculture, University of Peradeniya for 11 days from 04 May.

Dr L L W Somasiri, Soil Scientist participated in a short course on Remote Sensing for Agriculturists, held at the Postgraduate Institute of Agriculture, Peradeniya for 04 days from 23 November.

Ms D M D I Wijebandara, Technical Assistant of the Soils & Plant Nutrition Division continued her postgraduate training at the Postgraduate Institute of Agriculture, Peradeniya.

Ms H D Mangalika, Chief Clerk on 'Effective Supervision', 12 weeks from 18 July.

Mr D G Manamudali, Deputy Director (Adm. & Fin.), seminar on ETF benefits, on 11 July.

Mr P Premaratne Fernando, Supplies Officer, training course for the Diploma in Purchasing & Materials Management, for fifteen months from 25 July.

Mr W A D Fernando, Electrician, training course on Maintennace of Light Motor Vehicles, six days from 21 November.

Mr R P Somasiri, Mechanical Helper, training course on Maintennace of Light Motor Vehicles, six days from 21 November.

Mr T Gunadasa, Administrative Assistant, seminar on Law Relating to Termination of Employment on 26 November.

9.2 Overseas Training

Ms N H R M de Silva, Technical Assistant, participated in a two-month training course on Soil/Plant Analytical Techniques held in Philippines from 01 July.

Dr (Mrs) C Jayasekara, Head of the Plant Physiology Division undertook six months training course in Australia on Stable Carbon Isotope Discrimination, at the Australian National University from 15 March.

The following officers left the island on the dates indicated for postgraduate studies:

Ms M G F S Jayasundara, Assistant Soil Scientist left for postgraduate studies at the University of Western Australia on 07 February.

Mr K B Dasanayake, Assistant Agronomist left for postgraduate studies at the University of Aberdeen on 01 October.

Ms C S Ranasinghe, Assistant Plant Physiologist left for postgraduate studies at the University of Sussex on 01 October.

The following officers continued their postgraduate studies:

Ms L C P Fernando, Assistant Crop Protection Officer, at the University of Queensland, Australia.

Ms L K Periyapperuma, Assistant Botanist, at the Illinois State University, U.S.A.

Mr N A Tennakoon, Assistant Soil Scientist, at the University of Aberdeen, UK.

9.3 Overseas Visits

Dr R Mahindapala, Director, CRI participated in a TCDC - Bilateral Discussion Meeting held in Indonesia for seven days from 08 March.

Mr Naomal Dias, Chairman, CRB undertook a Consultancy in Coconut Cultivation for the Municipality of Abu Dhabi for two weeks from 15 April.

Mr K S Jayasekara, Officer-in-Charge, Soils & Plant Nutrition Division, undertook a Consultancy in Coconut Cultivation for the Municipality of Abu Dhabi for two weeks from 15 April.

Dr K R R A Peries, Head, Genetics & Plant Breeding Division, participated in a meeting on Coconut Database (Germplasm), held in France for 10 days from 18 May.

Mr M J C Perera, Head, Library Services attended the Second Project Steering Committee Meeting of the APCC/IDRC in Vietnam from 23 - 25 June.

Dr M de S Liyanage, Head, Agronomy Division participated in a meeting on the Use of Isotopes in the Management of Nitrogen Fixing Trees held in Austria for seven days from 16 August.

Dr (Mrs) C Jayasekara, Head, Plant Physiology Division participated in the IX International Congress on Photosynthesis, held in Nagoya, Japan from 30 September to 02 October.

Dr R Mahindapala, Director, CRI participated in the International Conference on Commission IV of the International Society for Soil Science, held in Bangladesh for four days from 28 November.

Mr D T Mathes, Head, Biometry Division participated in the International Biometrics Conference, held in New Zealand, for eight days from 29 November.

Dr R Mahindapala, Director, CRI participated in the Steering Committee Meeting of the Coconut Genetic Resources Network, held in Singapore for four days from 13 December.

10. Participation of CRI Staff in other Statutory Bodies, Committees etc.

Dr R Mahindapala

Member, Board of Governors, National Institute of Plantation Management.
Member, Board of Management, Postgraduate Institute of Agriculture, University of Peradeniya.
Member, Board of Directors, Sri Lanka Cashew Corporation
Member, Standing Committee on Agriculture and Animal Husbandry, National Resources, Energy and Science Authority of Sri Lanka.
Member, Editorial Committee, Natural Resources, Energy and Science Authority of Sri Lanka.

Member, Standing Committee on Research and Projects, Sri Lanka Council for Agricultural Research Policy
Member, Standing Committee for Co-ordinating Postgraduate Studies in Natural Sciences, University Grants Commission
Joint Secretary, Institute of Biology (up to October)

Dr P A C R Perera

Member, Sri Lanka Pesticides Formulary Committee
Joint Secretary, Institute of Biology (up to October)
Visiting Lecturer in Forest Entomology, University of Sri Jayewardenepura.

Mr K S Jayasekera

Member, Fertilizer Coordinating Committee of the National Fertilizer Secretariat.
Member, Fertilizer Advisory Committee

Mr T S G Peiris

Member, Committee of the Section B (Agriculture & Forestry) of the Sri Lanka Association for the Advancement of Science.
Visiting Lecturer in Statistics, University of Colombo
External Examiner in Biometry and Crop Experimentation, University of Eastern.

11. Academic and Professional Achievements

Dr W M U Fernando, Assistant Plant Breeder was awarded Ph D by the University of Birmingham, UK.

Mr P A Henry Nimal, Assistant Information Officer was awarded M Sc in Agricultural Extension by the University of Reading, UK.

Mrs C N K Rajapaksa, Assistant Crop Protection Officer was awarded M S in Entomology by the Texas A & M University, USA.

Mr L P Vidhana Arachchi, Assistant Soil Scientist was awarded M Sc by the Universiti Sains Malaysia.

STAFF PUBLICATIONS AND COMMUNICATIONS AT SCIENTIFIC MEETINGS

(CRI authors are shown in bold type)

Theses

Fernando, W M U (1992) A Biometrical and Population Genetic Study of *Lolium perenne*. (Ph D, University of Birmingham, UK).

Henry Nimal, P A (1992) Development of an Effective Agricultural Information System as a Strategy for the Improvement of the Coconut Sector in Sri Lanka. (M Sc, University of Reading, UK).

Rajapaksa, C N K (1992) Comparative Evaluation of Juvenoids for the Control of Cat Fleas, *Ctenocephalides felis* (Siphonaptera: Pulicidae) in Top Soil. (M Sc, University of Texas A & M, USA).

Vidhana Arachchi, L P (1992) The Effects of Palm oil Sludge on Soil Properties and Growth of the Oil Palm Seedlings, *Elaeis guineensis*. (M Sc, University Sains Malaysia, Malaysis).

Others

Abeygunawardena, P and **Fernando, M T N** (1992). Non-market components in coconut-based farming systems in Sri Lanka - An economic evaluation. *Paper presented at the 2nd Asian Farming Systems Symposium*; Colombo, 2-5 November.

Abeygunawardena, P and **Fernando, M T N** (1992). Economics of soil moisture conservation in coconut lands using coconut husk and coir dust. *Paper presented at the 48th annual sessions of the Sri Lanka Association for the Advancement of Science;* Colombo, 7-10 December.

Dias, M N, C J Asher and D G Edwards (1991) Effects of water stress on growth and panicle development of grain sorghum. *Tropical Agricultural Research*, 3; 254-265.

Dias, M N, C J Asher and D G Edwards (1991) Effects of nitrogen stress on panicle structure of sorghum cv. Texas 610 SR. *Tropical Agricultural Research*, 3; 329-338

Gunatilake, H A J and **Liyanage, M de S** (1992) Current status and future needs in weed research in coconut, Sri Lanka. *Journal of the Weed Science Society of Sri Lanka*, 1; 20-29

Jayasekara, C (1990) Some notes on the coconut root system. *Coconut Bulletin*, 7, (No 1/2); 19-21

Jayasekara, C (1992) Effect of N,K, and Cl on drought tolerant characters of different varieties of coconut. *Final Report of the CIDA Grant No. 87/27;* Natural Resources, Energy and Science Authority of Sri Lanka.

Jayasekara, C and **Mathes D T** (1992) A method to determine the leaf area of a frond and the whole canopy of an adult coconut palm. *Indian Coconut Journal*, 22; 3

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