COCONUT RESEARCH BOARD

COCONUT RESEARCH INSTITUTE OF SRI LANKA

REPORT FOR 1995

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COCONUT RESEARCH BOARD

REPORT OF THE

COCONUT RESEARCH INSTITUTE

FOR 1995

Editors

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

C Jayasekera, Ph D (Qld)

Printed at the Coconut Research Institute,Lunuwila. Sri Lanka

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N A Tennakoon, B Sc Agric;
M Phil (Kelaniya);
Ph D (Aberdeen); M I Biol
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M Sc (Malaysia); M I Biol

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A Jayathilaka

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T W Fernando (L I Chem C)

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R A L C Fernando

Lab & Field Assistant

H P Ashoka Kumara

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Clerk/Typist

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W A L R Fernando
Mrs W S R Fernando
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Mrs K P S Jayathilake
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N M H Wijewardena

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R M Dayaratne

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D W J Jayakody

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R Vithanage

Mason

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M Somasiri

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G D Gunasekera

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A A K Amarasinghe

Building Caretaker

K D T K Liyanage

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Assistant Manager (Farms)

A Thavaratnarajah
K P de Silva

Field Assistant

D E V R Wijetunga

Technical Assistant (E)

D M Pathirage

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W P R R Fernando

Senior Clerk

K P W Perera

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M A Sunil Fernando
W W A P R Fernando

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W L B Silva

Senior Clerk/Typist

H H J E Appuhamy

Ratmalagara Estate

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M R L A Perera

Field Officer

W M U Ratnayake

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S Alahakoon
T M Keerthiratne

Senior Estates Clerk

R P Victor

Isolated Seed Garden

Superintendent

S M Wijeratne Banda

Field Officer

D L J Nettasinghe

Clerk/Typist

J A R Reginold

Supervisor

M P W Fernando

Lab & Field Assistant

U V M Fernando

Pothukulama Research Station

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Clerk/Typist

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Newton Gamage

Makandura Estate

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P D Benat Silvan

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A Sugathadasa

Maduruoya Seed Garden

Superindentent

R B Attanayake

Supervisors

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M G D Placidus

Lab & Field Assistant

I A N Hemasiri

AGRICULTURAL RESEARCH PROJECT

Project Coordinator

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

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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

M de S Liyanage, Ph D

1. GENERAL

The year 1995 registered a total annual production of 2755 million nuts, indicating a marginal increase of 5 percent over the previous year.

The three seed gardens managed by the Coconut Research Institute (CRI) continued to make steady progress and supplied 1.45 million seednuts during the year, which represented a 40 percent increase over the previous year. On account of the well distributed rainfall in 1994, improved tall x tall (CRIC 60) plantation at the Isolated Seed Garden, Ambakelle registered 1.31 million seednuts, which was the highest figure recorded during the past decade.

The Project on Land Suitability Mapping for coconut supported by the Cess Fund made good progress and the soil survey of coconut growing areas in the South and South Western parts of the country was completed during the year. Following the identification of a 'mini' coconut triangle joining Matara, Middeniya and Tangalle, with a high coconut production potential, the CRB decided to establish a new research station in the South, and undertake Research and Development (R & D) activities to improve the coconut sector in the entire Province, which has been a long felt need.

A five-year research programme (1995 - 1999) was commenced from the beginning of this year, which included thirty two applied, twenty six basic/strategic research thrusts, seventy five new and fifty five ongoing experiments. The main thrust areas have been identified on the basis of the needs and circumstances of the coconut growers. The new Research Committee appointed by the Coconut Research Board (CRB) met twice during the year, to study the new research proposals. In the current research programme, priority has been given to fine tuning of the research recommendations made in the previous programme and implement projects that will deal with generation of cost effective technologies and increase productivity and income from coconut and coconut based farming systems.

The Council for Agricultural Research Policy (CARP) with the assistance of the GTZ agricultural management project in collaboration with the CRI held three separate one-day workshops for research managers, policy makers, coconut producers, industrialists and marketing executives, aimed at identifying problems and constraints related to the coconut sector and to suggest remedial measures to overcome such situations. The relevant findings are now being considered in formulating research and extension strategies.

The absence of a well planned programme of coconut processing research has been a major impediment to the further development of the coconut industry. The CRB has therefore decided to reactivate processing research and development activities at the CRI, in collaboration with other relevant national research institutes and universities.

At present cashew research in the country is at a low ebb as the Cashew Corporation is reported to be short of resources for research. As CRI has well developed research facilities and manpower and is in close proximity to a main cashew growing area, the prospect of CRI undertaking cashew research is being considered by the Ministry of Public Administration, Home Affairs, Plantation Industries and Parliamentary Affairs.

The current recommendations emanating from the past research and the progress of on-going programme of the Agronomy Division and Soils and Plant Nutrition Division were reviewed separately by a panel of external reviewers, to assess the strengths and weaknesses of on-going research and earlier findings and identify new areas needing attention.

During the year, several in-house research seminars were held on coconut breeding, fertilizer use, organic manuring and Leaf Scorch Decline of coconut palm.

The Agricultural Research Project (ARP) funded by the World Bank continued to provide assistance to the Institute for the development of manpower and infrastructural facilities for research. The CARP awarded three contract research grants to support projects on coconut breeding, coconut based farming systems and soil microbiology.

The Information Services Division was renamed as Extension Services Division following a decision of the CRB to give greater emphasis to technology transfer and provide other advisory support services to the medium and large estate owners.

The CRB appointed an Editorial Board to 'COCOS', the scientific journal of the CRI, for the purpose of raising the quality of publications and give more recognition to the journal.

Another new development that took place during the year was the decision of the CRB to re-establish a toddy tapping training scheme after a lapse of more than two decades, following a survey conducted by the Institute to study the present status and constraints of the toddy tapping industry.

The gradual decline of existing coconut plantation has caused much concern

amongst a larger section of people in the country had raised doubts about the sustainability and economic viability of the coconut industry. However, preliminary survey conducted by the Institute on this crucial issue of land fragmentation revealed that the annual loss of productive coconut lands in the coconut triangle is in the range of 800 - 1000 ha, at present. The resulting loss in fragmentation can easily be mitigated by increasing productivity of the lands with better management.

The CRB continued to provide technical assistance and advisory services to the estate sector particularly with regard to differential fertilizer recommendations (DFR) and control of coconut pests and diseases. In addition, a new extension service referred to as Persuasive Extension Programme (PEP) was launched during the year, to provide a more regular and persuasive extension effort aimed at motivating coconut land owners, in particular absentee landlords, to increase productivity of their land through the application of CRI technology. It will also assist the CRI scientists to study deficiencies of the technology generated,if any, and assess the magnitude of the accruing economic benefits. These services have enabled the Institute to maintain regular and closer interaction with the coconut farming community.

The CRI estates were maintained in good order, by adhering to scientific cultivation practices, and recorded an overall increase of 27 percent in nut production over the previous year.

In recognition of the completion of 35 years continuous service by some employees, an award ceremony was held during the year, for which the Hon. Minister of Public Administration, Home Affairs and Plantation Industries and Parliamentary Affairs was invited as the Chief Guest. The Hon. Minister also participated in a meeting at which the Heads of Research Divisions presented their research programmes and main research findings in the recent past.

2. COCONUT RESEARCH BOARD

During the year, the Board functioned under the Chairmanship of Dr. U P de S Waidyanatha and held nine meetings.

Of these, eight meetings were held in the Board Room of the Coconut Research Institute, Lunuwila and one meeting at the Isolated Seed Garden, Ambakelle.

The membership of the Board and attendance at meetings (number of meetings held) were as follows.

Dr U P de S Waidyanatha (Chairman) (9/9)

Dr Sisil Bandara Senarathna	(8/9)
Mr P S Karunasena	(6/9)
Ms K M D L Jayathilaka	(7/9)
Ms G D S C Sudasinghe	(8/9)
Mrs W T Y S Fernando	(9/9)
Mr M S M Naseem	(7/7)
Mrs P S Ratnayake *(Treasury Representative)	(8/8)
Dr M de S Liyanage (Director/CRI)	(9/9)
Mr D G Manamudali (Secretary)	(6/9)
Mr H S Herath (Secretary) (from 273 Meeting)	(2/9)

* Ex - Officio Member

Mr D G Manamudali, Deputy Director (Adm & Fin) continued to function as Secretary to the Board until the 271 Meeting of the Board after which he resigned from the Institute. Dr M de S Liyanage (Director/CRI) functioned as Secretary to the Board at its 272 Meeting and thereafter Mr H S Herath, Deputy Director (Adm & Fin) took over the function of Secretary to the Board. Dr K S Jayasekera was appointed as observer member of the Board, with effect from 20 November, 1995.

3. COMMITTEES OF THE COCONUT RESEARCH INSTITUTE

3.1 Research Committee

The Research committee held two meetings (41st & 42nd) to review the progress of implementation of the on-going research programmes and to finalise the new research programme for the period 1995 - 1999.

The membership of the Research Committee and attendance at meetings (number of meetings held) were as follows:

Dr U P de S Waidyanatha (Chairman)	(2/2)
Dr M de S Liyanage	(2/2)
Vidya Jyothi Dr C R Panabokke	(2/2)
Vidya Jyothi Dr P R Wijerardena	(2/2)
Dr S N de S Seneviratne	(1/2)
Prof S Vidanapathirana	(1/2)
Prof U Samarajeewa	(2/2)
Dr M N M Ibrahim	(2/2)
Dr A L T Perera	(2/2)
Dr D A Nethsinghe	(0/2)
Dr S Jayasekera	(2/2)
Dr H B Kotagama	(1/2)

Mr H Abeysekera	(1/2)
Dr (Mrs) C Jayasekera (Convenor)	(2/2)

3.2 Administrative Committee

Only one meeting of the Administrative Committee was held during the year. The membership of the Administrative Committee was as follows.

Dr U P de S Waidyanatha (Chairman)
Mr Gamini Bambaradeniya
Mr Jayantha Jayaratne
Mrs I Sugathadasa, (Ministry Representative)
Dr M de S Liyanage, (Director/CRI)
Mr D G Manamudali, Deputy Director (Adm. & Fin.) Convenor
Mrs W T Y S Fernando
Mr D B J Ranatunga

3.3 Estates Committee

The Estates Committee held five meetings during their field visits to CRB properties and comprehensive reports for further development of the estates and seed gardens were submitted. The composition of the committee was changed to promote active participation of CRI scientists and monitor the progress of field work programme.

The membership of the committee and attendance of meetings (number of meetings held) were as follows.

Dr (Mrs) C Jayasekera (Chairperson)	(4/5)
Dr D N S Fernando	(5/5)
Dr (Mrs) W M U Fernando	(3/5)
Mrs C N K Rajapakse	(5/5)
Mr A Kurukulasooriya (Convenor)	(5/5)

3.4 Other Statutory Committee

3.4.1 Provident Fund Committee

The Provident Fund Committee held seven meetings during the year, to attend to matters relating to the administration of Staff Provident Fund and approval of loans. Mr D T Mathes and Mrs Anoma de Alwis were elected as member representatives to the committee, while Mr R C M Handalage functioned as the Board's nominee.

The membership of the committee and attendance at meetings were as follows.

Dr U P de S Waidyanatha (Chairman)	(7/7)
Dr M de S Liyanage (Director)	(5/7)
Mr D T Mathes (Member)	(7/7)
Mrs Anoma de Alwis (member)	(5/7)
Mr D R C M Handalage (member)	(3/7)
Mr D G Manamudali [(Secretary - PF up to August, 95)]	(5/5)
Mr H S Herath [(Secretary -PF from November 1995)]	(1/1)

An interest rate of 16.5% against the PF savings was declared for members for the year 1994.

3.4.2 Board of Trustees - Medical Aid Scheme

The Board of Trustees held twelve meetings during the year to attend to matters relating to the administration of the Medical Aid Scheme which continued to provide health care to the members. The rules and regulations of the Medical Aid Scheme were amended to provide better health facilities to the members.

Dr (Mrs) W M U Fernando and Mr A S Nanayakkara were elected as member nominees to the Board of Trustees. The Board's contribution to the scheme was Rs. 1,271,201.42.

The membership of the committee and attendance at meetings were as follows.

Dr M de S Liyanage (Chairman)	(10/12)
Mr D G Manamudali	(06/08)
Mr H S Herath (from 01 November, 1995)	(02/02)
Dr (Mrs) W M U Fernando	(09/12)
Mr A S Nanayakkara	(09/12)
Mr P Daluwatta (Secretary)	(12/12)

Seventy five percent of the interest on the investment of medical aid fund was disbursed among 345 members and each received Rs. 688/-.

4. THE COCONUT RESEARCH INSTITUTE

A brief account of research and development (R & D) activities of the Coconut Research Institute is given below:

4.1 Agronomy Division

The research programme of the Division for the past 20 years was evaluated by a panel of external reviewers, to appraise the current recommendations and to identify new areas needing attention. In the current research programme, much emphasis was given to fine tuning of existing recommendations on soil moisture conservation practices, management of pasture, cattle and small ruminants under coconut and, further studies on the management of nitrogen fixing trees (NFT) for biomass production.

Some of the experiments initiated in the previous research programme (1990-1993) were continued. Among NFTs, *Gliricidia* followed by *Calliandra* showed the highest potential for biomass production under coconut, and tree management had a significant effect on enhancing biomass production and BNF. Investigations are underway to study the effect of *Gliricidia* and *Acacia* on coconut yield when planted at a higher density (24 trees/coconut square, under different agro-ecological and soil conditions.

Cashew has shown to be a promising intercrop under coconut in the Dry and Dry Intermediate Zones. In view of the large canopy size of existing local varieties, experiments have been initiated to study the performance of small canopied, vegetatively propagated cashew under coconut. Several medicinal plant species such as *Piper longum* (Tippilli), *Kaemferia galanga* (Ratnitol), and *Adathode vascia* (Adathoda) performed well under coconut and their yield and medicinal properties were comparable to those planted in the open area.

In on-farm trials, intercropping with cash crops such as ginger, banana, pineapple and cassava had no adverse effects on coconut in the Wet and Intermediate Zones. Further, Colocasia was found to be a promising intercrop in young coconut plantations in the wet zone transmitting 40 percent light.

In animal integration models, upgrading of local breed of cattle in the Wet Zone enabled to raise the milk production from 2 to 4 litres day^{-1}. It has been observed that 15 goats ha^{-1} could be the optimum stocking rate for coconut lands.

During the year the Division conducted seventeen experiments, which included studies on competitive effect of adult coconut palm in underplantations, localised application of inorganic fertilizer for coconut, application of different organic material on leaf scorch decline (LSD) palms and low yielding palms. The Division also maintained twenty six (26) crop/farm models.

4.2 Genetics and Plant Breeding Division

Progenies derived by crossing putative drought tolerant germplasm accessions with elite tall palms from Ambakelle were planted in selected agro-ecologies within the coconut triangle. These introgressed material were expected to inherit desirable characters from both populations, thus providing a new base population for future breeding programmes, with a broader genetic base.

The coconut cultivars in the progeny evaluation trial at the Isolated Seed Garden (ISG), Ambakelle performed well achieving 90% flowering after seven years from planting. This trial provided valuable information of the parent palm stand in field No. 1 and 2 at the ISG as a source of mother palms for future breeding work. The progeny evaluation trials at Bandirippuwa and Ratmalagara Estates revealed that there was no significant difference in the yield of three cultivars (T x T, T x DG and T x SR), despite the differential fertilizer levels of half one and one and a half times the recommended dosage, even after two years.

The superiority of hybrids in terms of yield potential was further expressed in the progeny trails at Bandirippuwa and Ratmalagara, compared to Tall cultivars. Of the tall cultivars T x SR performed better than T x T in early vegetative growth and flowering at six sites. Steps have been taken for mass production of T x SR progeny.

The results of cultivar evaluation trails located at Thammenna and Bandirippuwa revealed that DG x T was better than DY x T in nut yield and total copra production producing about 4 kg of copra/palm/year in excess of DY x T under sub-optimal conditions. The data indicated that DG is a better female parent than DY for producing D x T hybrids.

The favourable rainfall distribution in 1994, led to a remarkable yield improvement of palms at the Isolated Seed Garden, Ambakelle recording a total production of 1.3 million T x T seednuts with an average of 98 nuts/palm/year.

Emphasis was given to the collection of coconut germplasm from non-traditional areas, with the objective of extending coconut cultivation outside the main growing Districts of the island under the above programme.

Characterization and identification of suitable coconut germplasm for breeding purposes, using biochemical markers (isozyme) was facilitated by the standardization of protocols for enzyme extraction and identification of enzyme systems showing variation among individuals. Results indicated that differentiation is possible between improved cultivars *Tall x Tall* and Moorock tall and, the ordinary tall variety.

4.3 Soils and Plant Nutrition Division

The Division conducted seventeen field experiments on coconut nutrition and field management, three experiments on characterization of coconut soils and five laboratory and glasshouse experiments.

Studies on coconut nutrition revealed that nitrogen and potassium deficiency in palm were most predominant (75-90%) followed by magnesium (50%) even on most productive soils such as the Madampe series. These nutritional deficiencies are believed to have resulted from inappropriate manuring practices. Regular monitoring of leaf nutrient status of well managed estates belonging to the CRI suggest that the correct balance of potassium and magnesium could be maintained only by application of Mg fertilizer at least three months after manuring with NPK fertilizer.

Experiments on the comparison of different phosphate fertilizer sources indicated that there was no appreciable difference in the growth of young palms and leaf phosphate levels of adult palms due to the application of either Eppawala Rock Phosphate (ERP) or Saphos phosphate (SP). Furthermore, phosphate level of adult palms grown on different soil and climatic conditions remained unaltered after continuous application of ERP for two years, suggesting that ERP could be recommended as a phosphate source for adult coconut. A preliminary study of the micronutrient status of coconut soils indicated that certain soils are deficient in Copper and Zinc.

The accumulation of ammonical and nitrate nitrogen in ground water was detected in close proximity to those estates, regularly fertilized with fast releasing nitrogen fertilizers. The nitrate concentration in certain areas even exceeded the safety limit of 10 ppm which has caused pollution of ground water.

During the year, a detailed soil survey was completed in the Southern Province and coconut growing areas in the South Western Province. Preparation of land suitability and soil maps is in progress.

On the basis of characterization of soil physical properties, coconut growing soils in the coconut triangle were classified broadly into superior, good and poor classes. Further, it has been shown that B horizon in the soil profile is more important than A and AB for root growth and hence management practices have to be directed toward improving and maintaining B horizon of the soil profile.

Studies on the efficiency of two fertiliser application techniques suggested that broadcasting facilitates the retention of significantly high amounts of Ammonium nitrogen and potassium while localised application led to the retention of high magnesium and phosphate in the soil.

Long term effect on the use of organic manure on coconut in lateritic soil indicated that application of 18 kg goat manure and inorganic fertilizer supplementation enhanced soil microbial activity.

Several NFT species such as *Gliricidia, Calliandra* and *Acacia* when cultivated along with coconut were capable of improving the physical properties of Andigama Soil Series. Also, the microbial activity and nitrogen mineralisation rates were found to be higher in the tree integrated system.

4.4 Crop Protection Division

The control of major pests of coconut through an integrated approach continued to receive high priority in the research programme.

Surveillance and monitoring programmes to forecast coconut caterpillar resurgence were continued. Severe outbreaks of coconut caterpillar were reported in the Southern and North Western Province which were brought under control mainly by augmentative release of parasitoid insects, thus reducing the insecticide usage as much as 80%.

During the year, more than 100 pest incidences were reported and appropriate control measures were recommended. The Division continued to assist coconut growers in the management and control of coconut pests. Approximately 2,000,000 parasitoid insects were released to coconut caterpillar infested ares in the North Western, Southern and Eastern Provinces, to bring the pest population under control.

Studies on upgrading the current bio-control programme for coconut caterpillar are in progress. Ovipositional activity of *Goniozus nephantidis* was determined. Studies on field release of *G. nephantidis* indicated that in severe outbreaks, release of 3 - 4 day old females (gravid) at many sites within the infested area is more effective than releasing newly emerged females (with immature ovaries).

New and inexpensive pheromone baited trap (open bucket type with hood) developed by the CRI was found to be effective for red weevil control.

Insecticide screening tests led to the recommendation of new and safe alternative insecticides to control few other injurious insects of coconut. In one study Carbosulfan 5G, a slow release granular insecticide at the rate of 5 - 15 kg/palm was recommended to prevent and control black beetle damage in coconut. Imidacloprid (Admire SL 200), a low toxic and environment friendly insecticide with long residual effect as against (the currently researched) Chlorphyrifox was

recommended to control termites in coconut nurseries and mature palms.

Establishment of honey bee colonies in the wet zone led to a 4% increase in button nut setting in palms when associated with mixed cropping over those in monoculture plantations.

Repeated application of Tridemorph (Calixin), a systemic fungicide at 4 monthly intervals through root feeding at the rate of 15 ml/palm was found to be effective against further spread of Ganoderma disease in coconut palms: this disease has been identified as a fatal disease gradually spreading in the Southern Province.

Spodoptera litura fabricus was identified and recorded as a minor pest of coconut (variety San Ramon), where larvae attack the base of seedlings, eventually causing death.

Several consignments of *Pareuchaetes pseudoinsulata* and *Baculovirus oryctes* were released to coconut plantations for control of the weed '*Chromolaena odorata*' and coconut black beetle, respectively.

4.5 Plant Physiology Division

Two long term experiments, namely field performance of embryo cultured seedlings and vegetative growth performance of Tall x Tall and Ambakelle Special seedlings were terminated during the year. These studies revealed that there were no appreciable differences in vegetative growth and flower initiation of embryo cultured and amputated seedlings compared with ordinary bare rooted seedlings.

The Division placed much emphasis on the evaluation of physiological and biochemical characters of locally available varieties and cultivars of coconut. In a study with thirteen cultivars, differences in the rate of photosynthesis were observed among them with San Ramon showing the least fluctuation throughout the year.

A study on the effect of canopy and root pruning on button nut setting and nut development was continued with some modifications to canopy pruning treatments, in order to determine the critical level of pruning on the yield.

Carbon isotope discrimination studies were extended to determine the heritability of drought tolerant and high yielding characters of "Ambakelle Special" palms in comparison to their controlled pollinated F_2 progeny.

Two new experiments were started to determine (a) the effect of toddy tapping and concomitant nut production on total sap and (b) the quality and quantity of sap produced from cultivars such as *Bodiri, Navasi* and *San Ramon*, with a view

to identify and recommend suitable cultivars for toddy tapping.

In another experiment, development of suitable storage techniques to improve shelf-life of young king coconuts was started. Preliminary results indicated that among treatments, waxing the whole nut and cold storage at 16° C was effective in improving the shelf life of young king coconuts up to two weeks after harvesting.

4.6 Tissue Culture Division

The Division continued its research programme, giving much emphasis on the development of an efficient protocol for clonal propagation of coconut. The research progress was interrupted due to problems encountered in immature embryo, leaf and root culture experiments. Formation of calli from immature embryo explants and direct somatic embryogenesis from leaf and root explants was inhibited due to a change in the composition of culture medium caused by the particular brand of activated charcoal used in the medium, suggesting that activated charcoal plays a significant role in maintaining the concentration of plant growth hormones and growth factors in the culture medium. These investigations also led to the identification of a batch of charcoal suitable for induction of calli from immature embryo explants.

In spite of the problems encountered, 5 clonal plantlets were produced as a result of successful germination of somatic embryos (obtained from previously subcultured embryogenic calli) derived from immature embryo explants. Two of these plantlets are ready for transplanting in the soil.

The propagation of '*dikiri pol*', using embryo culture technique was continued and the number of '*dikiri*' seedlings produced during this year was significantly higher than in the previous year.

The response of coconut cultivars to water deficit conditions was studied by the embryo culture technique using Polyethyleneglycol (PEG) to simulate water stress.

The possibility of using gamma radiation to induce mutations to zygotic embryos of coconut was investigated for the first time.

4.7 Biometry Division

The Division continued to assist the research staff in designing field experiments and statistical analyses and interpretation of results, use of computers, software packages and database management.

During the year, palms in the calibration trial at Walpita Estate recorded a marginal increase in total number of bunches as compared to 1994 but showed a 18% decrease in the number of nuts per palm as compared to the previous year.

The monthly harvesting continued to be promising as shown by an 16.6% increase in number of bunches and 22.6% increase in the number of nuts, as compared to two monthly harvesting of coconut.

The variation in yield between coconut picks within a year was found to be much greater than the yield between years mainly due to the changing weather and climatic factors.

The agri-meteorological studies at Bandirippuwa, Ratmalagara Estates and at the Isolated Seed Gardens were maintained. A new agri-meteorogical station was established at Maduruoya Seed Garden.

4.8 Extension Services Division

The Information Services Division was renamed as Extension Services Division following a decision of the CRB to give greater emphasis to technology transfer, particularly to the Estate Sector. An extension effort called the Persuasive Extension Programme (PEP) was launched during the year in order to promote the estate owners, particularly the absentee landlords, to adopt technologies generated by the CRI. Under this programme the economic potential of their land and the income that could be realised through the application of CRI technology are being emphasised. During the year, 58 farm development plans covering 1429 acres were completed under this programme. The implementation of the proposed farm development plans will be monitored by the staff.

A preliminary survey on toddy tapping was conducted to assess the present status and constraints of this age old industry. Another survey was undertaken on coconut land fragmentation to estimate the annual loss of prime coconut land in the coconut triangle.

The popular series of one-day training programme in coconut Estate Management was completed with a larger participation of coconut growers than in the previous year. Several attachment training programmes were arranged for trainees from the Coconut Cultivation Board, Universities, Agriculture Schools and National Apprenticeship Training Authority and other related institutions.

Several study tours were arranged for visitors from local and foreign institutions.

Two Research Extension Dialogues (RED) were held with the active participation of the research staff of the CRI and extension personnel of the CCB. The Division actively participated in the coconut trade exhibition 'COCOTRADE' held at the BMICH in Colombo to mark the "Coconut Week" announced by the Government.

4.9 Estates Management Division

The three seed gardens and four estates were under the management of the Division. Agricultural practices in all CRB properties were maintained in good order by following the CRI recommendations. Emphasis was made to carry out moisture conservation practices in all properties. Action was taken to extend the area under cover crops and nitrogen fixing trees in all estates.

Plantations in the seed gardens and estates received fertilizer according to the Differential Fertilizer Recommendation, based on foliar analysis. Few observation plots were established at Bandirippuwa Estate to demonstrate the effect of organic manuring on the yield and quality of coconut. Tapping of palms for sweet toddy and preparation of treacle was commenced at Bandirippuwa Estate.

Of the total extent of 572 ha, 40 percent (325 ha) were under immature coconut. In the developed estates (Bandirippuwa, Rathmalagara, Poththukulama, Walpita and Isolated Seed Garden) 42 percent of the area was under immature coconut. The estates recorded a 27 percent higher crop yield than in 1994, except at Bandirippuwa which showed a drop of 5% mainly due to uprooting of the senile palm population. The three seed gardens produced a total of 1.45 million coconut seednuts, indicating a 40 percent increase over 1994. In keeping with the policy, 95 percent of the total seednut production was given to the CCB. At Ratmalagara Estate, wild elephants inflicted heavy damage to coconut seedlings in the experimental area managed by the Soils and Plant Nutrition Division. A water distribution system and water tank with the capacity of 10 000 litres were installed at Makandura Seed Garden.

The average nut yield from CRI estates was around 9948 nuts/ha, which was an 8 percent increase over the previous year. The average cost of production (COP) and net sales average (NSA) was estimated at Rs. 2198 and Rs. 4108 per 1000 nuts, respectively.

4.10 Library

The library compiled with requests for information from both the CRI staff and outsiders. The staff of the institute was provided with services such as reference, lending, literature search, interlibrary loan and current awareness. The database on

coconut were increased considerably by adding a large number of references.

4.11 Administration Division

During the year, 10 Executive and 44 non-executive positions were filled.

At the end of 1995, there were 354 employees in the CRI permanent staff. Regular staff meetings were held to discuss the implementation of the work programme for the year 1995. Every attempt was made to maintain good employer-employee relationship, and as usual the Division continued to assist in all welfare activities.

Nineteen employees who completed 35 years of continuous service in the Institute received merit awards. The function was graced by the Hon. Minister of Public Administration, Home Affairs, Plantation Industries & Parliamentary Affairs, the Chairman and Members of the Coconut Research Board, the Director and staff of the Coconut Research Institute. The Hon. Minister and Ministry officials also visited the Research Divisions to familiarise with the work in progress.

The Budget expenses during the year was Rs. 84 million, made up of Rs. 64 million as Recurrent and Rs. 20 million as Capital Expenditure. The total revenue (excluding transport) for the year was Rs. 69 million which is a 30 percent increase over the previous year.

The Board's contribution to the Medical Aid Scheme was Rs. 1,271,501.42. A sum of Rs. 1,452,616.00 was paid as reimbursement on medical expenses. The total membership of the scheme was 389 during the year under review. The rules and regulations of the Medical Aid Scheme of the institute were revised.

The Board continued to extend financial assistance to the Co-operative Society, Recreation Club and Art Circle of the institute.

Maintenance work of building, electricity, vehicles and machinery was carried out by the Engineering Unit.

5. OUTSIDE FUNDED PROJECTS

5.1 Agricultural Research Project

The Agricultural Research Project (ARP) funded by the World Bank administered by the Ministry of Agriculture, Lands and Forestry continued to support development of infrastructural facilities at the Institute.

Construction of a field laboratory, office and chemical stores at the Isolated Seed Garden, Rajakadaluwa and a chemical/fertilizer store at Ratmalagara Estate were completed. Further, construction work at Maduruoya and Makandura Seed Garden are in progress.

The project continued to offer postgraduate training and short-term training to the staff and provided spares for scientific equipments, library books, office equipment and furniture.

5.2 Other Projects

The International Atomic Energy Agency (IAEA) extended financial support for a further period of one year, to study the effect of tree management on biological nitrogen fixation (BNF) of *Gliricidia* and *Leucaena* under the Contract Research Programme.

The Overseas Development Administration (ODA) in collaboration with the Natural Resources Institute (NRI) UK awarded a research grant to support the project entitled "Investigation of diseases of unknown etiology of coconut". Under this project, leaf scorch decline (LSD) palm will be studied, with much emphasis on mycoplasma like organisms (MLO) and viroids.

The International Board of Plant Genetic Resources (IBPGR) with assistance from the Asian Development Bank awarded a research grant to support the project entitled "Acceleration of collection and conservation of coconut biodiversity at risk and evaluating existing coconut population for physiological characterization".

The Sri Lanka Council of Agricultural Research Policy (CARP) with assistance from Agricultural Research Project awarded three research grants.

6. VISITORS

The important visitors to the Institute include the following:

Mr Herbert Wimalaratne, National Institute of Business Management, Colombo
Mr D S Toklentino, Philippines
Mr M Nakajima, Japan
Dr C A Ozair, Pakistan Agriculture Research Centre
Mr A B M L Ishal, Ministry of Agriculture, Bangladesh
Mr G H R Heydara, Ministry of Agriculture, Iran
Mr K Kiritani, Taiwan
Mr H A N Namki, South Korea

Mr J S Park, South Korea
Mr A H N Ha Jal, South Korea
Mr T B Surestha, Ministry of Agriculture, Nepal
Mr K Matsushita, Japan
Mr K B Saxena, India
Mr Willam T F Chiu, Taiwan
Dr M F Billett, University of Aberdeen, UK
Mr D Hope, University of Aberdeen, UK
Ms Ellen Dekens, Belgium
Dr Zahoor Ahmad, Pakistan Agriculture Research Centre
Mr M Afzal, Pakistan Agriculture Research Centre
Mr Nebuo Muroja, JICA, Pakistan Office
Mr S Watanabe, Kandy
Mr R Wickramanayake, Hon. Minister of Public Administration, Home Affairs, Plantation Industries and Parliamentary Affairs
Mr Sunil de Silva, Additional Secretary, Ministry of Public Administration, Home Affairs, Plantation Industries and Parliamentary Affairs
Mr L C Gooneratna, Lake House Plantations Ltd, Colombo
Mr R Hardler, International Potash Institute
Dr Athula Perera, University of Peradeniya, Peradeniya
Dr K P Premaratne, University of Peradeniya, Peradeniya
Dr Hulugalle, Australia
Dr S Eden Green, Natural Resources Institute, UK
Prof Edwin Metcalf, School of Chemical and Life Sciences, University of Greenwich, UK.

7. ACKNOWLEDGEMENTS

The co-operation given by the Deputy Director (Research), Deputy Director (Adm. & Fin.) and staff of the Coconut Research Institute in successful implementation of the programme of work is gratefully acknowledged.

The valuable contribution made by the Chairman and Members of the Board and those who served at various Committees are acknowledged with deep appreciation.

The continued support given by following organizations is also acknowledged:

* Ministry of Public Administration, Home Affairs, Plantation Industries and Parliamentary Affairs
* The Agricultural Research Project of the Ministry of Agricultural Lands and Forestry

* Coconut Development Authority
* Sri Lanka Council for Agricultural Research Policy
* GTZ/CARP Project
* International Atomic Energy Agency
* National Institute of Plantation Management
* Natural Resources, Energy and Science Authority of Sri Lanka
* The Coconut Genetic Resource Network (COGENT)/Asian Development Bank
* Coconut Cultivation Board
* Central Plantation Crop Research Institute
* Overseas Development Administration and Natural Resources Institute
* Australian Development Assistance Bureau
* Food and Agriculture Organisation
* Asian and Pacific Coconut Community

REPORT OF THE AGRONOMY DIVISION

Head - D N S Fernando, Ph D

1. GENERAL

Research activities and, on-farm trials with cropping/farming systems, management of nitrogen fixing trees for green manuring and soil moisture conservation practices were continued.

The International Atomic Energy Agency (IAEA) in Vienna continued to support Biological Nitrogen Fixation (BNF) programme on tree legumes. The Council for Agricultural Research Policy (CARP) continued financial assistance for the adaptive research trials. The Commonwealth Scientific and Industrial Research Organization (CSIRO) commenced support for a project on evaluation of cultivars of *Casuarina equisetifolia* (nitrogen fixing tree species) under coconut.

Dr. Anura Herath of the Department of Export Agriculture was appointed Consultant in Agricultural Economics to assist the farming system research programme and economic evaluation of recommendations made by the Coconut Research Institute.

The research activities of the Division during the last 20 years were evaluated by a panel of external reviewers.

2. RESEARCH PROJECTS

PROJECT 1: IMPROVEMENT OF ORGANIC MATTER STATUS AND WATER STORAGE CAPACITY OF SOIL

Experiment 1.10: Effect of three methods of 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

During the year, the growth of *Pueraria* was good and the green matter production of *Pueraria* was 60-70 kg per coconut square. Management treatments of *Pueraria* were repeated during the year. Nut and copra yields did not show any significant difference due to different management practices *of Pueraria* grown under coconut.

Coconut palms were fertilized with the DFR mixture during the year.

D N S Fernando & K C P Perera

Experiment 1.14: Effect of tree management on BNF in *Gliricidia* and *Leucaena* grown under coconut - 1992

All three species of tree legumes *Gliricidia, Leucaena*-Nitrogen fixing; and *Cassia siamea*-Non fixing) were managed by pruning at 4 and 6 monthly intervals, while the remaining trees were left unpruned throughout the year. As reported in the previous year, tree management had a positive effect on above-ground biomass production and biological nitrogen fixation in both NFT species. Trees pruned at 4 monthly intervals continued to produce the highest biomass and fixed more atmospheric nitrogen, irrespection of the species. Of the two NFT species, *Gliricidia* outperformed *Leucaena* in terms of biomass production and nitrogen fixation potential.

This experiment is in progress.

M de S Liyanage, H A Abeysoma & D N S Fernando

Experiment 1.15: Improvement of water storage capacity of soil - 1995

Despite the beneficial effects of husk pits and mulching on soil moisture conservation the majority of growers do not follow this practice due to various reasons. In certain areas it is believed that mulching could cause root mat formation around the palm. Further, present recommendations on moisture conservation practices have not considered soil type and agro-ecological condition of the site.

Therefore, objective of this study was to determine the effects of various recommended methods for moisture conservation on major soil types and agro-ecological conditions. The treatments were arranged in a randomized block design with four replicates.

T_1 - Control/bare soil, weeded.
T_2 - Mulch with 12 coconut fronds falling from the tree.
T_3 - T_1 + 1/3 circle trench and put back soil.
T_4 - T_1 + 1/3 circle trench filled with husk and soil. This will be repeated every three years on apposite side.
T_5 - Husk mulching the manure circle (2m) with two layers of husks.

T_6 - $T_4 + T_5$

T_7 - Jumbo pits (1.3 x 0.6 m trench along the coconut avenue at 2.0 m away from the coconut palms). The opposite side of the palm will be treated after 3 years.

T_8 - 2.5 x 1.3 x 0.6 m (8'x4'x2') husk pits between palms.

The experiment will be conducted in six locations representing different soil classes and agro-ecological zones.

During the year, the experiment was established in the following three locations.

Sudu series	-	Kajulanda Estate, Madampe(IL1)
Hettipola series	-	Kobeigane(IL3)
Shallow Boralu soil	-	Marapola, Veyangoda(WL3)

H A J Gunathilake, D N S Fernando & S D J N Subasinghe

PROJECT 2: REHABILITATION OF LOW - YIELDING PLANTATIONS

Experiment 2.2.3: Effect of cultural operations designed to induce root formation on rehabilitation of low yielding plantations, Rathmalagara Estate, Madampe - 1993

There was no significant improvement in growth and yield parameters of treated palms other than the visual improvement observed as in the previous year. Treatments were repeated to complete a full circle application of organic matter and top soil. Palms were fertilized with APM mixture.

D N S Fernando, K B Dassanayake & K C P Perera

Experiment 2.3.4: To study the effect of root pruning on palms showing drastic yield reduction due to heavy root mat formation - 1995

Farmers in Kalpitiya Peninsula (mainly in the coastal belt) have observed the formation of a thick mat of roots close to the soil surface which make other cultural practices difficult and this abnormal situation has led to shortening of the economic life span of coconut (30-35 years).

The objective of the experiment is to study the effects of root pruning and induce new root formation on palms showing drastic yield reduction and mat formation at an early age around 25-30 years, especially in the intercropped areas.

Treatments were laid in Randomized block design with four replicates.

T_1 - Control
T_2 - Root pruning once a year with recommended fertilizer
T_3 - Root pruning once a year without fertilizer
T_4 - Fertilizer application only

Two locations (Madurankuliya and Kalpitiya) were selected and treatments applied during the year.

H A J Gunathialake, D N S Fernando & I Dupathi

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

So far, there were no significant differences in growth parameters of coconut and cashew among the five different models. Of the total population, 30 percent of cashew trees started flowering and gave a mean yield of 780g of cashew nuts per tree.

H A J Gunathilake & S D J N Subasinghe

Experiment 4.2.3: On farm cropping models in the Wet and Intermediate Zone of coconut - 1987

Collection of agronomic and economic data from eleven existing models is being continued. The intensity of cash crops with a high market price (eg. vegetable, ginger, sweet potato, cassava, banana, pineapple) was increased as farmers preference. Nut yield records indicated that there was beneficial effect on coconut with high intensity cropping under moderate management level (Table 1).

Crop model at Daigala (WL3) has demonstrated that soil erosion could be reduced by achieving a good ground cover in coconut based cropping systems including nitrogen fixing trees(NFT's). Another crop model at Udulla (WL1) showed that colocasia could be cultivated even with 40 percent of light availability under young coconut palms (8 years old and 8.5 x 8.5 m spaced).

Farm models also produced encouraging results. Milk production was increased from 2.0 l/day to 4.5 l/day due to upgrading of the cattle breed from local to local X AMZ (Farm Model at Gaspe, WL1).

Farm model at Ratmalagara Estate, Madampe showed that 15 goats per coconut hectare could be managed successfully with a single row of Ipil-Ipil with

TABLE 1. *Effect of different intercrops on nut yield of coconut (Exp. 4.2.3)*

Site	Agro Ecological	Crops	Nut Yield (nuts/ha) Without Intercrops	With Intercrops	% difference
Udulla	WL_2	Coconut+Banana+ +Yam	5700	6000	+ 5.2
Gaspe	WL_3	Coconut+Pasture +*NFT's+Milk cattle	7950	11250	+41.5
Walpita-1	WL_3	Coconut+Pepper+ +Banana	-	12600	-
Walpita-2	WL_3	Coconut+Pineapple +Banana	-	14850	-
Kadane-gedara	WL_3	Coconut+Pineapple +Banana+Cashew	5850	9150	+56.4
Kahatawila	IL_1	Coconut+Pineapple +Ginger	5400	5850	+ 8.3
Rathmala-gara	IL_1	Coconut+Pasture +NFT's+Goats	11100	12300	+10.8
Deegalla	IL_1	Coconut+Cashew	5250	5400	+ 2.9

setaria grass. However, damage on NFT's by goats indicated that localized planting of NFT's(a separate block) is more adaptable than those of distributed planting(planting in the avenue of coconut).

H A J Gunathilake, M T N Fernando & S D J N Subasinghe

Experiment 4.2.6: Selection and evaluation of adopted, stable, high yielding and high quality cultivars of pasture grass species of *B. brizantha, P. maximum* and *P. puerperium* - 1991. (Inter - institutional Research Project)

Planting material of different pasture species (selected for better performance) raised in the nursery, was not sufficient to be transplanting in the field.

S G J N Senanayake, D N S Fernando & K C P Perera

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

At both locations, establishment of *Pueraria* cover was not satisfactory and as a result, plots were invaded by weeds. Especially at Rathmalagara Experiment, *Pueraria* showed signs of being completely wiped out. Gliricidia, at both locations produced sufficient green matter (to supply 35kg/palm), with 3 prunings per year. There was no significant difference in nut and copra production due to treatments.

D N S Fernando, M N Fernandopulle & K C P Perera

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

During the year *Gliricidia* was pruned three times and the green matter production was sufficient to provide 50 kg/palm. A significant difference in nut and copra production was not observed due to treatments.

D N S Fernando, M N Fernandopulle & R Marasinghe

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

The green matter production of *Gliricidia* was sufficient to provide 12 kg/palm after three years of planting. This may be due to the hard lateratic nature of the soil. Therefore the balance amount of green matter had to be supplied from outside. Palms were fertilized with APM mixture.

D N S Fernando, M N Fernandopulle, M Bastian & M A Wasanthimala

Experiment 7.12.3: **Substitution of inorganic nitrogen for coconut seedlings with two different sources of organic matter. Bandirippuwa Estate, Intermediate Dry Zone, Bandirippuwa - 1992**

The objective of the experiment was to study the possibility of substituting inorganic N fertilizer with *Gliricidia* and cowdung. The fertilizer treatments were arranged in a randomized block design with four replicates.

T1 - Control (no fertilizer for coconut)
T2 - YPM mixture
T3 - *Gliricidia* lopping equivalent to the nitrogen content in YPM mixture
T4 - Cowdung equivalent to the nitrogen content in YPM mixture.

During the year girth and number of fronds of seedlings were measured twice and there was no significant difference between treatments. However, seedlings treated with YPM have shown some improvement of girth (6%) and number of fronds (8%) over the control (no fertilizer).

D N S Fernando, M N Fernandopulle & K C P Perera

Experiment 7.12.4: **Study the effect of high density planted *Gliricidia* and *Acacia* under coconut for substitution of inorganic nitrogen of coconut palms on sandy loam soil in the Intermediate Dry Zone, Pothtukulama Estate - 1995**

Experiment 7.12.5: **Study the effect of high density planted *Gliricidia* and *Acacia* under coconut for substitution of inorganic nitrogen of coconut palms on clay loam soil in the Intermediate Wet Zone, Horombawa - 1995**

Application of 30-35 kg of *Gliricidia* green matter/palm/year provide the required nitrogen for each coconut palm. However in-situ planted tree species could create competitive effects on coconut in the long run, especially if soil moisture and nutrients become limiting. In addition to *Gliricidia*, there are other promising leguminous tree species (eg. *Acacia*) with desirable characters (eg. slow decaying and release of nitrogen when used as a mulching material) which could be grown in coconut plantations.

Therefore six experiments (four will be planted in the year 1996) were designed to represent major soil types under different agro-climatic conditions and *Gliricidia* and *Acacia* are planed under coconut. The treatments are arranged in a randomized block design with 3 replicates.

Treatments:

(1) Mulch with coconut fronds
(2) *Gliricidia* - density 1(16 trees/coconut square)
(3) *Gliricidia* - density 2(24 trees/coconut square)
(4) *Gliricidia* - density 2 lopping buried in 1/4 circle trenches.
(5) *Acacia* - density 1(16 trees/coconut square)
(6) *Acacia* - density 2(24 trees/coconut square)

D N S Fernando, A Samarajeewa, M Bastian & I Costa

PROJECT 17: PREMATURE DECLINE OF PALMS

Experiment 17.4: Studies on effect of root pruning and incorporation of organic manure on LSD palms, Walpita Research Station - 1989

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

A palm by palm survey was carried out to count scorched fronds and data have indicated that treatments have no effect on leaf scorch at initial stages (incipient and mild) but all treatments except the same soil have shown some indications on positive effects (statistically not significant) on LSD and % affected fronds have decreased.

Experiment is in progress.

D N S Fernando, N A D P Nainanayaka & M Bastian

PROJECT 20: INTERCROPPING

Experiment 20.8: Inter-cropping coconut with selected medicinal plants (A collaborative trial with CISIR)

Yields of *Piper longum, Kaemferia galanga* and *Adathoda vasica* under coconut performed almost similar to those cultivated in the open area (without coconut) (Table 2). However, *Hibiscus abelomoschus, Withania somnifera, Aloe vera* and *Solanum xanthocarpum* performed poorly under coconut.

H A J Gunathilake

Experiment 20.9: Performance of grafted cashew under coconut, Rathmalagara Estate, Madamape - 1995

Cashew has proven to be promising inter-crop in the Dry and Dry Intermediate zones. However the large canopy of mature trees and low productivity of cashew nuts of locally available varieties are limiting the wide spread use of cashew.

The objective of the experiment was to study the performance of vegetatively propagated cashew and seedlings of cashew under mature stand of coconut and their effect on yield of coconut. The treatments were arranged in a randomized block design with three replicates.

T_1 - Control (no cashew with coconut)
T_2 - Cashew seedlings
T_3 - Bud grafted cashew plants
T_4 - Air layered cashew plants

The above three types of cashew plants were established in October/November season, 1995.

H A J Gunathilake & A Samarajeewa

PROJECT 29: STUDIES ON FERTILIZER USE

Experiment 29.2 (b): Studies on the localized application of fertilizer in coconut on lateritic gravel soil. Rathmalagara Estate, Madampe - 1993

Localized application of APM fertilizer mixture for coconut palms was repeated during the year. Due to the decomposition, organic matter(cow dung and

TABLE 2. *Yields of medicinal crops under coconut (at the end of year 1 of establishment)*

Medicinal Crops	Medicinally used part	Total yield/year/coconut ha. (kg) Open area	Under Coconut
Piper longum	pods (dry)	184.8	299.9
Kaempferia galanga	rhyzome (dry)	1016.2	780.5
Plumbago indica	root (dry)	2849.0	1251.4
Aloe vera	leaves (wet)	59375.0	38266.3
Adathoda vasica	leaves (dry)	869.5	702.0
Cassia angustifolia		-	-
Hibiscus abelomoschus	seeds (dry)	583.2	73.4
Withania somnifera	root (dry)	594.0	102.7
Solanum xanthocarpum	total plant (dry)	1180.3	451.9

coir dust) contents in pits appeared to be reducing and were maintained up to the soil surface by adding the same materials. There were no differences in growth performance of palms due to the treatments.

Records on growth parameters were maintained during the year.

D N S Fernando, M N Fernandopulle & R Marasinghe

3. TRAINING AND EXTENSION ACTIVITIES

Drs. D N S Fernando, H A J Gunathilake, Mr. M T N Fernando and Mrs. S Samarajeewa delivered lecturers on Moisture conservation in coconut lands, Rehabilitation of low yielding coconut palms, Integration of animal husbandry in coconut Lands, Cropping systems to increase productivity of coconut lands to growers and officers from the Coconut Cultivation Board, Mid Country Perennial Crop Development Project and Plantation Companies etc. and also to visitors from overseas.

These officers also undertook several advisory visits to coconut estates and estates with intercropping and animal husbandry activities.

4. ACKNOWLEDGEMENTS

The assistance of the staff of the Agronomy Division in the implementation of research programme is gratefully acknowledged.

Thanks are due to the Head and the staff of the Soils and Plant Nutrition and Biometry Divisions for their assistance in chemical analysis of soil and plant samples, and collection and analysis of data respectively.

REPORT OF THE GENETICS AND PLANT BREEDING DIVISION

Acting Head - W M U Fernando, Ph D

1. GENERAL

Attempt to widen the genetic base of existing populations used in the breeding programme were made by planting progenies arising from putative drought tolerant germplasm accessions crossed with Ambakelle tall palms in several sites representing different agro-ecological zones. Introgression of characters, high yield of Ambakelle tall palms with drought tolerance of germplasm accessions would expected from the resulting progenies.

The favourable rainfall distribution in 1994 led to a remarkable yield improvement at the Isolated Seed Garden Ambakelle with a total production of 1.3 million Tall x Tall seednuts at an average of 98 nuts/palm/yr.

Emphasis was given for pre-prospection and collection of coconut germplasm from non-traditional areas and several collections were made during the year with the objective of extending cultivation into new areas. A field laboratory was constructed at the Isolated Seed Garden at Ambakelle for the purpose of large scale pollen processing for mass production of improved varieties.

2. RESEARCH PROJECTS

PROJECT 5: PRODUCTION OF IMPROVED COCONUT VARIETIES

Experiment 5.1.1: Evaluation of five improved cultivars

These trials were initiated in 1984 as part of a study to evaluate the performance of local coconut cultivars under different agro-ecological regions. The findings of the study would lead to site-specific recommendation for planting coconut cultivars.

Design: Randomized block with 4 replicates

Plot size: 20 palms/replicated plot
Treatments:

- V_1 Dwarf green x Tall (DG x T) (CRIC 65)
- V_2 Dwarf yellow x Tall (DY x T) (CRIC 65)
- V_3 Tall x Tall (TT) (CRIC 60)
- V_4 Moorock Tall (MT)
- V_5 Ordinary Tall (from plus palms) (PPT)

Location	Year of establishment	Soil type	Agroecological region
Bandirippuwa	1983	Loamy sand	Wet intermediate zone
Thammenna	1983	Latasol	Dry zone
Palugaswewa	1985	Sandy clay loam	Dry intermediate zone
Suriyapura	1986	Lateritic gravel/clayey	Wet zone

Comparable yields were obtained in all five cultivars at Bandirippuwa and Thammenna showing a difference in performance over previous years. A steady increase in yield compared to the previous year was observed at Thammenna whilst maintaining a satisfactory yield especially in hybrid cultivars, producing 70 nuts/palm/yr in the 12th year after planting. A slight decrease in yield was observed at Bandirippuwa compared to 1994 due to less favourable climatic conditions. Of the two hybrid cultivars, DG x T performed better than DY x T, which was more pronounced under less favourable conditions. (Tables 1, 2, 3 and 4). The management conditions of Suriyapura trial improved with the change of ownership but accurate yield records could not be maintained due to theft and other problems.

The cultivars at Palugaswewa showed comparable performance with plantations of similar age (10 years from planting) despite the set-back caused by severe cattle and black beetle damage during the establishment phase. Systematic yield recording will be initiated in 1996 and further evaluation will be made for both experiments. The percentage flowering of cultivars at Suriyapura and Palugaswewa is given in Table 5.

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

Experiment 5.2.1a: Programme for improvement of nut size and nut number on palms at the Isolated Seed Garden

The progeny obtained by crossing palms selected for sustained high nut weights during adverse climatic conditions in 1991, planted in field no. 14 ISG (151 progeny families) was maintained satisfactorily. A further set of 95 progeny families arising from above crosses, each consisting of 3-5 individuals were planted at Maduru Oya Seed Garden in February.

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

Table 1. *Percent palms in flower, the number of palms harvested, and the number of nuts per palm from each cultivar during the current (10th year) and previous year, in the evaluation of cultivars trial at Bandirippuwa estate, Lunuwila*

Cultivar	Percentage flowering Year 10 94	95	Year 11	Number of palms harvested 94	95	Number of nuts harvested 94	95	Nuts/palm 94	95
DG x T (V_1)	100	100		74	74	7430	5201	101	70
DY x T (V_2)	100	100		77	79	6363	4828	83	61
T x T (V_3)	98	100		75	78	3788	3697	51	47
MT (V_4)	100	100		75	75	2942	3367	39	45
P P T (V_5)	98	100		74	77	3730	3815	50	50

(Note: 80 palms per treatment in 04 blocks)

Table 2. *Fruit component analyses of the evaluation of cultivars trial at Bandirippuwa Estate (1995) (data is the mean of six picks in 1995)*

FRUIT COMPONENT	CULTIVAR 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)	1297	0.21	1421	0.23	1473	0.23	1544	0.24	1412	0.22
Dehusked weight (g)	722	0.24	769	0.26	765	0.24	799	0.24	736	0.24
Split nut weight (g)	549	0.21	593	0.24	585	0.21	608	0.21	565	0.20
Kernel weight per nut (g)	356	0.22	365	0.23	370	0.22	388	0.22	365	0.22
Estimated copra weight (g/nut)	231	na	246	na	244	na	255	na	235	na
Estimated copra weight (kg/palm)	16.2	na	15.0	na	11.5	na	11.5	na	11.8	na

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

Table 3. *The percent palms in flower, the number of palms harvested and the number of nuts per palm from each cultivar during the current year (10th year) and previous year, in the evaluation of cultivars trial at Thammenna Estate, Puttalam)*

Cultivar	Percentage flowering		Number of palms harvested		Number of nuts harvested		Nuts/palm	
	Year 10 1994	Year 11 1995	1994	1995	1994	1995	1994	1995
DG x T (V_1)	99	100	77	78	4643	6253	60	80
DY x T (V_2)	100	100	72	76	2839	4798	39	63
T x T (V_3)	100	100	73	75	2060	3442	28	46
M T (V_4)	95	96	68	70	1663	2439	24	35
P P T (V_5)	100	100	76	77	2374	3634	31	47

(Note: 80 palms per treatment in 4 blocks)

Table 4. *Fruit component analysis of the evaluation of cultivars trial at Thammenna Estate (Data is the mean of six picks in 1995)*

FRUIT COMPONENT	CULTIVAR									
	DG x T		DY x T		T x T		MT		PPT	
	A	B	A	B	A	B	A	B	A	B
Fresh nut weight (g)	1330	0.20	1075	0.28	1320	0.22	1425	0.22	1130	0.24
Dehusked weight (g)	674	0.24	681	0.27	717	0.26	706	0.27	728	0.26
Split nut weight (g)	556	0.18	500	0.23	556	0.23	539	0.24	545	0.23
Kernel weight (g)	337	0.24	323	0.26	356	0.25	347	0.27	354	0.25
Estimated copra weight (g/nut)	216	na	217	na	229	na	226	na	233	na
Estimated copra weight (kg/palm)	17.3	na	13.7	na	10.5	na	7.9	na	10.9	na

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

Table 5. *Percent palms in flower, in the evaluation of cultivars trials at Suriyapura and Palugaswewa Estates*

Cultivar	Percentage flowering	
	Suriyapura	Palugaswewa
DG x T (V_1)	100	80
DY x T (V_2)	100	86
T x T (V_3)	92	84
M T (V_4)	98	90
P P T (V_5)	96	87

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Experiment 5.2.1b: Selection of parent palms for raising planting material for the proposed germplasm repository at Middeniya and the new seed garden

An elite set of palms from field no. 1 and 2 (19 palms) were selected on the basis of systematic progeny testing based on the vegetative and flowering data of the progeny trial in field no. 11A ISG (CRI, 1988). A further set of 41 palms was selected from field 4 at ISG based on 5 years (1989-93) yield data. The criteria used in the selection of palms were that the mean number of (1989-93) nuts/palm/yr > 80, and number of nuts/palm/yr during 1991 > 60 and mean husked and split nut weight over 5 years (1989-93) > 500 gm and husked and split nut weight in 1991 > 500 gms. The palms at ISG suffered severe drought damage during 1991.

A total of 100 palms including the 40 palms selected during 1993 (CRI, 1993) from field 4 ISG would be used in a systematic pollination programme starting from 1996.

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Experiment 5.2.2: Crossing of selected palms at ISG with promising germplasm accessions

The trial was initiated in 1993 in order to evaluate the performance of the progeny derived by crossing Ambakelle elite palms with putative drought tolerant germplasm accessions. The main objective was to introgress desirable characters such as high yield and stability in production whilst producing a new base population for future breeding with a broader genetic base.

Design : Randomized blocks with five treatments (crosses) replicated in 5 blocks, with twelve palms/plot.

Treatments	Crosses	Ambakelle tall x Moorock tall Ambakelle tall x St Annes tall Ambakelle tall x Kasagala tall Ambakelle tall x Debarayaya tall Ambakelle special

Location	**Year established**	**Soil type/ soil class**	**Agroecological region**
Girtland	1995	Gravel	Wet intermediate zone
Melsiripura	1995	Reddish brown latasol	Wet intermediate zone
Siringapatha	1995	Sandy loam	Wet zone

The three sites Melsiripura, Girtland and Siringapatha were planted during October and November and the planting at Bata-Atta and Kivulakelle could not be undertaken as proposed, due to the failure of Maha rains at the appropriate time for site preparation.

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Experiment 5.2.3: Selfing of F2 palms at Bandirippuwa Estate

Evaluation of the F_2 generation palms originating from Dwarf x Tall crosses in field no. 7c Bandirippuwa has revealed that certain progenies of selfed palms produced nuts with higher husked nut weight compared to crossed progenies and the data indicate that inbreeding depression is not a rule in selfing of coconut. Therefore the present experiment was planned with the objective of comparing selfed and crossed progenies at subsequent generations of selfing and 36 progeny families, obtained by selfing and crossing within a selected sample of F_2 palms were planted at Ratmalagara Estate Madampe in a fully randomized design. The details of planting material are given in Table 6.

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

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

Table 6. *Details of F_1 and F_2 parents of the F_3 progeny families planted at Ratmalagara Estate for evaluation of the F_3 progenies arising from Dwarf x Tall crosses of coconut*

F1 Self No.	F2 palm No. (Mother palm)	Method of pollination SP/OP	F3 progenies (individuals in each family)
222 x 222	4563	SP (Artificial)	14
		OP	15
125 x 125	4837	SP (Artificial)	14
		OP	15
	4911	SP (Artificial)	04
		OP	11
	4973	SP (Artificial)	15
		OP	08
144 x 144	4868	SP (Artificial)	05
		OP	04
	4935	SP (Artificial)	05
		OP	04
	4944	SP (Artificial)	10
		OP	08
	4945	SP (Artificial)	06
		OP	13
	4865	SP (Artificial)	06
		OP	13
148 x 148	4914	SP (Artificial)	02
		OP	-
	4832	SP (Artificial)	01
		OP	05
	4833	SP (Artificial)	11
		OP	08
226 x 226	4580	SP (Artificial)	03
		OP	10
	4635	SP (Artificial)	01
		OP	04
	4579	SP (Artificial)	03
		OP	02
132 x 132	4923	SP (Artificial)	15
		OP	11
157 x 157	4917	SP (Natural)	14
		OP	13
158 x 158	4677	SP (Artificial)	05
		OP	06
		Total	293

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 for the evaluation of progeny (1987)**

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)**

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)**

Experiment 5.4.3.1: **Observation 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)**

It has been shown that mass selection alone would not be sufficient to improve the selection efficiency of coconut populations (Liyanage, 1967) and hence selection of parents based on performance of their progenies was found to be imperative. A series of trials was established to evaluate the progeny of crosses of selected Tall and dwarf palms at ISG and of San Ramon, in different agroclimatic areas and under different management conditions, so that recommendations could be made of suitable crosses for different agroclimatic zones and/or universal types for growing under a range of environmental conditions.

Design: Factorial design with 3 varieties and 3 fertilizer levels arranged in a randomized block design with 3 replicates

No. of palms/plot: 10 palm

Treatments	Crosses	Fertilizer levels
	Tall x Dwarf green (V1) Tall x Tall (V2) Tall x San Ramon (V3)	Recommended fertilizer (T1) Half of the recommended dosage (T2) One and a half times the recommended dosage (T3)

V_1T_1 V_1T_2 V_1T_3
V_2T_1 V_2T_2 V_2T_3
V_3T_1 V_3T_2 V_3T_3

Locations	Year of establishment	Soil type	Agroecological region
Bandirippuwa	1986	Loamy sand	Wet intermediate zone
Ratmalagara	1986	Lateritic	Wet intermediate zone
Mudalihamy Andigama	1986	Sandy loam	Wet intermediate zone
Mangala Eliya (with T(OP) as a control variety)	1987	Loamy sands	Dry intermediate zone
Daisy Valley (with DG x T and DG x SR as added treatments)	1987	Clay loam	Wet intermediate zone
Puras Andigama (with DGxSR added)	1987	Lateritic	Wet intermediate zone

Two observation trials were established at Sirikandura (1989; TxDG, TxT, TxSR and TxDY) and at Ratmalagara Estate (1989; DGxT, DYxT, DGxSR and DYxSR) to confirm their performance under general estate maintenance.

The application of differential fertilizer treatments to palms at Bandirippuwa and Ratmalagara since June 1993 did not reveal a significant difference in yield. A sharp drop in per palm yield from 1994 to 1995 was observed in hybrid cultivars at both sites (Tables 7 and 8). The favourable climatic conditions during 1993 compared to 1994 would have played a significant role in controlling the yield in hybrids. In contrast, tall cultivars produced a higher per palm yield in 1995 compared to 1994 attaining stability in production with the age. All three cultivars showed better performance at Bandirippuwa (loamy soil) compared to Ratmalagara (Lateritic soil) and the difference between sites was greater in hybrids indicating their sensitivity to different soil and moisture regimes. (Tables 7-12).

Comparison of cultivar performance over sites shows that irrespective of the conditions, the hybrids attained 80% flowering by the 7th year indicating the genetic potential of early flowering. In contrast the flowering and yield potential of tall cultivars varied significantly between sites, with Mangala Eliya outperforming all sites, attaining 90-95% flowering at the end of 8.5 years after planting and only 40% flowering at the Puras block Andigama of the same age. Of the Tall cultivars, T x SR has out performed T x T in flowering and vegetative growth in five sites out of six and the difference in performance between the two cultivars was greater under sub-optimal environmental conditions.

Table 7. *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 6.5	7.5	8.5	9.5	Yield (nuts/palm) 1995
T x DG	88 (100%)	88 (100%)	88 (100%)	88 (100%)	58
T x T	51 (59%)	74 (82%)	86 (96%)	89 (100%)	43
T x SR	50 (56%)	72 (80%)	83 (92%)	88 (100%)	35

(DG - Dwarf Green; T - Tall; SR - San Ramon)

Table 8. *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 6.5	7.5	8.5	9.5	Yield (nuts/palm) 1995
T x DG	61 (67%)	84 (94%)	90 (100%)	90 (100%)	30
T x T	08 (9%)	27 (30%)	75 (83%)	83 (92%)	13
T x SR	23 (26%)	70 (78%)	82 (91%)	82 (91%)	16

(DG - Dwarf Green; T - Tall; SR - San Ramon)

Table 9. *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			
	6	7	8	9
T x DG	53 (60%)	77 (89%)	86 (100%)	86 (100%)
T x T	1 (1%)	16 (20%)	35 (44%)	48 (61%)
T x SR	3 (3%)	25 (30%)	54 (65%)	66 (80%)

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

Table 10. *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			
	5.5	6.5	7.5	8.5
T x DG	56	75 (94%)	79 (100%)	79 (100%)
T x T	6	30 (36%)	58 (71%)	74 (91%)
T x SR	3	39 (46%)	66 (84%)	72 (95%)
T (OP)	9	60 (60%)	69 (81%)	79 (93%)

(DG - Dwarf Green; T - tall; SR - San Ramon; T(OP) - Tall Open Pollinated)

Table 11. *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		
	6	7	8
T x DG	50 (63%)	70 (80%)	76 (89%)
T x T	2 (2%)	14 (16%)	22 (26%)
T x SR	8 (9%)	30 (34%)	45 (54%)
DG x SR	62 (73%)	79 (92%)	79 (92%)

(DG - Dwarf Green; T - Tall; SR - San Ramon)

Table 12. *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					Yield nuts/palm
	4	5	6	7	8	1995
T x DG	26	54	78 (90%)	82 (91%)	82 (92%)	21
T x T	2	02	11 (13%)	38 (42%)	63 (74%)	05
T x SR	0	05	33 (40%)	58 (64%)	68 (84%)	10
DG x SR	20	43	71 (80%)	75 (83%)	84 (3%)	18
DG x T	26	54	76 (87%)	83 (92%)	83 (92%)	25

(DG - Dwarf Green; DY - Dwarf Yellow; T - Tall; SR - San Ramon)

The progeny subjected to 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 is to evaluate the hybrid progenies DG x T, DY x T, DG x SR and DY x SR.

Consistent results were obtained on the performance of Dwarf yellow in hybridization and in the progeny resulting from crosses, suggesting that Dwarf green is a better female parent than Dwarf yellow (Tables 13 and 14) in the production of hybrids.

Table 13. *Cumulative number of palms in flower in the four types of progeny, T x DG, T x T, T x SR, and T x DY at Sirikandura Estate (1989)*

Progeny	Years after planting		
	4	5	6
T x DG	20	42 (60%)	58 (81%)
T x T	2	3 (4%)	20 (28%)
T x SR	0	13 (18%)	30 (42%)
T x DY	15	22 (31%)	44 (61%)

Table 14. Cumulative number of palms in flower in the four types of progeny, DG x T, DY x T, DY x SR and DG x SR at Rathmalagara Estate (1989)

Progeny	Years after planting		
	4	5	6
DG x T	1	6 (38%)	14 (78%)
DY x T	0	3 (17%)	11 (62%)
DY x SR	0	1 (5%)	11 (65%)
DG x SR	0	7 (39%)	16 (89%)

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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

Selection of superior palms based on the performance of their progeny has been shown to be an effective method of identifying characters of low heritability mainly controlled by polygenes (Falconer 1981). The parents were a selected sample of palms from the population in field No 1 and 2 at ISG showing high and stable yields on the basis of nut numbers and nut weights over a period of 18 years. A minimum of four progenies from each of 56 full sib families were planted, in order to study the inheritance of yield stability, drought tolerance and other related characters.

Design: Fully randomized with a minimum of four progenies each from 56 families

Location: Isolated Seed Garden, Ambakelle

Agroclimatic zone: Dry intermediate zone

The full sib families planted in field no. 11 A of the Isolated Seed Garden performed well attaining 91% flowering at the end of seven years from planting. Certain individual palms recorded a yield of 113 nuts/palm/yr which should be selected for further improvement to obtain superior palms. The efficiency of selection of elite palms was checked by evaluating the performance of progeny families (Table 15). The mean yield of female parents during the past five year period (90-94, period with a highly fluctuating rainfall distribution) showed a

correlation of 0.42 with the mean total leaf production in the progeny during the 3-5 yr period from establishment and a correlation of -0.64 between mean flowering time of progeny and mean yield of female parents during 90-94. However, mother palms which recorded a mean yield below 60 nuts/palm/yr during the 90-94 period produced progenies which flowered late indicating the importance of selecting palms over a wide range of climatic conditions (stress periods included) in order to eliminate the palms that are susceptible to stress conditions.

Table 15. *Details of the female parent and full sib progenies arising from crossing with selected male parents in the progeny trial at ISG*

Female parent No.	Mean yield of female parent nuts/palm/yr (90-94)	Mean leaf production in progeny during 3-5 years	Mean flowering period in progeny (Months)
1.02	91.5	22.65	64
1.04	70.5	23.26	61
1.05	92.3	24.11	60
1.06	89.5	25.80	65
1.07	69.3	24.71	63
1.09	70.3	24.62	61
1.10	62.8	22.95	62
1.11	56.0	22.50	72
1.12	95.3	22.45	65
1.21	85.0	24.80	57
1.28	106.3	24.65	59
1.31	59.8	20.60	68
1.34	98.0	25.09	60
2.01	92.3	17.75	-
2.37	61.8	22.00	70
2.44	70.3	21.97	62
2.53	41.5	18.00	72
2.57	56.8	22.83	63

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Experiment 5.4.5.2: Comparative evaluation of DG x Tall hybrid progeny of parents of the first and second generation palms at the ISG for yield and physiological drought tolerance (At Andigama Farm, Giriulla)

The objective is to evaluate the performance of hybrid progeny arising from first and second generation dwarf green palms at the mini-seed garden, ISG, with

a view to improving the water use efficiency of DG x Tall hybrid while retaining its precocity and high yield. Ambakelle special and CRIC65 cultivars are used as controls in the trial.

Nuts used for the trial were from the second pick of ISG (March 1993) from first generation dwarf green palms (3339, 3569, 3677, 3714 and 3715), second generation dwarf green palms (6, 9, 16, 19, 55, 60, 63, 64, 65, 67, 86, 103, 109, 157, 172, 179 and 244), ten randomly picked dwarf green palms at Field 09 (CRIC65) and ten randomly picked Ambakelle special palms at ISG.

Design: The trial was planted in a completely randomized block design with 8 blocks. The plot size was kept at 8 because three of the varieties being evaluated are DG x T hybrids. Each plot was surrounded by a guard row of Ambakelle special.

Year of Planting: December, 1993

Location: Andigama Farm, Giriulla

Agroclimatic area/soil type: Wet intermediate zone/Clay loam soil

Growth measurements were recorded at three monthly intervals in order to monitor the vegetative growth of palms. Severe rat damage occurred in the trial despite control measures taken against the spread of weeds. A total of 49 vacancies were filled during the year and a further 60 vacant seed holes were reported due to the above damage.

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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)

The plantation was maintained during the year and the application of fertilizer was undertaken in May and November. Seven vacancies of *Nawasi thembili* and two vacancies of *dwarf red* were filled during the year. The two *dwarf red* seedlings died due to black beetle damage. The status of the crop museum at end of the year is summarized in Table 16.

Table 16. *The status of the new variety block or crop museum*

Variety	No. of palms to date	Vacancies	Bearing palms	Palms in flower (new)	Young palms	Total no. palms
Dwarf Yellow	07	-	07	-	-	07
Dwarf Green	07	-	07	-	-	07
Dwarf Red	05	02	05	-	-	07
King coconut	07	-	07	-	-	07
Ratharan thembili	05	02	05	-	-	07
San Ramon (Russet)	07	-	07	-	-	07
San Ramon (Green)	07	-	07	-	00	07
Kamandala	07	-	07	-	-	07
Gon thembili	07	-	06	00	01	07
Nawasi	07	-	07	-	-	07
Bodiri	07	-	07	-	-	07
Pora pol	04	03	02	-	02	07
Ran thembili	07	-	03	01	03	07
Dikiri	07	-	04	01	02	07
Nawasi thembili	07	-	-	-	07	07
DG x T	07	-	06	-	01	07
DY x T	06	01	03	-	03	07

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

A self pollination programme was initiated for ***Ratharan thembili*** in early 1995 in order to supply vacancies in the crop museum.

The current status of the indigenous germplasm conservation block at B/E is shown in Table 17.

Experiment 5.5.3: Conservation of San Ramon, (1986)

One hundred and twenty six (126) palms were in bearing as at 31 December and 11 vacancies were reported.

The status of the San Ramon conservation block at Bandirippuwa as at 31 December is summarized in Table 18.

Table 17. *The status of the local germplasm collection at Bandirippuwa as at 31 December*

Status of collection	Type (form) of coconut						
	Bodiri	*Gon thembili*	*Pora pol*	*Ran thembili*	*Nawasi pol*	*Dikiri*	*Kamandala*
Number established	80	69	57	38	36	03	06
Vacancies	29	16	22	05	01	02	01
Young palms	01	02	13	15	26	00	01
In flower	00	00	02	04	00	00	01
In bearing	42	50	16	07	09	01	03
Seedlings	08	01	04	07	00	00	00

(Note: Total number of standing palms = Young palms + Seedlings + In flower + In bearing)

Table 18. *The status of the San Ramon conservation block at Bandirippuwa Estate*

Status	Number
Total number established	162
Vacancies	11
Young palms	18
Palms in flower	07
Palms in bearing	126

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

The self pollination programme was continued for *dwarf green* and *dwarf red* in order to supply vacancies in the field and for new planting (Table 19). A total of 376 selfed dwarf green nuts and 215 dwarf red nuts were collected during the year and laid in the research nursery. During the year two bearing palms and a young palm of *dwarf green* succumbed to black beetle damage followed by red weevil infestation.

Table 19. *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	No. of nuts harvested
Dwarf green	34	1496	416	374	376
Dwarf red	14	419	95	86	215

Table 20. *The status of the dwarf palm block at Bandirippuwa Estate*

Status	DR	DY	DG
Total number established	73	44	99
Vacancies	15	27*	69
Young palms/Seedlings	01	00	02
Palms in flower	00	00	00
Palms in bearing	57	17	28

* Fifteen of these planting points have been supplied with tall x tall seedlings by the estate. Arrangements were made to supply dwarf green vacancies in the early part of 1996. (Table 20).

Experiment 5.5.5: Germplasm from other countries (1985)

Experiment 5.5.5.1: Import of exotic material

No imports were undertaken during the year. Three tall and two dwarf cultivars from Indonesia, namely *Palu tall*, *Bali tall* and *Tenga tall*, and *Nias yellow dwarf* and *Salak dwarf* were recommended to the Coconut Research Board for importation as embryos and pollen in limited quantities after careful screening for pest and diseases. A proposal will be submitted in early 1996 to the Department of Agriculture to obtain approval for importation.

Experiment 5.5.5.2: Purification and multiplication of exotic material already available Cameroon Red Dwarf (CRD); Brazilian Green Dwarf (BGD)

The hand pollination programme was discontinued this year and 83 BGD seed nuts were collected from pollinations done during last year and laid in the nursery.

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*)

No new collections were made during the year due to scarcity of land in the present gene banks. Collection will be undertaken in an accelerated programme from January 1996 onwards under the project "Acceleration of collection and conservation of coconut biodiversity at risk in Sri Lanka' and "Evaluation of existing coconut population for physiological adaptation and setting up of *in-situ* germplasm repositories" approved by the International Board for Plant Genetic Resources (IBPGR) and funded by Asian Development Bank. As a result of several responses received from the Coconut Development Officers of the Coconut Cultivation Board, several survey missions were undertaken during the year for identifying superior sources of germplasm. Emphasis was placed to locate sources from non-traditional coconut growing ares. Two sources were identified from kahatagasdigiliya area in the Anuradapura District in the North-Central province, two sources in mid-country area in Central province and one source from Ambalantota area in the Southern Province.

Kahatagasdigiliya area

Two coconut populations planted in a home garden belonging to Mr. U. Muhandiram of Andaragollawa and to Mr. Sugathapala, of Rathmalgahawewa respectively were identified as superior as they thrived well despite sub optimal conditions. Apart from this, these plantations were known to have undergone several selection cycles from the original plantations in the past. Both land owners shared the idea that the material obtained from their own mother palms performed better in their survival capabilities than the material introduced from elsewhere (eg. National Replanting Programme).

Ambalantota area, Dickwella Estate

A population showing characters similar to San Ramon was identified on this estate, known as "Indian Pol" to the local grower. There were 3-4 generations of such populations available on the estate which may have been subsequently planted through several selection cycles. Apart from these, a few palms showing characters similar to San Ramon, but with pink colouration in the mesocarp just round the top of the nut as in Ran thembili and few Raththaran thembili palms with the pink colouration were also observed.

Kandy area, Haragama Estate, Haragama

This is a large estate with an extent of about 241 ac. currently managed by the National Livestock Development Board. In the past the estate was known for its palms producing nuts with high kernel thickness and high milk yield.

Kandy area, Aluthwatta Estate, Kengalla

This estate was earlier under the management of the 'Soysa' family of Panadura and is now under the Mahawelli Authority with about 900 ac in extent. The old plantation is believed to be more than 80 years old. A pollination programme using prepotent pollen from CRI on selected tall palms of the estate had been carried out during 1960, under the supervision of Mr. Keith Anderson, the superintendent. The palms which were used in the hand pollination could be traced even now.

Under the *in-situ* conservation programme (eco-bank) proposed last year, selection of elite palms adapted to the different ecologies and several putative physiologically adapted sources namely, Kivulakelle estate, Madurankuliya, and Andigedera estate, Kiniyama were carried out during the year for supplying the seed nuts with the hope of planting within their own estate or within the same area in order to test their adaptability.

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Assembly and evaluation of collected material

Conservation Block - Poththukulama Research Station (PRS)

This plantation was maintained satisfactorily during the year. Growth measurements were recorded and fertilizer was applied in two stages in June and November. Not a single germplasm accession, including the Dehigahalanda accession and self pollinated brown dwarf which were collected during 1994 and 1995 could be introduced during the year due to scarcity of land in the genebanks.

Vacancies amounting to 04 seedlings from *Clovis* accession, 05 from *St. Annes*, 16 from *Margaret*, 16 from *Dwarf brown* (OP), 08 from *Walahapitiya*, 08 from *Debarayaya*, 08 from *Maliboda*, 02 from *Cameroon Red Dwarf* and 08 from *Akuressa* occurred during the year and were supplied in the conservation block. The status of the PRS germplasm block is given in Table 21.

Table 21. *The status of the PRS conservation block, as at 31 December*

Accession	% Flower	% Bearing	No. of palms	No. of vacancies	Total
01. Moorock	58.0	45.6	81	01	82
02. Palugaswewa	68.6	43.3	83	02	85
03. Pitiyakanda	75.3	51.8	81	04	85
04. Clovis	23.4	13.2	81	04	85
05. Namalwatta	66.2	46.7	77	08	85
06. St. Annes	64.6	20.7	82	03	85
07. Mageret	21.6	12.04	83	02	85
08. Kasagala	-	-	71	09	80
09. Debarayaya	-	-	79	02	81
10. Kundasale dwarf	22.3	7.9	76	12	88
11. Akuressa	11.7	10.5	85	05	90
12. Ambakelle special	5.6	4.5	88	03	91
13. Melsiripura	-	-	85	06	91
14. Mangala Eliya	-	-	81	05	86
15. Goyambokka	-	-	86	04	90
16. Cameroon Red Dwarf	26.3	19.4	72	14	86
17. Goluwapokuna	2.6	-	75	06	81
18. Keenakelle	-	-	74	16	90
19. Dwarf Brown	8.5	-	82	08	82
20. Maliboda	-	-	87	03	90
21. Horakelle	-	-	73	17	90
22. Walahapitiya	-	-	82	03	85
23. Wellawa	-	-	64	15	79
24. Drought Screened Embryo	-	-	18	01	19
25. Brazilian Green Dwarf	-	-	36	03	39

Conservation Block- Bandirippuwa Estate

This block was maintained satisfactorily during the year. Growth parameters were recorded and fertilizer application was done in two split applications in June and November. The status of the germplasm conservation block at Bandirippuwa estate is given in Table 22.

Table 22. *The states of the germplasm conservation block at Bandirippuwa*

Accession	% Flower	% Bearing palms	No.of palms	No.of vacancies	Total
01. Wellawa	35.8	25.9	81	03	84
02. Pitiyakanda	27.5	25	80	06	86
03. Ambakelle tall	48.6	41.6	72	14	86
04. Moorock	28.0	22.8	35	9	84
05. Namalwatta	3.33	-	30	56	84
06. Debarayaya	-	-	71	19	80
07. Clovis	1.17	-	85	-	85
08. Palugaswewa	-	71	09	81	-
09. Ambakelle special	2.5	-	78	-	78
10. Akurassa	-	-	34	52	86

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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

No new collections were made during the year.

Collection of drought tolerant germplasm

No new selections were made during the year.

Evaluation and utilization of germplasm

Evaluation of nine promising germplasm accession at Nariyapotta division, Andigama farm, Giriulla.

Out of 675 seedlings planted as trial seedlings, 74 casualities were reported during the year due to severe rat damage, thus increasing the total number of vacancies in the trial to 245 including the vacancies recorded in 1994. Growth measurements were recorded only once in November. Fertilizer application and infillings were postponed to early 1996 due to insufficient rainfall received in the latter part of the year.

The status of the evaluation trial as at 31 December 1995 is given in Table 23.

Table 23. *The present states of the germplasm evaluation trial at Andigama farm, Giriulla*

Accessions	No. of seedlings established	No. of mother palms	Progeny size	No. of vacancies
Moorock	75	15	4-6	25
Margret	75	15	4-6	25
Maliboda	75	15	4-6	27
St. Annes	75	15	4-6	22
Debarayaya	75	15	4-6	31
Clovis	75	15	4-6	34
Ambakelle special	75	15	4-6	27
T x T	75	15	4-6	32
Walahapitiya	75	15	4-6	21

CRD x Ambakelle tall cross

Hundred and ninety six seed nuts resulting from the cross were laid at Bandirippuwa Research Nursery together with CRIC 65 seednuts to be used as the control. Seedlings would be ready for planting in 1996.

DG x Debarayaya tall cross

Seedlings resulting from the above cross were planted in June this year at Raddegoda Estate, Delwita in the dry intermediate zone. A total of 96 seedlings, comprising 48 of DG x Deberayaya and 48 of CRIC 65 were planted in a completely randomized design. The growth measurements at six months were recorded in December 1995. Fertilizer was applied in November. Arrangements were made to repeat the trial at Rathmalagara estate in the season (April/May) Yala 1996.

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Experiment: Characterization of coconut germplasm and identification of suitable genotypes for breeding, using biochemical markers (isozymes) (1994)

Out of the isozyme systems tested, Glucose Oxaloacetate Transaminas (GOT), Alcohol Dehydrogenase (ADH), Phosphoglucoisomerase (PGI) systems showed no variation between Tall, dwarf and hybrid genotypes of coconut. The Esterase (EST) system showed a clear variation among genotypes but not among varieties. i.e. individuals within a variety showed both homozygous and heterozygoud banding patterns. The leaf and haustorium tissues arising from the same individuals showed different levels of polymorphisms at EST-1 locus.

Forty samples each from populations tall x tall, dwarf x tall, plus palm tall, Moorock tall and Dwarf were analyzed for enzyme systems EST, and peroxidase (PER) in which clear banding patterns were obtained. A maximum of 5 alleles for EST-1 locus and 3 alleles for PER-1 locus was observed.

The allele frequencies of the above loci for individual populations were calculated and the results indicated that higher polymorphism was present in Moorock tall and tall x tall, compared to Plus palm tall and the difference was mainly seen in the frequency of a rare allele present in improved cultivars. Experiments are in progress to detect specific alleles in extreme phenotypes to tag preferable characters such as yield and drought tolerance.

This study is funded by the Council for Agricultural Research Policy (CARP) for the duration May 1994-1996.

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PROJECT 6: PRODUCTION OF HIGH QUALITY SEEDS AND SEEDLINGS

3. MISCELLANEOUS RESEARCH

3.1 Improvement of nursery techniques

Testing the suitability of optional material in replacement with coir dust for raising coconut seedlings in polybags in areas especially outside the coconut triangle (1995)

The limitation in land availability in the traditional coconut growing areas has resulted in extending cultivation to the non-conventional areas especially in the

Mahaweli area where irrigation facilities are available. The recommended potting mixture for raising coconut seedlings in polybags contsists of 1 part of top soil, 2 parts of cowdung and 3 parts of coir dust. Coir dust is the major constraint in these areas, specially in dry zone where Saw dust, Paddy husk and partially decomposed Straw and weed thrash are available in abundance.

Therefore an experiment was started to test the suitability of alternative material for coir dust, in a fully randomized design with 25 replicates per treatment.

Growth parameters i.e. height, girth and number of leaves were recorded at the time of transplanting the sprouted nuts in to polybags and 5 months after seed nut laying. The growth measurements at 7 months after seed nut laying would be recorded. Final results would be based on the percentage of issuable seedlings.

C K Bandaranayake, A A L Perera & R Jayatillaka

4. SEED GARDENS

4.1 The Isolated Seed Garden at Ambakelle

4.1.1 Rainfall

The amount and distribution of rainfall for 1995 is shown in Table 24 along with the values for the previous year and the 10 year average (1986-1995). A marked increase in rainfall intensity was shown (1834.1 mm) during the current year compared to the figures in 1994 (1286 mm). But the distribution was poor since most of the rain was concentrated within April, May and November leaving a long dry period during January to February and during August and September.

4.1.2 Nut yields

Total crop figures for 1994 and 1995 are shown in Table 25 along with the 10 year average (1986-1995). The nut yields of *Talls* and *Dwarfs* are shown separately in Table 26. A remarkable yield improvement in the tall palms was observed during the year with a record production of 1.31 million nuts, the highest during the last 10 years. The high intensity of rain during January to March in 1994 has increased the 1st and 2nd crop of 1995 by almost 95% compared to corresponding picks in 1994. The per palm yield was 98 nuts in Tall and 85 nuts in Dwarf. The yield forecast for 1996 could not be expected to be as good as 1995 due to the poor distribution of rainfall and the lower intensity during the critical months of January, February and September in 1995. The crop disposal from the ISG is given in Table 27.

Table 24. *The amount and distribution of rainfall for 1994 and 1995 and the 10 year average (1986-1995) for comparison at ISG*

Month	1994 A	B	C	1995 A	B	C	10 year average (1986-1995) A	B	C
January	110.5	10	10	51.2	5	5	56.4	4	4
February	71.6	8	7	32.6	7	5	30.7	3	2
March	79.6	5	5	59.5	3	3	52.7	4	4
April	141.4	8	6	315.6	16	16	158.7	10	9
May	184.3	11	11	370.3	14	13	153.7	10	5
June	85.5	6	5	58.1	14	12	99.7	8	8
July	29.4	7	4	50.7	3	3	51.1	5	4
August	4.9	4	2	0.5	1	1	22.6	4	3
September	115.9	12	11	16.0	3	3	93.3	8	8
October	274.6	19	18	127.7	15	14	243.6	16	15
November	165.5	16	13	717.0	13	13	297.0	14	14
December	12.8	4	3	34.9	3	3	76.9	6	5
Total	1286.0	110	95	1834.1	97	91	1336.4	92	81

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

Table 25. *Total nut yields at ISG from the six picks of the year*

Pick	1994	1995	Ten year average (1986- 1995)
01	118 008	220 114	123897.7
02	128 157	246 453	154780.6
03	195 926	329 918	186634.7
04	185 438	295 516	165563.9
05	172 117	258 482	152904.6
06	176 256	183 886	131479.0
Total	975 902	1 534 369	915260.5
Number of bearing palms	15 586	15 957	
Average number of nuts per palm	62	96	

Table 26. *Nut yields from tall and dwarf palms at ISG*

A: Tall Crop

Pick	1994	1995	Five year average (1991- 1995)
01	101 167	191 213	111057.6
02	107 570	215 600	150827.6
03	170 397	281 122	195901.4
04	164 490	247 643	176597.6
05	155 299	213 213	145787.6
06	157 050	161 559	124589.4
Total	855 973	1 310 350	904761.2
Number of palms in bearing	13 213	13 331	
Number of nuts/palm	65	98	

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

B: Dwarf (D x T) Crop

Pick	1994	1995	Five year average (1991- 1995)
01	16 841	28 901	20233.6
02	20 587	30 853	25092.4
03	25 529	48 796	33591.4
04	20 948	47 873	33448.0
05	16 818	45 269	28428.4
06	19 206	22 327	24745.0
Total	119 929	224 019	165538.8
Number of palms in bearing	2 643	2 626	
Number of nuts/palm	45	85	

Table 27. *Crop Disposal at ISG 1995*

Method of disposal	No. of nuts from Tall	DG	DY	Total
Delivered as seed nuts	853 718	83 992	78 255	1 015 965
For research purposes				
GPB	750	236	193	1 179
PPD	200	200	-	400
TCD	2 996	181	-	3 177
Agro D.	2 100	-	-	2 100
Nut allowance to staff	13 237	-	-	13 237
Copra	204 060	17 478	13 002	234 540
Rejections	33 258	4 432	3 450	41 140
To be disposed	200 031	8 984	13 616	222 631
Total crop	**1 310 350**	**115 503**	**108 516**	**1 534 369**

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

Details of the emasculation programme are shown in Table 28. A total of 2820 *dwarf* palms comprising 1827 *dwarf green* and 1193 *dwarf yellow* forms were emasculated during the year.

Table 28. *Emasculation of dwarf palms for the production of CRIC 65 seed nuts*

Field number	Number of palms emasculated		Number of inflorescences emasculated		Number of button nuts at emasculation	
	DG	DY	DG	DY	DG	DY
05	158	-	2008	-	24848	-
09	605	-	5922	-	75499	-
10A	112	854	1436	13903	16445	232756
10B	318	339	4248	5222	56544	73219
14	434	-	5816	-	73139	-
Total	1627	1193	19430	19125	248475	305975

4.1.4 Thinning of palms

A systematic thinning programme was undertaken in the double avenue plantation (field no. 11B), in order to reduce the competition between palms and provide sufficient solar radiation. Sixty seven weak palms were removed out of a total of 247 palms (in 2.6 Ac) keeping palm density at 170 palms/ha.

R R A Peries, W M U Fernando, M H L Padmasiri & R Jayatilleke

4.2 Makandura seed garden

A survey was carried out on palms at Makandura Seed Garden, in order to carry out a systematic thinning programme. The survey was carried out during 31 May - 02 June and two groups of palms were identified based on their performance. A percentage of 6.7 palms (347 out of 5146) were marked for immediate removal and another 6% was marked for further monitoring. The removal of weak palms will also help to create more space for existing palms and thereby reduce the competition for solar radiation caused by high density planting.

A A L Perera, W M U Fernando & R Jayatilleke

4.3 Maduru oya seed garden

A total of 449 seedlings arising from 95 progeny families (progeny size varying from 3-5 individuals) were planted at the seed garden. The parent palms were selected on the basis of stability in nut size under adverse weather conditions during 1991 at the ISG.

R R A Peries & A A L Perera

5. SEED PRODUCTION

In collaboration with the Coconut Cultivation Board, reselection of plus palms was carried out at Moorock Estate, Mawathagama, Wilpothamukalana Estate, Batthulu Oya, Dematagolla Estate, Melsiripura, Dehigahalanda Estate, Ambalantota and Keenekelle Estate (block 5c), Mudukatuwa.

Selection of elite palms to obtain seed nuts for planting at the same location was undertaken at the Kivulakelle estate, Madurankuliya and Andigedera estate, Kiniyama, both estates being managed by Wayamaba Plantations (Pvt) Ltd.

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6. POLLEN AND POLLINATION

6.1 Pollen collection and issue

Details of pollen collection and issues are summarized in Table 29. Pollen from typica variety was collected from 20 selected palms at Kasagala Estate, 48 selected palms from Debarayaya Estate, 50 selected palms from Moorock Estate and 50 selected palms from St. Annes Estate. A total of 53, 93, 33 and 76 ampoules of mixed pollen were sealed from Kasagala, Debarayaya, Moorock and St. Annes respectively. Pollen of dikiri pol was collected from Bandirippuwa Estate (a palm in TC Division) and from Weligama. A total of 40 ampoules and 25 ampoules were sealed respectively from each site.

7. RESEARCH NURSERY

7.1 Bandirippuwa Research Nursery

Tables 30, 31 and 32 summarize the data on seed nuts laid, seedling issues and the availability of seedlings as at 31 December respectively.

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Table 29. *Pollen collection and Issue during the year 1995*

	No. of ampoules							
		Tall				Variety palms		F2 palms
	ISG	(K)	(D)	(M)	(S)	(BE)	(Weligama)	(BE)
Carried over from 1994								
Pollen from individual palms	-	-	-	-	-	15	-	43
Mixed pollen	53	-	-	-	-	-	-	-
Sealed in 1995								
Pollen from individual palms	-	-	-	-	-	40	25	-
Mixed pollen	-	53	93	33	76	-	-	-
Issued for pollination programmes								
Pollen from individual palms								
1. At BE	-	-	-	-	-	25	10	-
Other uses (Viability tests, demonstrations, breakages etc.)								
Pollen from individual palms	15	-	-	-	-	5	-	10
No viability /Low viability								
Pollen from individual palms	38	-	-	-	-	10	-	33
Balance as at 31 December 1995								
Pollen from individual palms	-	-	-	-	-	15	15	-
Mixed pollen	-	53	93	33	76	-	-	-

(K - Kasagala; D - Debrayaya; M - Moorock; S - St. Annes)

W B S Fernando

Table 30. *Seed nuts laid in the Bandirippuwa nursery during the year (1995)*

Variety	Source	Number of seed nuts			
		In beds	In polybags	In pre-nursery	Total
Hand pollinated nuts					
Brazilian Green Dwarf	Old nursery B/E	-	-	83	83
Dwarf red	New variety block	-	-	215	215
(F3)	BE	-	-	54	54
CRD x T	BE	-	-	196	196
Dwarf Green	New variety block	-	-	376	376
Other					
T x T	ISG	-	-	750	750
DG x T	ISG	231	-	-	231
DY x T	ISG	185	-	-	185
Total		**416**	**-**	**1674**	**2090**

Variety/Accession	G & PBD		Other divisions		Other purposes		Commercial issues		Total	
	A	B	A	B	A	B	A	B	A	B
Dwarf x tall	-	129	6	-	-	5	149	3	155	137
Ambakelle special	-	16	-	-	-	-	125	-	125	16
Tall x Tall	-	75	12	50	-	-	690	17	702	142
Dwarf Red	-	2	-	-	-	6	40	4	40	12
Dwarf Green	-	-	-	-	-	6	-	-	-	6
Dwarf Yellow	-	-	40	-	-	1	-	2	40	3
Dwarf brown	-	16	-	-	-	1	-	-	-	17
San Ramon	-	-	-	-	-	1	14	4	14	5
Bodiri	-	-	-	-	-	1	-	-	-	1
Kamandala	-	-	-	-	-	-	-	-	-	1
Nawasi thembili	-	7	-	-	-	-	-	-	-	7
Cameroon Red Dwarf	-	2	-	-	-	-	-	-	-	2
Moorock	-	-	-	-	-	-	-	-	-	-
Clovis	-	4	-	-	-	-	-	-	-	4
St. Annes	-	5	-	-	-	-	-	-	-	5
Margaret	-	16	-	-	-	-	-	-	-	16
Walahapitiya	-	8	-	-	-	-	-	-	-	8
Debarayaya	-	8	-	-	-	-	-	-	-	8
Maliboda	-	8	-	-	-	-	-	-	-	8
Akuressa	-	8	-	-	-	-	-	-	-	8
Tall x St. Annes	-	180	-	-	-	-	-	-	-	180
Tall x Moorock	-	170	-	-	-	-	-	-	-	170
Tall x Kasagala	-	180	-	-	-	-	-	-	-	180
Tall x Debarayaya	-	180	-	-	-	-	-	-	-	180
F3 Generation	-	299	-	-	-	-	-	-	-	299
King Coconut	-	-	-	-	-	-	4	-	4	-
Total	**-**	**1313**	**58**	**50**	**-**	**22**	**1022**	**30**	**1080**	**1415**

(A and B are seedlings from conventional seed beds and polybags respectively).

Table 32. *Availability of planting material at Bandirippuwa Research Nursery as at 31 December*

Variety	Seedlings over 5 months in age		
	In seed beds	*In polybags*	*Total*
Germplasm collections			
Moorock	11	60	71
Debarayaya	-	39	39
Walahapitiya	-	24	24
Margaret	-	38	38
St. Annes	-	53	53
Clovis	-	16	16
Maliboda	-	15	15
Dehigahalanda	-	54	54
San Ramon	20	-	20
Dwarf yellow (Weralugama)	-	03	03
Mahawewa spicata	-	11	11
Self/Cross pollination programme			
Dwarf Russet	-	321	321
Dwarf Green	-	33	33
Brazilian Green Dwarf	-	98	98
Dwarf Red	15	18	33
Akuressa	-	239	239
Kamandala	-	17	17
NawasI	-	72	72
Ran Thambili	-	05	05
Nawasi Thembili	-	05	05
Dwarf Yellow	-	34	34
F3 generation	-	101	101
Crossing programmes			
T x Moorock	-	135	135
T x St. Annes	-	174	174
T x Kasagala	-	145	145
T x Debarayaya	-	182	182
CRD x T	-	85	85
DG x Debarayaya	-	138	138
Other			
Ambakelle Special	-	34	34
DG x T	04	-	04
T x T	-	59	59
T x T (Potting mixture trial)	-	539	539
Total	**50**	**2747**	**2797**

8. EXTENSION AND TRAINING ACTIVITIES

Dr. R R A Peries, Dr. W M U Fernando and Mr. A A L Perera functioned as resource persons at several training programmes organized by CRI, CCB and NIPM on 23/24 January, 31 January, 2/3 February, 15/16 March, 28 April, 01 August, 28 September, 30 October, 18 and 22 December.

9. ACKNOWLEDGEMENTS

The cooperation and assistance extended by the staff of Genetics & Plant Breeding Division in conducting the field experiments, tedious data collection and documentation is gratefully acknowledged.

REPORT OF THE SOILS AND PLANT NUTRITION DIVISION

Head - M N Fernandopulle, Ph D

1. GENERAL

The Division conducted seventeen field experiments on coconut nutrition and field management, two miscellaneous field experiments and five laboratory and greenhouse experiments.

Studies on the characterization of soil physical properties in coconut growing areas, (funded by the CARP) were completed in June. Following a cluster analysis of major physical characteristics of soils, widespread soil series in the coconut growing areas have been classified into three groups, i.e., superior soils, good soils and poor soils.

Characterization of soil microbiological properties of different soil series is in progress.

The major field work in the Southern Province, under Land Suitability Mapping Project was completed in June, 1995. Fifty eight different soil series were identified and classified according to their potential for coconut cultivation. Preparation of soil and land suitability maps for the southern region are in progress. The accumulation of ammonium and nitrate in ground water was evident in close proximity to those coconut estates regularly manured with inorganic fertilizers. The nitrate concentration in certain instances even exceeded the safety level recommended by the World Health Organization (WHO).

The threshold values of potassium and magnesium in soils for coconut were established for three widespread coconut growing soils. The nutrient mapping study revealed that potassium deficiency in palms was the most predominant (75-90%) followed by magnesium (50%) in Andigama, Madampe and Sudu series.

Chemical analysis of leaf samples collected randomly from palms in different soil series indicated that Fe and Mn levels in the leaf were well above the sufficiency range and Cu and Zn levels were below the range.

Growth of young palms was not markedly changed by the application of either Eppawela rock phosphate (ERP) or saphos phosphate treatments at the end of the 4th year. Also, there was no significant change in leaf P level of adult palms, two years after complete switch over from saphos phosphate to ERP.

2. LABORATORY STUDIES

2.1 Phosphorus availability in different types of Eppawala phosphate sources in different soils

An incubation experiment was initiated to investigate the phosphorus availability in different types of Eppawala phosphate fertilizers. For this study, three soils were selected with contrasting characters namely Sudu series - low fertility and high leaching; Madampe series - high fertility and medium leaching and Boralu series - moderate fertility and high adsorption capacity.

Four different phosphate fertilizers i.e. Commercially available Eppawala Rock Phosphate (CERP), Upgraded Eppawala Rock Phosphate (UERP), Selected Eppawala Rock Phosphate (SERP) and Imported Rock Phosphate (IRP) were applied at the rate of 0.31 g of P per 1 kg of soil. Accordingly UERP -1.3 g, SERP -1.0 g, CERP -1.3 g and IRP -1.0 g were applied to each 250 g soil in pots. To determine the effect of organic manure on the availability of P from these sources, cattle manure was included as a treatment.

The treatment combinations (3 soil types x 4 fertilizers x 2 organic manure) were replicated three times. The first sample was taken at the end of April and thereafter the samples were taken at monthly intervals over a period of five months. Phosphorus in soils was analyzed for the capacity factor (2.5% acetic acid extraction and Olsen's bicarbonate extraction) and for the intensity factor (0.01 M $CaCl_2$ extraction and H_2O extraction).

At the end of five months, it was observed that the P capacity of all three soils was increased 4-6 times by all three ERP sources as well as IRP. The increase in the soil P capacity by IRP, UERP and CERP treatments was significantly higher than SERP treatment ($p < 0.05$) in both Boralu series (pH 5.3) and Madampe series (pH 5.5). In Sudu series (pH 6.1), the highest soil P capacity was obtained for the CERP treatment. None of the phosphate source significantly increased the soil P intensity. Application of phosphate sources with cattle manure to soil did not significantly affect the solubility of rock phosphate. The study showed that as far as the phosphate release to soil during a short period (5 months) is concerned, SERP is inferior to ERP, UERP and CERP. There was no significant difference between the effect of IRP, UERP and CERP on increasing the soil P capacity.

J S Kuranage, N A Tennakoon, L L W Somasiri & M N Fernandopulle

2.2 Evaluation of Laboratory Methods for Potassium Estimation of Soils in the Intermediate Zone Low Country

The study was conducted using ten soil series including both A and B horizons collected from coconut growing areas in the Intermediate zone Low country of Sri Lanka. The available potassium was determined through the biological measurement and three different chemical extractions (1) 1M ammonium acetate, pH 7.0, (2) 0.43M acetic acid, pH 2.54 and (3) 0.003M hydrochloric acid, pH 2.54.

Panicum maximum (var A) was used as the indicator plant and grown in pots filled with each soil in green house with K (+K) and without K (-K) application. Grass was harvested at 30 day intervals. The dry matter weight of cuttings was measured to determine the effect of potassium on dry matter increase. The parameter of relative yield was obtained by the ratio of the yield of -K treatment to that of +K treatment. The relative potassium uptake was also calculated in a similar manner.

There were highly significant linear correlations ($r > 0.95$) among potassium values by each of the extractant. Biological parameters and potassium values by each of the extractant showed curvilinear relationship.

Results of this study clearly showed that both 0.43M acetic acid and 0.003 M hydrochloric acid can be used for the determination of exchangeable K, instead of traditional 1M ammonium acetate. The use of 0.43M acetic acid has an additional advantage, as it can be used for soil phosphorus determination, and furthermore, the method is convenient and cheaper than 1M ammonium acetate.

D Liyanage & L L W Somasiri

3. RESEARCH PROJECTS

PROJECT 4: FIELD MANAGEMENT SYSTEMS

Experiment 4.5: Evaluation of input balance in coconut plantations under different agro-climatic conditions (modified 1994)

Well water samples from four CRI estates (Ratmalagara, Makandura, Bandirippuwa and Walpita Estates) were collected at monthly intervals. Chemical analyses revealed that the concentrations of different anions and cations in well water are subjected to seasonal changes over the year which varied from site to site. The chemical analysis of well water of each of the estate is given in Table 1.

Bandirippuwa Estate

The pH of the well water in Bandirippuwa estate ranged from 6-7 during the period January to May and it dropped to the acidic range of 4.5-6.0 with effect from

Table 1. *The chemical analysis of well water of different estates*

Estate	Range of ion concentration in ppm						pH range
	K^+	Mg^{2+}	Ca^{2+}	Na^+	NH_4^+	NO_3^-	
Bandirippuwa Estate	3-4	1-3	1-10	5-11	0.1-1.5	1-10	4.5-7.0
Ratmalagara Estate	5-10	1-5	4-10	10-20	0.1-5	2-5	6.1-6.4
Makandura Estate	5-10	0.5-2	2-5	5-10	0-10	2-10	5.0-6.0
Walpita Estate	1-5	1-3	1-5	5-10	0.1-10	0.5-5	4.5-5.5

June. The nitrate concentration in well water remained in the range of 1.0-4.5 ppm until May and increased up to 6-10 ppm range with effect from June. The NH_4^+ concentration also changed in the same pattern. During January to May, the NH_4^+ concentration range was 0.05 to 0.2 ppm and June to October the concentration range increased from 0.5 to 1.5 ppm. The NO_2^- concentration remained low (< 0.005 ppm) throughout.

Ratmalagara Estate

The electrical conductivity of water ranged from 150-226μmho cm^{-1}. Nitrate concentration was considerably higher and ranged from 2-5 ppm and there was no clear pattern of change with time. Ammonium ion concentration remained low until April (at the range of 0.1-0.4 ppm) and increased until July (up to the range of 2-5 ppm) and then declined towards the end of the year. The nitrite concentration was found to be very low (> 0.005 ppm) at all times.

Makandura Estate

The pH of the water ranged from 5-6 and the acidity increased towards the end of the year. The nitrate concentration ranged from 2-5 ppm up to June but increased up to 5-10 ppm within the period of July to September and then dropped back to 2-4 ppm range. The NH_4^+ concentration also remained at 0-0.5 ppm range up to April, increased up to the range of 2-10 ppm and remained until July and then dropped to the range of 0.1-2.0 ppm with effect from August. The concentration of nitrite remained low (<0.005 ppm) at all the time. No appreciable changes in the concentration of K^+, Mg^{2+}, and Ca^{2+} were observed.

Walpita Estate

The pH of well water in the Walpita estate was rather acidic (4.5-5.5) and no considerable seasonal fluctuations were not observed. The electrical conductivity ranged from 100-300 μ mho cm^{-1}. The NO_3^- and NH_4^+ concentrations was appreciably high (3-5 ppm) up to June and NH_4^+ concentration was high (5-10 ppm) up to May. During the period July to October the NO_3^- concentration dropped to

the ranges of 0.5-3.5 ppm and 0.1-5.0 ppm respectively. The NO_2^- concentration remained low (< 0.005 ppm) throughout the year.

The overall results indicated that seasonal variation of N levels in ground waters is considerable. The NO_3^- level in the ground water exceeds 10 ppm level (recommended critical level by FAO) particularly where the water table is shallow. It appears that high rates of nitrogen fertilizer application has led to ground water pollution.

M N Fernandopulle, L L W Somasiri,
U S S Perera & E M A T Banda

Experiment 4.6: Effect of sodium chloride on decomposition of organic manures

A pot experiment was commenced in November 1995 for the above study. The treatments are given below.

T1	-	Adult Palm Mixture (APM)
T2	-	Organic manure (OM) only
T3	-	OM + NaCl level 1
T4	-	OM + NaCl level 2
T5	-	OM + supplemented with P & K

The organic manures used for the experiment were cattle manure (35 kg), goat manure (18 kg) and poultry manure (35 kg), respectively. The quantity of each organic manure was decided on its N equivalent of 368 g. In addition, APM (3 kg) was used as one treatment. Sodium chloride levels were 1 kg (level 1) and 2 kg (level 2) respectively.

Rates of fertilizer/manure application were calculated according to the pot size. These rates corresponded to the recommended rates of fertilizer/manure for coconut.

The pots were filled with three different soils namely Sudu series, Boralu series and Madampe series. The experimental layout is Randomized Block Design with three replicates.

N A Tennakoon & M A Wasanthi Mala

Experiment 4.7: Evaluation of the effects of application of poultry manure for coconut

Two contrasting coconut growing soils; i.e., Ambakelle series (IL3, S3) at Poththukulama and Boralu series (WL3, S4) at Badalgama were selected for this experiment.

The treatments of this experiment are given as follows.

T1	-	Control
T2	-	Fresh litter (layer)
T3	-	Fresh litter (broiler)
T4	-	Stored for 1 month (layer)
T5	-	Stored for 1 month (broiler)
T6	-	Stored for 3 month (layer)
T7	-	Stored for 3 month (broiler)

Fertilizers were applied by two different methods, namely surface broadcasting and in 90 cm wide and 15 cm deep trenches around the palm. The rate of the manure application was 30 kg per palm per year with P and K supplements.

The design of these experiments is split plot with 3 complete blocks of seven main plots and two split plots. The main plots consisting of 8 palms, were divided into sub plots of 4 palms each for two different methods of fertilizer application.

The mapping of the area at Poththukulama and collecting pre manurial yield data were completed. Soil and leaf samples, were also collected. Growth parameters such as number of fronds, girth measurements at the base of the coconut palms were also recorded. A land having Boralu series is yet to be selected from Badalgama area.

N A Tennakoon

Experiment 4.8: Use of polythene for soil moisture conservation under rainfed condition

For this experiment Sudu series at Kajulanda estate and Andigama series (moderately deep phase) at Rathmalagara estate were selected.

Yield records and soil survey were completed for demarcating the experimental plots. The objective of the experiment is to investigate the possibility of the use of polythene for conservation of soil moisture and nutrients in the manure circle of the palm instead of husk. Following treatments were introduced.

Treatment 1 (T_1)	-	1/3 of the circular trench round the palm; 60 cm wide and 60 cm deep filled up only with soil
Treatment 2 (T_2)	-	Trench as in T_1 but filled up with husk (recommended practice)
Treatment 3 (T_3)	-	Trench as in T_1 but the sides of the trench lined with polythene and filled up with soil
Treatment 4 (T_4)	-	Trench as in T_1 but the sides of the trench lined with polythene and filled up with husk
Treatment 5 (T_5)	-	Control (no trench)

The experiment is in progress.

L P Vidhana Arachchi, S K Gunaratna & K R E M Fernando

PROJECT 7 : STUDIES ON THE NUTRIENT REQUIREMENT OF COCONUT

Experiment 7.7: Nutrient requirement of coconut based on leaf and soil analysis (Differential Fertilizer Recommendation -DFR)

An observation trial was commenced at Poththukulama estate to compare the effect of DFR and normal fertilizer recommendation. Four plots consisting of 15 palms receiving different treatments were demarcated as follows.

Treatment 1 (T1) -	Differential fertilizer recommendation
Treatment 2 (T2) -	4.5 kg of Adult coconut mixture + 1.2 kg of urea
Treatment 3 (T3) -	3 kg of Adult coconut mixture + 0.8 kg of urea
Treatment 4 (T4) -	No fertilizer

Blocking out of the experiment was completed in November 1995. The first differential treatment application will be done during the first quarter of 1996. Yield records of the experiment are being maintained.

N A Tennakoon & L L W Somasiri

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

Soils and leaf samples (14th frond) were collected from 100 coconut lands falling into different soil series in the Intermediate-Wet zone(IL_1 agro-ecological

region). For the purpose of sampling, coconut lands under different levels of managements (i.e., poorly managed to well managed) were selected from each series. Soils were collected from the depth of 0-25 cm and 25-50 cm both from the manure circle (MC) of individual palm and from the centre of square (CS) of four palms. Soil samples were analyzed for available phosphorus, potassium and magnesium. The leaf samples were also analyzed for major nutrients. The threshold values for soil nutrients for different soil series were derived by correlating soil and leaf nutrient levels.

Soil series	Exchangeable K mg/kg	Exchangeable Mg mg/kg
Madampe series	38	100
Andigama series	60	234
Sudu series	48	70

The status of major nutrients in the 14th frond of coconut palms on five coconut soils are given in Table 2.

In all five soil series, P nutrition was found to be sufficient. Nitrogen level was sufficient only in Kurunegala and Kuliyapitiya series. In Madampe and Andigama series, Mg was found to be sufficient but K level was below the sufficiency range. In Sudu series, N, K and Mg were below the sufficiency range. The study is in progress.

L L W Somasiri, D P Panditharatne, K L Ranasinghe, U S S Perera & E M A T Banda

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

The fourth half yearly differential N (Urea), K (Muriate of potash) and Mg (Kieserite) treatments were applied in January and June, 1995 respectively. Saphos phosphate was applied as the basal dressing according to the CRI recommendation for young palms. Growth measurements of the treated palms were taken every three months. Analysis of growth measurements at the age of 4 years indicated that the number of fronds and the height of palms were not significantly different between treatments.

M N Fernandopulle

Table 2. *The leaf (14th frond) nutrient concentration of palms on different soil series*

Nutrient	No. samples	Concentration (%)	CV (%)
		Madampe series	
N	10	1.6 ± 0.2	12.3
P	10	0.13 ± 0.01	12.8
K	10	0.7 ± 0.2	29.7
Mg	10	0.25 ± 0.05	26.8
		Andigama series	
N	8	1.7 ± 0.1	3.7
P	8	0.13 ± 0.01	12.0
K	8	0.9 ± 0.2	26.2
Mg	8	0.32 ± 0.40	14.9
		Sudu series	
N	8	1.7 ± 0.2	13.8
P	8	0.13 ± 0.10	67.4
K	8	0.9 ± 0.3	42.3
Mg	8	0.24 ± 0.06	29.5
		Kuliyapitiya series	
N	9	2.0 ± 0.1	8.8
P	9	0.14 ± 0.01	9.4
K	9	1.1 ± 0.36	30.5
Mg	9	0.21 ± 0.04	25.5
		Kurunegala series	
N	8	2.2 ± 0.64	35.6
P	8	0.14 ± 0.02	12.9
K	8	1.0 ± 0.2	27.4
Mg	8	0.23 ± 0.04	20.7

Sufficiency range of each nutrient in dry matter of coconut leaf (14th frond).

Nutrient	Concentration
N	1.9 - 2.1 %
P	0.11 - 0.13 %
K	1.2 - 1.5%
Mg	0.25 - 0.35%

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

The fourth half yearly differential P-manuring was done in January and June, 1995, respectively with the basal fertilizer mixture of N, K and Mg at the rates recommended for young palms.

Growth measurements of palms in different treatments were taken in every three months. At the end of the 4th year of the experiment, there was no significant difference in growth of young palms due to the application of Eppawela rock phosphate, saphos phosphate, or triple super phosphate.

M N Fernandopulle

Experiment 7.16: Effect of chloride on coconut yield
1. **Wayagolla Estate, Attanagalla (1995)**
2. **Ganewatta Estate, Ganewatta (1995)**

Based on one year yield data, demarcation of plots has been completed. Preliminary leaf and soil sampling was completed in November. The differential treatment application was done at Wayagolla estate in December. Treatments will be imposed at Ganewatta estate in March, 1996.

The treatment scheme is as follows.

T1 - Control
T2 - KCl - 1.6 kg/palm/y
T3 - K_2SO_4 - 1.8 kg/palm/y
T4 _ NaCl - 1.2 kg/palm/y
T5 - Na_2SO_4 - 1.45 kg/palm/y

Basal dose : Ammonium sulphate 1.6 kg
Saphos phosphate 0.6 kg
Dolomite 1.0 kg/palm/year

Chemical analysis of leaf and soils are in progress. Yield records are being maintained.

L L W Somasiri

Experiment 7.17: Studies on micro-nutrient status of coconut

The micro nutrient status of coconut palms on different soil series was determined as a preliminary study. The 14th leaf of randomly selected palms from five different soil series was analyzed for micronutrient. The nutrient concentrations are shown in table 3.

According to sufficiency ranges of each nutrient, none of the samples showed deficiency of Fe and Mn. The concentration of Cu was below the sufficiency range in all five soil series. The concentration of Zn fell below the sufficiency range in certain cases. Therefore, occurrence of hidden deficiency in Cu and Zn of coconut in the above five soil series is more likely than deficiencies in Fe and Mn.

A pot experiment has been established to study the Cu status of a range of coconut soils. *Panicum maximum* has been selected as the indicator plant. The experiment is in progress. Analysis of soils of different soil series is also in progress.

Sufficiency ranges for micro nutrient status of coconut leaf (14th frond)

Fe	-	40 ppm
Mn	-	60 ppm
Cu	-	5-7 ppm
Zn	-	15-24 ppm

K K I C K Kannangara, A H N Hewage & L L W Somasiri

PROJECT 24: STUDIES ON IRRIGATION OF COCONUT

Experiment 24.1: Design a suitable drip irrigation system for coconut plantations

For this study, Andigama soil series at Rathmalagara estate was selected and detailed soil survey and initial yield records were completed.

Soil physical characteristics were evaluated for standardization of soils in the site. Estimation of lateral and vertical wetting pattern of soil were carried out to determine optimum flow rate of dischargeable water through drip system.

Table 3. *Micro nutrient concentration of leaf (14th frond) of coconut palms on different soil series*

Nutrient	No. samples	Concentration (ppm)	CV(%)
		Madampe series	
Fe	9	56 ± 24	58.1
Mn	9	395 ± 45	15.1
Cu	9	5 ± 2	50.8
Zn	9	45 ± 20	57.7
		Sudu series	
Fe	6	844 ± 172	24.3
Mn	6	334 ± 50	17.7
Cu	6	4 ± 2	31.2
Zn	6	52 ± 10	23.8
		Andigama series	
Fe	8	241 ± 55	27.5
Mn	8	402 ± 71	21.1
Cu	8	4 ± 1	34.5
Zn	8	29 ± 5	21.5
		Kurunegala series	
Fe	7	44 ± 13	34.5
Mn	7	139 ± 60	51.8
Cu	7	nd*	
Zn	7	11 ± 2	25.4
		Kuliyapitiya series	
Fe	9	39 ± 14	46.3
Mn	9	148 ± 66	57.9
Cu	5	2 ± 1	59.6
Zn	9	12 ± 6	65.1

* not determined

Experiment is in progress.

L P Vidhana Arachchi, S K Gunaratna & K R E M Fernando

Experiment 24.2: Effect of size of the irrigation zone on the growth and water relations of coconut and its nutrient balance, Ratmalagara Estate, Madampe (1990) - demonstration

The drip irrigation model for coconut as well as intercrops was maintained as a demonstration. As the rainfall during the year was satisfactory, irrigation was not provided for a significant period. The nut yields of the demonstration block was maintained.

D P Panditharathne

PROJECT 29: STUDIES ON FERTILIZER USE

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

Bandirippuwa Estate, Lunuwila (1989)
Ratmalagara Estate, Madampe (1989)
Poththukulama 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)

Eppawala Rock Phosphate (ERP) was recommended to all CRI estates as a source of phosphate for adult palms. There was no decline in leaf phosphorus level at the end of 1995. Although there was an overall drop in leaf nitrogen levels, they were within the sufficiency range. Potassium nutrition in all estates was maintained at the sufficiency range but the leaf magnesium levels were below the sufficiency range. Despite the recommendation of kieserite for correcting magnesium deficiency based on the leaf analysis data in 1994, no significant improvement was observed in leaf magnesium level at the end of 1995.

It appears from the foregoing observations that simultaneous application of potassium and magnesium fertilizers is not effective in correcting nutrient deficiencies. Following the above observations, it has been decided to recommend application of kieserite at least three months after application of NPK fertilizer.

M N Fernandopulle, N A Tennakoon & L L W Somasiri

Experiment 29.2: Estimation of the decomposition rate of different kinds of organic manures and nutrient availability to the coconut palm

Two typical coconut growing soils of the Borupan series (DL_3, S_2) at Mangala Eliya and Kuliyapitiya series (IL_2, S_2) at Horombawa, Narammala were selected for this experiment.

The treatments are given below.

T1	-	Control (APM 3 kg/p/y)
T2	-	Cattle manure (35 kg/p/y)
T3	-	Goat manure (15 kg/p/y)
T4	-	Poultry (layer) manure (30 kg/p/m)
T5	-	Poultry (broiler) manure (30 kg/p/m)
T6	-	Gliricidia (30 kg/p/m)

Basal dose : P, K and Mg are supplemented.

The experiments were laid in randomized complete block design with 3 blocks and comprised of 6 palms per plot at Mangala Eliya at 4 palms per plot at Horombawa.

Growth parameters such as the number of fronds, girth measurements and other yield parameters such as number of bunches, number of female flowers and number of nuts were recorded at Mangala Eliya experimental site.

Mapping of the site at Horombawa was completed.

N A Tennakoon

Experiment 29.3: Evaluation of different fertilizer application techniques on the yield of coconut

Two experiments were commenced under this study, representing two coconut growing soils of Borupan series (DL_3, S_2) at Thammanna estate, Puttalam and Boralu series (WL_3, S_4) at Wayagolla estate, Attanagalla.

The treatments are given below.

T1	-	Control (No fertilizer but only turning of soils)
T2	-	APM broadcast/turn/no mulch
T3	-	APM broadcast/turn/mulch with coconut fronds

T4 - ACM broadcast in dry period, urea broadcast in rainy period/no turn/mulch with coconut fronds

T5 - Band application (APM broadcast as a band i.e. 30 cm wide circle, 60 cm away from the palm then turn and mulch with coconut fronds

T6 - Localized application (equal amounts of APM and dolomite into 10 holes (300 g APM and 80 g of dolomite/hole), 60 cm away from the bole around the palm and mulch (hole size is 15 cm x 15 cm x 15 cm)

The layout of these experiments is randomized complete block design with 4 blocks and 6 palms per plot.

Yield data, soil and leaf samples were collected prior to treatment application. Treatments were applied at both sites in December.

N A Tennakoon

4. PROJECTS FUNDED BY OUTSIDE AGENCIES

4.1 Land Suitability Mapping Project (CESS funds)

Soil survey in the Southern coconut growing region was continued. Land form analysis was carried out by 1:25,000 aerial photo interpretation. Field work was carried out to identify different soil groups and to study their morphological characteristics. Performance of coconut in each soil group was assessed by the present yield and growth characteristics of palms.

Field work on soil survey at Hambantota, Matara, Galle, Ambalangoda, Aluthgama, Panadura-Horana, Timbolketiya were completed in June. Fifty eight different soil groups were identified within this area.

The favourable areas for coconut have been identified in IL_{1A}, IL_{1B} and WL_4 agro-ecological regions. The land form of WL_2 and WL_1 regions are rolling or hilly and therefore becomes marginal for coconut cultivation.

Preparation of detailed soil and land suitability maps of Colombo, Kalutara, Galle, Matara, Hambantota and Ratnapura Districts is in progress. Also, preparation of a technical report on soils of coconut growing areas is in progress. Work has already commenced to prepare composite soil maps (scale 1;250,000) for the coconut triangle and Southern area separately and also composite land suitability maps (scale 1:100,000) for the southern area. Those maps will be printed and made available to the public. However, detailed soil maps and land suitability maps of the

Southern coconut growing region will not be printed on 1:63,360 scale but retained as base information. But those maps will be issued in the form of blue-prints on request.

L L W Somasiri, N Nadarajah, L Amarasinghe, D S Wijetunge & K L Ranasinghe

4.2 Characterization of physical properties of coconut soil and studies on the development of coconut roots (CARP Project No. 12/175/149)

Characterization of soil physical properties of major soil series (horizon wise) in the coconut triangle was completed. The soil series used for the characterization were Madampe, Andigama, Rathupasa, Sudu, Ambakelle, Welipellessa, Borupan. Weliketiya, Kalpitiya, Wilpattu, Mavillu, Gambura, Melsiripura, Maho, Kurunegala, Wariyapola, Kuliyapitiya, Boralu, Pallama and Katunayake. Results revealed that bulk density and available water mainly affect coconut production. Using multiple regression and cluster analysis, above soil series were classified into three classes according to their soil physical properties as demonstrated in table 4.

Results also revealed that B horizon in the soil profile is more important than A and AB horizons for the performance of the palm. Hence management practices should be directed towards improving and maintaining the B horizon.

Detailed studies on soil physical properties of Andigama and Madampe soil series in relation to biochemical (ATPase activity, proline accumulation and starch glucose conversion rate) and anatomical characters of absorption cells, root tips and respiratory organs of coconut seedlings were carried out to evaluate the effect of soil physical constraints on growth of coconut seedlings. Results showed that soil physical constraints such as compaction, low availability of water and aeration reduced the ATPase activity and starch-glucose conversion rate resulting in retardation of the growth of coconut seedlings.

L P Vidhana Arachchi, S K Gunaratna & K R E M Fernando

4.3 Study of the microbiological and other related properties of different coconut soils and the assessment of their changes amended with organic manure (CARP Project 1995-1997)

This experiment was commenced in January 1995. For this study, sixty sites were selected within the main coconut growing area of the country representing 20 soil series; namely Rathupasa, Madampe, Katunayaka, Kurunegala, Pallama,

Table 4. *Classification of soil series into different groups using cluster analysis and their soil physical properties*

Soil Physical Properties	Clustered groups (maximum R^2 fitted)		
	Superior soil series	Good soil series	Poor soil series
	* Melsiripura * Ambakelle	* Katunayake * Rathupasa * Madampe * Kurunegala * Pallama * Wilpattu * Mavillu * Borupan	* Andigama * Kuliyapitiya * Boralu * Maho * Wariyapola * Sudu * Kalpitiya
Total available water (mm) in root zone	304 ± 6	226 ± 48	88 ± 17
Bulk density (g/cm3)	1.36 ± 0.25	1.49 ± 0.07	1.5 ± 0.1
Aeration capacity (%)	24 ± 0.14	32.3 ± 1.2	27 ± 12
Micro pores volume (%)	24.6 ± 9.3	12.1 ± 0.7	16.1 ± 9.6
Macro/Micro pores ratio	1.1 ± 0.4	2.99 ± 0.16	3.1 ± 3.5
Sand (%)	75.3 ± 8.5	84.8 ± 0.16	81.0 ± 9.2
Silt (%)	10.4 ± 4.1	4.14 ± 1.5	8.8 ± 6.1
Clay (%)	15.8 ± 5.6	10.4 ± 0.4	10.3 ± 5.3

Melsiripura, Sudu, Wilattawa, Andigama, Negombo, Weliketiya, Boralu, Thambarawa, Kalpitiya, Ambakele, Gambura, Wariyapola, Maho, Warakapola and Kuliyapitiya. Soil samples were collected from six of the above soil series namely; Rathupasa, Madampe, Sudu, Andigama, Wilattawa and Boralu (3 locations per each soil series) for the microbiological, chemical and physical analyses.

According to the available data, the microbial population densities and their activities were low in moisture limiting soil series than nutrient limiting soil series. The microbiological, chemical and physical parameters of these soil series were determined. Identification of bacteria and fungi in these soil series is in progress.

N A Tennakoon, K S K S Fernando & K G D Priyantha

5. MISCELLANEOUS STUDIES

5.1 Study on efficiency of different fertilizer application techniques for coconut

This study was conducted to assess the efficiency of two fertilizer application techniques for coconut; i.e., surface broadcast application and localized application in small pits. The experiment was commenced in 1992 at Ratmalagara Estate, Madampe. Each treatment has 24 coconut palms.

Surface application was effected by broadcasting 3 kg of Adult Coconut fertilizer and 0.8 kg of urea over the manure circle extending up to 1 3/4 m from the base of the palm covering an extent of 9.62 m^2 around the palm.

The localized application was effected by applying fertilizer into pits (30 cm x 30 cm x 30 cm) cut at a distance of 60 cm from the base of the palm. Each coconut palm had two fertilizer pits. The pits were filled with cattle manure up to half of its volume and inorganic fertilizers were applied into it. One half of the recommended ACM (1.5 kg) and urea (0.4 kg) were applied to each pit.

The two techniques were compared by determining the available nutrients (N, P, K, and Mg) of soil samples collected at three depths (0-20 cm, 20-40 cm, 40-60 cm) at various distances from the palm. The soil sampling distances were selected as follows:

(i) Palms receiving fertilizer in pits:

- (a) from the pit at the depths mentioned above
- (b) 100 cm and 140 cm away from the base of the palm but in line with the pit and the palm at the depths mentioned above

(ii) Palms receiving fertilizer by surface broadcasting

- (a) 40 cm and 80 cm away from the edge of the manure circle at the depths mentioned above
- (b) within the manure circle (at 60 cm distance from the base of the palm) at the depths mentioned above

The leaf nutrient (14^{th} leaf) concentration of all treatment palms were determined.

The soil nutrient status at each depth at each distance is given in table 5.

Table 5. *Soil nutrient status at different distances to the treatment palms*

Available P (μg/g)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	19.31	6.21	4.63	32.87	16.08	8.26
20 - 40	2.87	2.87	1.81	25.22	9.06	4.07
40 - 60	7.53	1.87	1.34	20.53	4.07	2.87

Exchangeable K (μg/g)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	76.56	39.46	36.96	60.83	57.18	43.15
20 - 40	136.03	23.52	22.68	56.81	43.39	32.18
40 - 60	129.99	19.83	21.04	68.7	42.89	23.33

Exchangeable Mg (μg/g)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	19.13	6.2	4.63	36.71	16.08	8.26
20 - 40	20.67	2.87	1.80	25.21	9.06	4.07
40 - 60	7.53	1.87	1.34	20.53	4.07	2.87

Ammoniacal N (μg/g d.w.b.)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	20.54	22.73	6.08	15.38	36.33	12.39
20 - 40	30.02	22.32	17.31	21.23	19.37	9.75
40 - 60	35.53	10.51	36.41	12.01	9.53	10.51

Table 5. *Contd.*

Nitrate N (μg/g d.w.b.)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	18.21	20.42	18.46	24.44	23.51	19.62
20 - 40	23.04	18.33	15.66	27.26	21.66	16.43
40 - 60	26.42	21.62	20.19	20.66	18.44	17.21

Total N (%)

Depth (cm)	Surface application			Localized application		
	In MC	40 cm	80 cm	In pit	40 cm	80 cm
0 - 20	0.08	0.08	0.08	0.08	0.07	0.06
20 - 40	0.07	0.07	0.07	0.07	0.07	0.05
40 - 60	0.06	0.06	0.06	0.08	0.07	0.07

There was no differences between the two methods of fertilizer application as far as the retention of NO_3-N and total N in soil is concerned. Both downward and lateral movements of P and Mg were higher in the localized application than in the surface application. The highest P concentration was observed in the pit. Overall results showed that the P concentration in lateral positions of localized application was higher than that of surface application.

Except total N, the concentration of other nutrients at various distances were significantly different between surface application and localized techniques. Ammoniacal N showed the difference only at the second lateral sampling position (80 cm away from the first sampling point).

There was no significant difference in the concentration of NH_4^+-N, NO_3^--N and K at all three depths. But total N, available P and Mg concentration showed significant differences with the depth.

The leaf (14th frond) nutrient concentrations of palms under both fertilizer application techniques were in the sufficiency range and no significant differences were shown between two fertilizer application techniques table 6).

Table 6. *Leaf (14th frond) nutrient concentration of treatment palms*

	Surface application	Localized application
N %	2.18	2.13
P %	0.13	0.13
K %	1.2	1.4
Mg %	0.28	0.27

At the beginning of the experiment, there was no difference in nutrient levels between treatment palms. In the initial stage, there was no difference of levels between treatment palm at the initial stage too.

Overall results suggest that the surface application retained significantly higher K ($P \leq 0.05$) and NH_4-N ($P \leq 0.05$) in soil than the localized application. In contrast the localized application retained significantly higher ($P \leq 0.05$) Mg and P in the soils than the surface application.

H M M Herath & N A Tennakoon

5.2 Long term effects of organic manure application on a coconut plantation on lateritic soils

Different levels of organic manure (goat manure) and recommended inorganic fertilizer were applied regularly to coconut palms on lateritic soils at Saraswathi estate, Divulapitiya for a period of five years from 1985 to 1990. The treatment combinations were T1-T6 i.e. no fertilizer, recommended inorganic fertilizer mixture, 6, 12, 18 and 24 kg of goat dung substituted with inorganic fertilizers respectively. In 1991, the experiment was terminated and handed over to the owner for general maintenance. In 1995, ten years after first fertilizer application, the soils were collected for assessment of soil quality by analysis of microbiological and chemical parameters. The analysis showed that microbiological parameters i.e. total number of bacterial colonies, total number of fungi, CO_2 evolution, N mineralization and ammoniacal N concentrations in goat manure treated soils were significantly higher ($P < 0.05$) than that of control and inorganic fertilizer treated soils. The highest microbiological values were observed in soils treated with 18 kg of goat manure and inorganic supplements than other treatments, even at 10 years after the commencement of the experiment. The chemical analyses are in progress.

N A Tennakoon & S D Hemamala

5.3 Downward movement of major nutrients in different coconut soils

The downward movement of major nutrients was assessed 60 days after the manure application to coconut palms in 1994. The experiment was continued in 1995 also. Soil samples were taken from different depths at 6 months and one year after the fertilizer application in 1995.

The study showed that six months after fertilizer application concentrations of NH_4-N, NO_3-N exchangeable K, Mg & Ca were significantly ($P \leq 0.05$) higher in Boralu series than Sudu and Madampe series. The depletion of nutrient in different soil series decreased in the order Sudu > Madampe > Boralu except nitrate N and exchangeable Mg. The latter nutrients decreased in the order Madampe > Sudu > Boralu. It was also found that nutrient concentration decreased with time and depth.

N A Tennakoon, S D Hemamala & A A Fernando

5.4 Effect of nitrogen fixing tree (NFT) species on soil physical properties of Andigama series

The root distribution pattern of NFT species, *Calliandra calothyrsus, Leucaena leucocephala, Acacia auriculiformis* and *Gliricidia sepium,* their interaction with coconut roots and effect on soil physical improvement of Andigama series were studied.

Soil physical properties such as gravel distribution, texture profile, bulk density, aeration capacity, total available water and readily available water fraction were evaluated within the effective root zone of NFT species.

The results showed that seedling of *Calliandra calothyrsus, Acacia auriculiformis* and *Gliricidia* sepium improved soil physical properties and readily available water fraction throughout the soil profile of Andigama series up to 1.25 m depth better than *Leucaena leucocephala.* It was also observed that the former three species effectively enhance root growth of the coconut palm.

L P Vidhana Arachchi, M de S Liyanage,
K R E M Fernando & S K Gunaratna

5.5 Evaluation of soil microbiological activity in the NFT/Coconut integrated system

Soil microbiological activity at 0-10 cm depth in a mixed plantation of coconut/nitrogen fixing trees (NFT) was compared with coconut monoculture

plantation at Ratmalagara Estate. The microbiological parameters i.e. total number of bacteria, total number of fungi, biomass C, CO_2 evolution and N mineralization rates and physical parameters such as available water were measured.

The microbiological activity and N mineralization rates were found to be significantly higher ($P < 0.001$) in NFT/coconut system than the coconut monoculture system, five years after establishment of NFT. The highest N mineralization occurred in soil samples incubated in the field for four weeks. The available soil water also increased ($P \leq 0.01$) in NFT/coconut system than monoculture plantation. The microbiological activity was in the order of coconut with *Gliricidia* > coconut with *Leucaena* > coconut with *Calliandra* > coconut with Acacia > coconut monoculture.

N A Tennakoon & M de S Liyanage

6. TRAINING ACTIVITIES

Dr. M N Fernandopulle, Dr L L W Somasiri, Dr N A Tennakoon and Mr. L P Vidhanaarachchi functioned as resource persons in training programmes conducted by the Coconut Research Institute, Coconut Development Training Centre, National Fertilizer Secretariat and the National Institute of Plantation Management.

Dr. L L W Somasiri supervised the research project of Miss. Dipika Liyanage, a final year student of the University of Peradeniya. The title of the project was "Evaluation of laboratory methods for potassium estimation of soils in the Intermediate zone, low country region.

Dr. N A Tennakoon supervised the research project of Miss. Manoshika Herath, a final year student of the University of Peradeniya. The title of the project was " Study on the efficiency of different fertilizer application techniques in coconut".

6.1 Extension activities

Dr. N A Tennakoon, 1995 - Locally available organic wastes and their use in coconut cultivation. A radio talk broadcasted by Sri Lanka Broadcasting Corporation in the 'Vidyalokaya' Programme on 22 August.

Dr. N A Tennakoon and G Pinto, 1995 - Toddy tapping in Sri Lanka. A survey was conducted in main coconut growing areas in Sri Lanka.

Hundred and seventy nine coconut estates were inspected for making

Differential Fertilizer Recommendations (DFR). The large number of requests to provide the DFR package is an indication of its acceptability and benefits to the coconut growers.

The following Nos. of leaf, soil, fertilizer and coir dust samples analyzed in the analytical laboratory.

Leaf samples analyzed	a)	Research	- 1302
	b)	DFR	- 1019
Soil samples analyzed	a)	DFR	- 1183
	b)	Research	- 1019
		microbiological	- 380
		chemical	- 1329
		physical	- 310
Fertilizer samples analyzed			- 89
Coir dust samples analyzed			- 40
Organic manure			- 48

7. ACKNOWLEDGEMENTS

The assistance and co-operation of the staff of the Soils and Plant Nutrition Division in compiling this report is gratefully acknowledged. Thanks are due to the Head and staff of the Biometry Division for assistance in designing experiments and statistical analysis of data.

REPORT OF THE CROP PROTECTION DIVISION

Head - C N K Rajapakse, M Sc

1. GENERAL

Control of major pests of coconut through an integrated approach has been a major achievement of the Crop Protection Division. Severe outbreaks of coconut caterpillar were successfully controlled mainly by biological means, reducing the insecticide use by 80%. New and safer alternative pesticides were screened against several pests of coconut, which led to the recommendation of new safer pesticides. Studies on upgrading the current bio-control programme of coconut caterpillar was carried out successfully during the year. Pest surveillance and monitoring programme continued to remain a high priority area in the work programme. Assistance was provided to growers on identification and control of insect pests and diseases of coconut.

2. RESEARCH PROJECTS

PROJECT 10: INTEGRATED MANAGEMENT OF MINOR PESTS OF COCONUT

Experiment 10.1: Evaluation of indigenous plant species against termites (*Odontotermes sp.*) (Laboratory experiment)

Water based rhizome extracts of *Curcuma domestica* (Turmeric) were separated with Ethylacetate and fractionated by solvent - solvent partitioning. Solvents used for the partitioning were hexane, carbontetrachloride, chloroform, ehylacetoacetate, and water. These fractionated extracts were tested for their toxicity to termites which attack coconut seedlings.

Bioassays were done for each extract using live termites. Each extract was replicated 5 times.

Results of these experiments were inconclusive.

C N K Rajapakse, D de Silva (Open University of Sri Lanka) & K F G Perera

Experiment 10.1: Evaluation of indigenous plant species against termites (Field testing)

In order to test the allelopathic activity of *Alocacia sp* (Habarala) and

Curcuma domestica (Turmeric) for termites, field studies were initiated at Girtland Estate, Welipennagahamulla and the coconut nursery in Kandetiya, Makandura.

C N K Rajapakse, H T R Wijesekara,
S P Manoher & W W F N Fernando

Experiment 10.2: Testing alternative insecticides to control termites

Admire SL 200 (20% Imidacloprid) a new insecticide was tested against termites as an alternative to the currently recommended Chlorpyrifos. Imidacloprid belongs to a new group of active ingredients, the Nitroguanidines. Admire SL 200 shows low toxicity to warm-blooded animals, systemic properties and considerable residual activity.

Laboratory and field evaluation of Admire SL 200 was carried out against three species of termites which attack coconut. For laboratory evaluation, four concentrations of Admire SL 200 were tested against *Odontotermes obeses*, which attacks coconut seedlings. The concentrations used were, 0.025%, 0.05%, 0.1% and 0.2%.

Each treatment was replicated 5 times. Uniform size fungus combs with live termites were sprayed with the above concentrations and kept in a room at 85% relative humidity. Mortality counts of termites were recorded 24 hours after spraying. Field testing was carried out at Girtland estate, Welipannagahamulla. Three concentrations of Admire SL 200 were tested against *O. obeses, O. horni* (root invading sp.) and *Nasutitermes ceylonicus* (bark invading sp.). Different concentrations of the insecticide solution were drenched around infested palms at the rate of 5 l per palm.

Results from the laboratory test showed high efficacy of Admire SL 200 against termites. Even the lowest concentration of active ingredient (0.025%) was considerably toxic to termites (Table 1). But the results of field test revealed that effect of lower concentrations was less on termites than the highest concentration (0.1%) (Table 2).

Concentrations below 0.05% would not be suitable for termite control under field conditions. Concentrations of admire SL 200 ranging from 0.1% - 0.2% (1 ml/l - 2 ml/l) could be recommended at the rate of 5 l per m^2 area in the nursery or around the palm. The current recommended insecticide, chlorpyrifos has low residual activity, hence repeated applications are necessary to control the pest. Therefore, Admire SL 200 would be a suitable alternative.

Table 1. *Percentage mortality of termites (Odontotermes obeses) at different concentration of Admire SL 200 (Laboratory test)*

Concentration (a.i)*	% Mortality
0.025%	77.35
0.05%	94.67
0.1%	100.00
0.2%	100.00
control	0

* active ingredient

Table 2. *The average number** of live termites per palm present in the palm bases one week and two weeks after treatment*

Concentration (a.i)	(weeks after tr.) 1	2
0.025%	185.00	-***
0.05%	44.5	60.4
0.1%	6.5	2.6
control	218.9	211.10

** Termite counts were taken from 3 locations in each palm base
*** Data not available

C N K Rajapakse, D C L Happuarachchi, S P Manoher & D M Jayakody

PROJECT 11: ROLE OF THE BENEFICIAL FAUNA IN COCONUT PLANTATIONS

Experiment 11.1: Effect of establishing Honey bees (*Apis cerana*) on fruit set and yield of coconut at Bandirippuwa and Walpita Estates

The objective of this study was to investigate the influence of honey bees as agents of pollination of coconut and its impact on the yield component. Two experiments were carried out in ten acre blocks of coconut in the wet zone (Walpita estate) and intermediate zone (Bandirippuwa estate). Forty palms were selected in each location and grouped according to the yield. Emasculated inflorescences in twenty palms were bagged using nylon netting to prevent activity of honey bees. Rest were kept for open pollination.

In Walpita estate honey bees have contributed considerably to pollination thereby increasing the button nut setting significantly (Table 3). Bee colonies under monoculture coconut plantation in Bandirrippuwa estate performed weakly due to repeated attacks of wax moth. Therefore, observations were not continued at Bandirippuwa estate.

Table 3. *Mean percentage button nut set in experimental palms at Walpita Estate*

Treatment	N#	Mean	Significance
Bagged	313	32.224	*
Opened	313	38.475	

LSD = 2.7503
α = 0.05
Number of inflorescences

H T R Wijesekara, C N K Rajapakse, S P Manoher & W N Fernando

PROJECT 12: DISEASES AND DISORDERS OF COCONUT

Experiment 12.1: Evaluation of four systemic fungicides against root and bole rot disease in coconut caused by *Ganoderma boninense* Pat

Four systemic fungicides; Carbendazim (Bavistin), Tridemorph (Calixin), Tebuconazole (Folicur) and Epiconazole (Opus) were tested to control root and bole rot disease of coconut at Sitrakala estate, Ambalantota. Palms in mild and moderate stages of the disease, were selected for application of treatments and each treatment comprised of 11 palms. Fungicides were administered to the palms by root feeding technique at the following rates. Tebuconazole 10 ml/palm mixed with 10 ml of water, Tridemorph 10 ml/palm and 15 ml/palm mix with 10 ml of water and 15 ml

of water respectively, Epiconazole 10 ml/palm and 15 ml/palm mixed with 10 ml and 15 ml of water respectively and Carbendazim 20 ml /palm and 30 ml/palm.

Epiconazole was not absorbed by roots of coconut palms as it formed a thick layer over the cut surface of the root. Therefore, it was replaced with Tridemorph.

Results revealed that application of 15 ml of Tridemorph, reduced fresh disease symptoms (bleeding and bracket formation) in affected palms, when applied at four month intervals (Table 4).

Table 4. *Number of palms showing fresh disease symptoms in different treatments*

Treatment	Fresh bleeding Time (Months)				Fresh brackets Time (Months)			
	0	4	8	12	0	4	8	12
Carbendazim 20ml	6	1	2	2	3	1	1	0
Carbendazim 30ml	4	2	1	1	5	3	1	0
Tebuconazole	1	2	3	2	5	0	4	1
Tridemorph 10 ml	0	0	4	2	1	0	1	1
Tridemorph 15 ml	0	0	1	0	2	0	0	0
Control	5	0	1	2	2	0	0	0

H T R Wijesekara, K F G Perera & D M Jayakody

Experiment 12.2: Evaluation of integrated control measures for bole and root rot of coconut caused by *Ganoderma boninense* Pat

The study was carried out at Sitrakala estate, Ambalantota.

The following combinations of treatments were applied in integrated manner.

T 1 - Application of organic matter, cutting trenches (0.3 m x 1 m) around palms and application of 10 ml of Tridemorph through roots.

T 2 - Application of organic matter, spraying a spore suspension of *T. viridae* around palms and application of 10 ml of Tridemorph through roots.

T3 - Drenching of copper sulphate solution around palms, and application of 10 ml of Tridemorph through roots.

T4 - Cutting trenches (0.3 m x 1 m) around palms

T5 - Control

Twelve mildly to moderately infected palms were used for each treatment. Treatments were repeated at 4 month intervals.

Fresh bleeding was observed only in a very few palms with Treatments 2 and 3 compared to other treatments.

Application of organic matter and antagonistic fungi such as *T. viridae* to infected palms seems beneficial for preventing the spread of the disease. However, to implement an integrated control programme for long term management of the disease, the above results would not be adequate. Due to the dry weather prevailing in the area and soil condition in the estate, enhancing the activity of antagonistic fungus through organic matter application would not be possible. Application of systemic fungicides and soil drenching with copper sulphate would also be an inappropriate approach because it is uneconomical and would cause ground water contamination. Therefore, uprooting of severely affected palms, isolation of palms in mild and moderate stages of the disease with deep trenches, application of systemic fungicide (Tridemorph) through roots to individual palms and application of organic matter to affected palms may be much beneficial to prolong the economic life span of affected palms.

Table 5. *Number of palms showing fresh bleeding and brackets in different treatments*

Treatment	Fresh bleeding (months)			Fresh brackets (months)		
	4	8	12	4	8	12
T1	1	4	4	1	0	0
T2	1	0	1	0	0	0
T3	1	1	1	0	1	1
T4	1	3	4	0	1	0
T5	3	3	0	0	0	0

H T R Wijesekara, K F G Perera & S P Manoher

Experiment 12.3: Use of fungicides to control immature nut fall

Considerable yield losses were reported in three blocks of Daisy Valley estate, Mawathagama due to immature nutfall. These particular fields were located adjacent to a cocoa plantation. Isolations made from affected cocoa pods revealed high population of *Phytopthora palmivora*. This fungus has been identified as one of the main causes of immature nutfall of coconut in other countries. However, *P. palmivora* was not isolated from the fallen nuts or fresh nuts. Instead, *Fusarium sp.* was isolated in almost all coconut samples. This experiment was undertaken particularly assuming that the immature nut fall in Daisy Valley estate may be either due to *P. palmivora* or *Fusarium sp.*

Fields where immature nut fall was reported were surveyed and mapped. Twenty three palms were selected randomly and subjected to fungicide treatment. These palms were sprayed with 0.5% solution of a copper fungicide which contained copper oxychloride as active ingredient.

Twenty one palms were selected as controls. Number of fallen immature nuts in the experimental palms is being recorded while repeating the treatment at bimonthly intervals.

H T R Wijesekara, C N K Rajapakse, L L W Somasiri (Soils & Plant Nutrition Division) & S P Manoher

Experiment 12.4: Screening of fungicides for stem bleeding disease of coconut

Current CRI recommendation to control the disease is to scoop out the affected tissues from the trunk showing the signs of bleeding. But many farmers practice this method erroneously, sometimes causing serious injury to the fresh tissues. Therefore, screening a new systemic fungicide is essential to overcome this problem. In view of this, experiments have been initiated at Hettipola, Rambodagalla.

Fungicides used were 75% Tridemorph (Calixin), 50% Carbendazim (Bavistin) and 20% Tebuconazole (Folicur).

H T R Wijesekara, S P Manoher & D M Jayakody

PROJECT 14: INTEGRATED MANAGEMENT OF MAJOR INSECT PESTS OF COCONUT

Experiment 14.1.1: Studies on a new *Aphytis* species parasitizing coconut scale insects

Specimens of the new *Aphytis* species have been sent to the International Institute of Entomology for identification.

L C P Fernando & D C L Hapuarachchi

Experiment 14.1.2: Effect of coconut scale infestations on the yield of coconut

The experiment was commenced in one site at Wariyapola.

L C P Fernando & K F G Perera

Experiment 14.2: Integrated management of coconut caterpillar (*Opisina arenosella*)

Experiment 14.2.1: Studies on activity patterns of larval and pupal parasitoid species of coconut caterpillar

Experiment 14.2.1.1: Ovipositional pattern of *Goniozus nephantidis* females (Laboratory)

Daily ovipositional pattern of *G.nephantidis* females was studied on the alternate host *Corcyra cephalonica*. Females of *G. nephantidis* oviposit in batches which last about 3 - 4 hours. The eggs are generally deposited one day after the host is paralysed. Each batch of eggs is deposited on a single host. Females do not oviposit daily, but in intervals of 3.7 - 4.4 days. Mean number of 27.9 eggs (n= 43) are laid in 3-6 batches during the life time of females. Therefore, in the field a female would parasitize much less than six larvae, as oviposition could be greatly affected by adverse climatic conditions, natural enemies and other interferences.

P B L Dias (University of Ruhuna) & L C P Fernando

Experiment 14.2.1.2: Fate of *G. nephantidis* females in the area of release

Studies in the previous year have shown that *G. nephantidis* females have the full complement of mature ovarian eggs, 4-7 days after emergence (at the end of the pre-ovipositional period). Therefore, it was predicted that 4-7 day old females (gravid) would parasitize larvae in the vicinity of the release point, as their motivation will be to oviposit. Two trials in the screen house and in the field were carried out to test the above hypothesis.

Screen house trial:

Twenty three potted seedlings infested by coconut caterpillar were arranged in rows in the screen house. About 50, *G. nephantidis* females of 5 day old were released on the seedling placed in the centre. Twelve days later caterpillar larvae in the seedlings were examined for parasitism. Although adequate number of suitable stage larvae was present at the time of release only one larva in the centre seedling was parasitized. Hence, the fate of the released parasitoids were unknown.

Field trial:

With the same objective, an experiment was conducted in a heavily infested estate at Mangala Eliya (Puttalum district).

Twenty four palms up to a distance of 8 rows from a centre palm were selected and about 2000 gravid females were released on to the crown of the centre palm. Observations on parasitism were taken prior to release of parasitoids and 11, 20, 34, 38 and 60 days after release.

The results showed that parasitism by *G. nephantidis* has not increased considerably after the release of gravid females except a slight increase up to 20 days from the day of release (Table 6). As predicted the parasitism was distributed on the centre palm and other palms closer to the release point. Absence of fresh parasitism thereafter is unknown. Compared to the larval population of the pest, parasitism by *G. nephantidis* in the field was very low (Table 6). Therefore, it seems that if this parasitoid is to be used to check heavy infestations of coconut caterpillar inundative releases of gravid females would be necessary. Also, releases have to be made at several sites in a unit area. Further experiments need to be carried out in different areas to confirm the above suggestions.

Table 6. *Populations of coconut caterpillar and parasitization by G. nephantidis (n=25, 20 leaflets per sample) before and after release of 3 day old gravid females of G. nephantidis in Mangala Eliya*

Population	Before release	Days after release				
		11	20	34	48	60
Larvae (L3-L5)	2075	1673	636	115	2198	1660
Live pupae	49	335	521	40	14	290
Parasitized						
fresh	1	3	2	0	0	0
emerged	1	3	2	5	2	2

Experiment 14.2.1.3: Behaviour of *G. nephantidis* females during the pre-ovipositional period

Two trials in the screen house and in the field were conducted.

Twenty three caterpillar infested seedlings were arranged in 5 rows in the screen house. Sticky traps with a height similar to that of seedlings (about 1 m) were set around the group of seedlings . About 100 *G. nephantidis* cocoons from which adults were about to emerge were placed on the centre seedling. Sticky traps were observed each day for 12 days for trapped *Goniozus* and at the end of this period all seedlings were examined for parasitized larvae. Only 9 females were caught in the sticky traps at different intervals, but no parasitism were recorded. It seemed that females with immature ovaries may fly upwards and leave the site of emergence.

To complement the above screen house experiment, a field trial was carried out in an estate in Ganewatte to investigate whether one day old (having immature ovaries) females would parasitize coconut caterpillar larvae in the vicinity of release point or fly out to more distant palms.

One centre infested palm and another 27 palms up to a distance of 8 rows from the centre palm were chosen for sampling. About 1000 one day old females were released onto the crown of the centre palm. Population counts before release and 40, 60 and 90 days after release were recorded. Parasitism appeared only about 60 days after release (Table 7). and higher parasitism was observed in the palms at the edge of the sampling area.

Results indicated, that females leave the area of release without parasitizing hosts in the vicinity, but their offspring may return to the area after a period of time. Therefore, release of newly emerged *G. nephantidis* females may not be effective in controlling severe outbreaks.

Experiment 14.2.2: Cost effective control programme for coconut caterpillar

Studies in the previous year have shown that the insecticide requirement to control severe infestations of coconut caterpillar could be reduced by half, if integrated with parasitoids. To investigate whether insecticide usage could be reduced further to control severe outbreaks, experiment was carried out in two adjacent estates in Nikadalupotha area.

In the infested area of Papolagala A Estate 20 % of the palms were treated with 60 % monocrotophos keeping the rest (80%) untreated. In Papolagala C Estate, insecticides were administered to 33.3% of the infested palms keeping the other 66.6% untreated. It was assumed that the parasitism rate of the untreated palms

Table 7. *Population of coconut caterpillar and parasitization by G. nephantidis (n=28, 20 leaflets per sample) before and after release of one day old G. nephantidis females at Ganewatte*

Population	Before release	Days after release 40	60	90
Larvae (L3-L5)	898	539	41	873
Live pupae	81	177	93	12
Parasitized				
fresh	0	0	8	0
emerged	0	0	4	2

L C P Fernando, A Siriwardena, K A S Chandrasiri & D C L Hapuarachchi

would increase due to migration of parasitoids from treated palms. Population counts of both pest and the parasitoids were taken in selected palms at fortnightly intervals for three months. Weather data were collected.

Both larval and pupal populations of the pest decreased exponentially over the time in both estates (The Kruskal-Wallis test, $P > 0.05$). Also, the distribution of the pest and parasitoids followed similar trend in both estates (Fig 1 & 2). The fitted statistical model indicated that the rate of decrease in the pest population is higher in Papolagala A Estate where 20% of infested palms were treated. Maximum day temperature was the key climatic factor which influenced the increase of the pest population. However, due to the combined effect of chemicals and parasitoid activity in both estates, pest population was controlled to a minimal level within three months after treatments, thus preventing economic yield losses in affected palms. Results revealed that *Brachymaria nephantidis*, a pupal parasitoid of the coconut caterpillar was the predominant parasitoid species in this area.

C N K Rajapakse, L C P Fernando, K A S Chandrasiri & K F G Perera

Experiment 14.3: Integrated Management of coconut black beetle

Experiment 14.3.1: Incorporation of *Baculovirus oryctes* into the natural breeding sites of black beetle

This experiment was initiated at two locations, Marawila and Madampe in the coconut triangle.

C N K Rajapakse, H T R Wijesekara & K A S Chandrasiri

Experiment 14.3.2: Screening of insecticides for black beetle control

Slow release formulation of carbosulfan 5G, a granular insecticide was screened for black beetle control in comparison with the currently recommended insecticide carbofuran 3G at a site in Walahapitiya. Two concentrations (5 g/seedling and 15 g/seedling) of carbosulfan was tested along with the 15 g of carbofuran.

Both carbosulfan and carbofuran were mixed with equal amount of sand and applied to the innermost leaf axils around the spear leaf of affected seedlings. Fifteen seedlings were used for each concentration.

Fresh bud damage done by the black beetle was recorded for 5 months after treatments.

Results showed that the bud damage was lowest in seedlings treated with 15 g of carbosulfan (Table 8). Both 5 g of carbosulfan and 15 g of carbofuran were equally effective in controlling black beetle.

Table 8. Mean percentage of affected seedlings (during 5 month period) treated with carbosulfan and carbofuran

Treatment	% bud damage	Significance
Carbofuran 15 g	12.58	
Carbosulfan 5 g	15.98	
Carbosulfan 15 g	5.98	*
Control	26.23	**

(* $\alpha = 0.05$; ** $\alpha = 0.01$)

The current recommendation for black beetle control is to apply carbofuran granules at the rate of 15 g per seedling. Carbofuran is a systemic carbamate insecticide with a residual activity up to about 30 days. Therefore, frequent application of carbofuran is necessary to prevent and control black beetle. In contrast, Carbosulfan is a slow release formulation which belongs to the same group of insecticides. Therefore, its toxicity persists for at least 3-4 months in treated seedlings. Results revealed that even 5 g of carbosulfan is adequate to reduce the pest damage to a considerable extent. Preliminary observations have also revealed that carbosulfan is an effective alternative to carbofuran. Therefore, 5 - 15 g of carbosulfan could be recommended to be incorporated to the integrated management programme for black beetle.

C N K Rajapakse & K F G Perera

CARP CONTRACT RESEARCH PROJECT NO 12/266/210:

MONITOR AND CONTROL OF ADULT RED WEEVIL (*Rhynchophorus ferrugineous*) POPULATION IN SRI LANKA BY THE USE OF AN ATTRACTANT BAITED TRAP

A new and inexpensive pheromone trap has been developed for red palm weevil. The attractant used in this trap was the recently identified aggregation pheromone (4-methyl 5- nonanol) (Hallett *et al.*, 1993) of *Rhynchophorus ferrugineous*. Different traps including the CRI recommended type were tested in many locations in the coconut triangle. Traps tested were;

1. Open bucket type with the hood
2. Open bucket type with the funnel
3. Polythene trap
4. Currently recommended metal trap

The aggregation pheromone analogue used in this test was synthesized at the Chemistry department of the University of Kelaniya. Significantly ($p=0.05$) more pests were trapped in the open bucket type with the hood than in the other traps. The total cost of this trap is around Rs 100, while the currently recommended trap costs Rs 600/-. Behaviour of red weevil related to the aggregation pheromone is under study.

C N K Rajapakse, N Gunawardene (University of Kelaniya), N Waidyaratna & N Senaviratne

3. NEW RECORD OF PESTS OF COCONUT

Spodoptera litura Fabricus (Lepidoptera: Noctuidae) has been recorded as a minor pest in the coconut variety San Ramon. Larvae attacked the base of seedling eventually causing death.

C N K Rajapakse & K A S Chandrasiri

4. INCIDENCE OF INSECT PESTS AND DISEASES

During the year, over 100 pest incidences were reported and appropriate control measures were recommended. Outbreak of Red palm weevil (*Rhynchophorus ferrugineous*) in the North Western Province and coconut caterpillar (*Opisina arenosella*) in the North Western, Western, Eastern and Southern Provinces were reported. Also, severe infection of bud rot was reported from eight estates in the North Western Province (Table 9).

Table 9. *Reports of insect pests and diseases in 1995*

Pest/Disease	Total No. reports	Province WP	NWP	CP	SP	NCP	EP	SaP
Insect pests								
Red Weevil	24	02	18	01	02	-	-	01
Black beetle	16	01	10	-	03	01	-	01
coconut caterpillar	44	08	26	-	03	-	07	-
Scale insect	03	-	02	-	-	01	-	-
Termites	03	-	03	-	-	-	-	01
Minor pests	09	-	05	-	04	-	-	-
Diseases								
Bud rot	04	-	03	-	01	-	-	-
Stem bleeding	07	-	05	-	02	-	-	-
Other diseases	04	-	01			01	01	-

(WP-Western Province, NWP-North Western Province, CP-Central Province, SP-Southern Province, NCP-North Central Province, EP-Eastern Province, SaP-Sabaragamuwa Province)

5. CROP PROTECTION SERVICES

The Division continued to assist coconut growers to protect their plantations against pest and diseases.

5.1 Biological control

5.1.1 *Opisina arenosella* (Coconut Caterpillar)

Parasitoids of coconut caterpillar were mass reared in the insectary at Bandirippuwa Estate and despatched to many caterpillar infested areas. In certain areas, parasitoid releases were done under the personal supervision of CRI staff. The numbers of parasitoids released in different provinces are given in Table 10.

5.1.2 *Oryctes rhinoceros* (Black Beetle)

Many consignments of Baculovirus infected larvae were released to plantations in the Southern, Western and North Western Provinces for the control of black beetle.

5.1.3 Weeds

The biological control agent, *Pareuchaetes pseudoinsulata* was released to plantations for the control of the weed Podisinghomaran (*Chromolaena odorata).*

Table 10. *Releases of parasitoids in different provinces for the control of Coconut Caterpillar (1995)*

Parasitoid	WP	NWP	SP	EP
P1	264500	563400	71750	49000
P2	55700	100100	14500	3750
P3	14950	17050	6900	1700
P4	235100	57000	1500	-
P5	6000	7300	-	-
Total	576250	644950	94650	54450

P1 - *Bracon hebetor*
P2 - *Goniozus nephantidis*
P3 - *Eriborus trochanteratus*
P4 - *Trichospilus pupivora*
P5 - *Brachymaria nephantidis*

WP - Western Province
NWP- North Western Province
SP - Southern Province
EP - Eastern Province

5.2 Chemical control

Trunk injection with 60 % monocrotophos was done in severe outbreaks of coconut caterpillar (*Opisina arenosella*), red palm weevil (*Rynchophorus ferrugineous*) and scale insect (*Aspidiotus destructor*). Following a decision of the Coconut Research Board, pest control service was provided to the estate sector at low cost.

6. TRAINING AND EXTENSION ACTIVITIES

The following lectures/demonstrations were conducted:

Mrs. C N K Rajapakse on 'Pest and diseases of coconut and their control' to Project Managers of the Dept. of Irrigation 23 Jan, and to agriculture teachers of puttalum District on 25 July, 28 September and 01 October 1995.

Mr. H T R Wijesekara on 'Pest and diseases of coconut and their control' to Agricultural Instructors of the Agriculture Department on 19 & 21 December 1995.

Mr. H T R Wijesekara, Dr. (Mrs) L C P Fernando and Mrs. C N K Rajapakse on 'Pests and diseases of coconut and their control' to middle level management staff of coconut estates on 15 September 1995.

Dr. (Mrs.) L C P Fernando, Mrs. C N K Rajapakse and Mr. H T R Wijesekara on 'Pests & diseases of coconut and bee keeping' in coconut plantations for the group of trainees from the National Institute of Plantation management on 16 March, 1995.

The Technical and the Field staff of the Division conducted demonstrations on "Pests of coconut and their control" for Coconut Development Officers of the Coconut Cultivation Board and owners and management staff of coconut estates.

Divisional Research staff participated in the 4th Research Extension dialogue at Coconut Development Training centre and many other research discussions during the year.

Field day on *Baculovirus oryctes* was held in Kalpitiya CDO range for the benefit of coconut growers.

6.1 Training

A batch of 30 students from the Eastern University had one day training on pests of coconut and their control.

Ms. Lalani Dias, an undergraduate student of the University of Ruhuna, completed a project titled "Ovipositional behaviour of *Goniozus nephantidis*" from May to December, 1995.

A batch of final year students from the University of Colombo received one day training on biological control of coconut pests.

7. REFERENCES

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8. ACKNOWLEDGEMENTS

The co-operation and assistance extended by the staff of the Crop Protection Division in the research and other activities during the year are gratefully acknowledged. Sincere thanks are due to the Head and the staff of the Biometry Division for assistance in designing of experiments and analysis of data.

REPORT OF THE BIOMETRY DIVISION

HEAD - D T MATHES, FIS

1. GENERAL

Computerization: The computer facilities in the Division were strengthened with an additional 486 DX Personnel computer and the staff was shifting gradually from DOS environment to windows environment.

2. BIOMETRICAL ASSISTANCE

Assistance to the research staff was provided by way of statistical consultancy, selection of lands, layout of experimental designs, analysis and interpretation of data.

Special assistance was provided to Miss C S Ranasinghe (Plant Physiology Division), Mr. K B Dasanayake and Mr M T N Fernando (Agronomy Division) and Mr L P Vidanaarachchi (Soils & Plant Nutrition Division) in respect to their post graduate projects. A number of undergraduate and postgraduate students from the Universities of Colombo, Peradeniya, Matara and Sri Jayawardenapura 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)

(a) The bimonthly recording of vegetative and yield characters was carriedout during the year. Variation in yield parameters between the six picks of 1994 and 1995 is given in Tables 1 and 2. The total number of bunches for the year showed an increase of 3.1% over 1994. But the number of nuts per palm, showed an increase only in the first pick. On the whole, there was 18.2% decrease in number of nuts per hectare over the previous year. The recorded yield was 13985 nuts/ha compared to 17089 nuts/ha in 1994. The copra yield per hectare was 2844.5 Kg/ha which again represented a 23.8% decrease over 1994.

(b) Two monthly vs.monthly harvesting

Since the beginning of 1990, palms in the calibration trial were divided into two groups of 50 palms each and harvesting was carried out at two-monthly intervals

Table 1. *Average yield components of palms at Walpita Estate in 1995*

Pick Number	Number of bunches/palm	Number of nuts/palm	Number of nuts/ha	Number of nuts/bunch
1	2.1 (2.3)	12.3 (11.0)	1948 (1733)	5.9 (5.3)
2	2.6 (2.5)	15.0 (17.7)	2369 (2765)	5.7 (7.1)
3	2.2 (2.0)	19.3 (21.0)	3050 (3319)	8.8 (10.6)
4	2.1 (2.1)	16.8 (24.0)	2664 (3797)	8.1 (11.7)
5	2.2 (2.4)	14.3 (20.6)	2262 (3256)	6.4 (8.5)
6	2.1 (1.8)	10.7 (14.0)	1692 (2219)	5.2 (8.0)
Total	13.3 (12.9)	88.4 (108.1)	13985 (17089)	

(Figures in paranthesis are those recorded in 1994)

Table 2. *Average weight of husked nut and Copra yield of palms at Walpita Estate in 1995*

Pick	Weight of husked nut (g)		Copra (kg/ha)	
	1995	1994	1995	1994
1	652	766	406.43	424.79
2	661	751	501.09	664.48
3	626	663	610.98	704.16
4	652	639	555.82	776.41
5	607	661	439.37	688.71
6	611	667	330.82	473.62
Total/Ave.	636	681	2844.51	3732.17

(Copra Yield = husked nut weight x 0.32)

for one group and at monthly intervals for the other group. The number of nuts and number of bunches per 50 palms recorded prior to 1990 and after 1990 for the two groups are shown in Tables 3 and 4. The results indicated an increased yield for monthly harvesting from 1990 to 1995. The year 1994 being a good crop year, has shown a marked difference in the number of nuts and bunches for monthly harvesting as against two monthly harvesting. In spite of the poor crop in 1995 monthly harvesting practice, recorded 22.6% increase in nut yield as against bimonthly harvesting. The increase in number of bunches was 16.6%. The results suggest that there appears to be a reduction in the number of fallen nuts during poor weather conditions.

(The observations prior to 1990 shown in the Tables 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 Ave 87-89	1990	1991	1990 and thereafter 1992	1993	1994	1995
Monthly	4689	4976	5354	5023	2499	6167	4881
Two monthly	4492	4348	4910	4654	1947	4661	3981
Difference							
No	197	628	444	369	552	1506	900
%	4.4	14.4	9.0	7.9	28.4	32.3	22.6

Table 4. *Number of bunches per 50 palms*

Frequency of harvesting	Prior to 1990 Ave 87-89	1990	1991	1990 and thereafter 1992	1993	1994	1995
Monthly	639	711	630	691	579	673	715
Two Monthly	614	653	598	643	410	600	613
Difference							
No	25	58	32	48	169	73	102
%	4.1	8.9	5.4	7.5	41.2	12.2	16.6

D T Mathes, R Fernando, W M L G Fernando, K Herath & P Fernando

PROJECT 20. INFLUENCE OF CLIMATE AND WEATHER ON THE NUT YIELD OF COCONUT AT BANDIRIPPUWA ESTATE

(a) The yield variability: pick-wise and annual

The time series plot of pick-wise and annual data showed there was no systematic pattern such as trend, cycle, and seasonality in the series. The analysis of distribution of the autocorrelation coefficients of each series confirmed that the data were randomly distributed. Therefore, it can be concluded that year-to-year variation of pick-wise and annual data were accounted for by the climatic and weather variability due to the various climatic elements.

To test the variability of yields between picks and between years from (1976-1992), analysis of variance was performed using the nested type linear model. The results showed that the variance between picks is about five times the variance between years, indicating yield variability between picks is much greater than between years. This could be due to the higher variability of weather parameters within years than between years. The yields were significantly different between picks and between years. Pick 3 was significantly different from rest of the picks.

Based on the mean yield of picks, over the 17 year period, the picks can be ranked, as

$$P_3 > P_4 > P_2 > P_5 > P_1 > P_6.$$

The Kruskal-Wallis nonparametric test, however, showed that the ranking order of picks was significantly different between years ($p < 0.05$), thus indicating, no consistent trend in the order of the six picks for different years. The mean percentage contributions over the years from the individual picks to the annual yield were 12.6, 19.6, 23.7, 20.1, 14.0 and 10.0 for picks 1-6 respectively. The mean and the standard errors of the picks 1- 6 were 1526 (±421), 1294 (±352), 1262 (±362), 898 (±372), 809 (±238), and 646 (±204) respectively.

(b) Climate variability at Bandirippuwa Estate (BE)

The monthly climatic data on rainfall, pan evaporation, sunshine duration, wind velocity, minimum air temperature, maximum air temperature, relative humidity in forenoon, and in afternoon from 1976 to 1992 were analyzed. Further solar radiation and saturation deficit were estimated based on these variables.

The 75 percent expectancy value of annual rainfall at BE > 1600 mm. The mean monthly rainfall varied from around 35 mm (January) to 310 mm (November). There were two wet seasons in a year, during May/June, and October and November. More than 50 per cent of the annual rainfall in each year was accounted for by these four months. The rainfall during October and November was more consistant than that of May/June.

The mean annual evaporation was around 1400 mm (± 150) and the 75 per cent expectancy value of the evaporation > 1270 mm. The sunshine duration was highest during February and March. It decreased in the range of 9 to 5 hrs per day from February to June. The mean sunshine duration during July to December remained virtually static in the range of 6 to 7 hrs per day. It was also estimated that the mean daily solar radiation over the 17 year period was 18.3 $MJm^{-2}d^{-1}$. Thus the total annual solar radiation received was estimated at about 6680 MJm^{-2} (66.8 TJha-1). The wind velocity varied from about 6 km/hr in January to about 4.5 km/hr in October and November.

The variation of mean air temperature throughout the year was very low with a maximum of about 28 °C in April and a minimum of 27 °C in December. The mean diurnal temperature between months fluctuated in the range of 5 - 11°C. The maximum air temperature varied from about 33°C in February and March to about 30°C in July and August, while the minimum air temperature varied from around 25°C in June and July to 22°C in January and February. The relative humidity in the morning fluctuated around 80 during the year.

It was also estimated that there were distinct seasonal differences in the maximum saturation deficit, however the mean saturation deficit was virtually static between 0.6 and 0.8 kPa. During the dry seasons, from December to February, maximum saturation deficit increased steadily from 1.4 to 2.0 kPa. While during the rainy seasons (May, October, and November) it decreased to 1.2 kPa.

The ranking of months based on the descending order of the eight climatic variables is as follows:

RF	Oct > Nov > May > Jun > Sep > Apr > Mar > Jul > Aug > Dec > Feb > Jan
EV	Mar > Jan > Feb > Apr > May > Aug > Sep > Jul > Oct > Dec > Jun > Nov
SS	Mar > Feb > Jan > Apr > Dec > May > Aug > Oct > Jul > Sep > Nov > Jun
WV	Jan > Aug > Dec > Feb > Jun > Jul > Sep > Apr > Mar > May > Nov > Oct
TMAX	Feb > Mar > Apr > May > Jan > Dec > Nov > Jun > Oct > Sep > Aug > Jul
TMIN	Jul > Jun > Aug > May > Sep > Apr > Oct > Mar > Nov > Dec > Jan > Feb
RHAM	Nov > Oct > Jun > May > Jul > Dec > Sep > Aug > Apr > Jan > Mar > Feb
RHPM	Jun > Jul > Oct > May > Aug > Nov > Sep > Apr > Dec > Mar > Feb > Jan

The results showed that the months cannot be pooled together into homogeneous climatic groups.

T S G Peiris

4. ASSISTANCE IN USE OF COMPUTERS AND COMPUTING

(a) A basic training on the use of, Statistical Analysis System (SAS) and Word Processing packages were provided on an individual basis, to the research officers who went abroad on postgraduate training.

D T Mathes, T S G Peiris & H P De Zoysa

(b) Computerization of experimental data was continued throughout the year.

W E R C Fernando, K Herath & D T Mathes

(c) Computerization of the meteorological data at Bandirippuwa Estate, Ratmalagara Estate, Isolated Seed Garden and Maduru Oya seed garden and

providing such information weekly to Meteorology Department and other Institutions continued throughout the year.

Protus Fernando, J D J S Kularatne & D T Mathes

(d) Assistance was provided quite often to all research divisions on the use/application of data base packages and statistical packages.

H P De Zoysa, D T Mathes & J D J S Kularatne

(e) Assistance in computerizing and processing of information of the Medical Aid Scheme.

T S G Peiris

(f) Assistance was provided for the installation of computers and maintenance of hardware and software.

H P De Zoysa

5. YIELD RECORDING

The recording of yield components of experiments conducted by the Research Divisions was continued in the following estates.

I	Bandirippuwa	VI	Pothukulama
II	Ratmalagara	VII	Saddhatissa
III	Wayagolla Estate, Attanagalle	VIII	Walpita
IV	Thambapanni Estate, Puttlam	IX	Siringapatha
V	Ganewatta Estate, Ganewatta		

6. 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 accommodated from time to time. Visitors and students from Universities were briefed on the work of the Division.

7. AGRI-METEOROLOGY

The three agri-meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained. At Bandirippuwa, daily recordings were taken throughout the year on rainfall, air temperature (at 8.30 and 15.30 hrs), evaporation, relative humidity (morning and afternoon), sunshine hours and soil temperature at six different depths.

A new agri-meteorological station was established, at Maduru Oya Seed Garden, at Bogaswewa.

7.1 Bandirippuwa Estate

(a) Rainfall: All months recorded rainfall, with December receiving a low rainfall of 18.8 mm. Heavy rainfall was recorded for November (558.3mm) as against 1963.9 mm, the total rainfall for the year. It contributed to about 30% of the total rainfall. There were heavy showers during months of April, May and June. The rainfall during January, February and September were low compared with the corresponding values in 1994. (See Table 5).

(b) Temperature: The monthly maximum temperature ranged from 30.3 (August) to 32.7 ^{0}C (March). The monthly minimum temperature ranged from 22.2 (February) to 25.6 ^{0}C (May). (See Table 6).

(c) Sunshine: Longer sunshine hours were observed during the early part of the year with a maximum of 9.3 hrs per day in March. The average for the year was 7.4 h. (See Table 6).

(d) Evaporation: The lowest and highest evaporation was recorded in October and March respectively.

(e) Relative Humidity: The relative humidity in the morning fluctuated around 80 during the year. In the afternoon it varied from around 55 in December to around 80 in June.

(f) Soil Temperature: The average temperatures recorded at depths 5, 10, 20, 30, 60 and 120 cm during the morning were 27.6, 27.8, 28.2, 28.7, 29.7, 29.5 ^{0}C while those for the afternoon were 31.8, 30.4, 29.5, 29.1, 29.6, 29.5 ^{0}C respectively. (See Table 7).

(g) Wind velocity: The wind velocity varied from 3.0 km/hr in November to 6.00 km/hr in January with the mean of 4.9 km/hr.

7.2 Ratmalagara Estate

All months have recorded rainfall, with September showing the lowest. The rainfall for two months October and November, was 732.4 mm compared to the rainfall of 1629.7 mm shown for the whole year. (See Table 8).

7.3 Isolated Seed Garden

Fairly well distributed rainfall was shown over the year with August and September showing a rainfall of 13.8 and 2.7 mm. The total rainfall for the year was 1834.1 mm as against 1286.0 mm. in 1994. This is an increase of 30%. (See Table 9).

Table 5. *Rainfall(mm) for the last 10 years and in 1995 (Bandirippuwa Estate)*

Month	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	85-94 Ave	1995
Jan	13.0	61.7	31.2	0.0	25.4	201.8	37.7	5.3	3.8	122.4	50.2	45.3
Feb	189.0	35.0	0.0	111.4	0.0	16.8	12.2	0.0	20.6	195.7	58.0	51.6
Mar	228.9	62.0	118.3	87.4	65.7	84.3	97.5	0.0	63.5	71.4	87.9	100.8
Apr	103.9	60.2	237.6	283.0	234.9	74.8	90.3	54.5	191.4	132.9	146.3	276.6
May	275.3	284.7	187.2	109.9	52.3	227.7	481.5	413.5	255.2	262.9	255.0	399.1
Jun	291.3	44.7	61.6	255.8	153.4	29.0	269.4	260.2	49.2	70.4	148.5	207.2
Jul	14.5	33.5	6.4	151.8	99.0	156.3	105.8	78.0	73.6	60.6	77.9	35.2
Aug	139.9	77.2	156.5	105.2	20.4	0.3	22.6	57.3	56.7	37.5	67.4	35.4
Sep	168.4	94.7	410.7	303.4	222.1	11.9	59.3	362.6	200.9	279.6	211.4	41.1
Oct	195.6	224.3	579.3	88.8	395.9	395.1	309.2	443.7	324.7	378.3	333.5	194.5
Nov	306.3	149.4	194.7	370.7	379.4	623.3	161.4	317.9	301.6	284.2	308.9	558.3
Dec	63.7	63.5	79.9	19.1	50.3	90.2	29.1	60.7	237.6	9.1	70.3	18.8
TOTAL	1989.8	1190.9	2063.4	1886.5	1698.8	1911.5	1676.0	2053.7	1778.8	1905.0	1815.4	1963.9

Table 6. *Summary of meteorological observation in 1995 (Bandirippuwa Estate)*

Month	Temperature (C°) max	min	Evaporation (mm) per day	Relative humidity(%) a.m.	p.m.	Sunshine(hrs)	Wind Velocity (km/h)
January	31.7	22.4	4.3	81.0	61.0	7.5	6.0
February	32.0	22.2	4.5	79.2	59.9	8.5	4.7
March	32.7	22.7	5.1	77.1	64.6	9.3	3.8
April	31.7	23.9	3.8	82.4	71.1	8.5	3.3
May	31.2	25.6	3.7	84.4	76.7	7.0	5.0
June	31.7	25.4	3.4	85.0	79.7	5.6	5.6
July	31.2	25.3	3.9	82.2	76.0	7.8	5.2
August	30.3	25.1	3.9	83.1	75.5	7.8	5.8
Septempber	30.8	25.0	4.2	81.2	73.8	7.6	5.6
October	31.5	24.6	2.8	81.4	74.4	6.4	4.3
November	30.4	22.9	3.1	84.5	75.4	6.0	3.0
December	31.4	22.2	4.6	76.7	55.9	7.5	6.5
Average	31.3	23.9	3.9	81.5	70.4	7.4	4.9

Table 7. *Soil temperature (°C) at different depths (Bandirippuwa Estate)*

Month	Morning						Afternoon					
	5 cm	10 cm	20 cm	30 cm	60 cm	120 cm	5 cm	10 cm	20 cm	30 cm	60 cm	120 cm
Jan	26.2	26.7	27.3	28.0	29.1	28.9	30.2	29.7	28.6	28.4	29.0	28.9
Feb	26.4	27.1	27.7	28.4	29.4	29.1	32.1	30.9	29.3	29.0	29.3	29.1
Mar	27.9	28.1	28.8	29.4	30.3	29.8	35.6	32.3	30.7	30.1	30.1	29.7
Apr	28.4	28.3	28.6	29.2	30.1	30.0	32.8	31.1	30.1	29.8	30.0	30.0
May	28.2	28.3	28.5	29.0	29.8	39.7	31.2	30.3	29.4	29.3	29.8	29.7
Jun	28.2	28.4	28.6	29.1	29.9	29.9	30.1	29.6	29.2	29.1	29.8	29.9
Jul	28.1	28.2	28.4	28.9	29.8	29.8	30.8	29.9	29.3	29.0	29.7	29.7
Aug	28.3	28.5	28.8	29.2	30.1	29.9	31.8	30.6	29.7	29.4	30.0	29.9
Sep	28.4	28.6	28.8	29.3	30.1	30.0	31.9	30.8	29.8	29.5	30.0	30.0
Oct	27.9	27.9	28.1	28.8	29.9	29.9	30.7	30.0	29.3	29.2	29.8	29.9
Nov	26.2	26.3	26.5	27.1	28.0	28.1	29.8	29.0	28.0	27.6	28.0	28.1
Dec	26.9	27.2	27.9	28.6	29.5	29.3	34.0	31.0	29.7	29.4	29.4	29.2
Ave	27.6	27.8	28.2	28.7	29.7	29.5	31.8	30.4	29.5	29.1	29.6	29.5

Table 8. *Rainfall (mm) for the last 10 years and in 1995 (Ratmalagara Estate)*

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	85-94 Ave	1995
Jan	16.6	64.8	13.6	0.0	77.7	185.5	36.2	0.0	17.5	101.5	51.3	16.6
Feb	122.1	54.3	0.0	101.3	0.0	8.3	12.2	0.0	22.9	63.4	38.4	55.7
Mar	158.3	74.7	72.0	53.3	117.4	96.2	88.8	0.0	85.1	21.0	76.7	85.6
Apr	208.3	143.4	120.4	231.4	204.2	37.7	104.4	236.9	278.9	218.2	178.4	287.3
May	82.3	246.1	141.5	68.0	54.2	114.6	375.7	275.2	216.4	281.8	185.6	257.9
Jun	126.0	50.9	65.1	221.9	126.5	12.6	264.2	191.2	23.5	64.5	114.6	121.0
Jul	39.1	22.6	16.9	57.9	124.2	92.7	38.1	71.5	25.8	55.9	54.5	19.9
Aug	13.3	85.9	139.5	158.1	10.0	0.0	16.1	11.5	22.7	22.1	47.9	17.3
Sept	84.2	26.4	190.0	259.7	161.4	17.4	43.0	192.8	198.3	132.7	130.6	13.5
Oct	209.9	153.0	502.8	58.0	238.9	389.2	211.3	326.9	281.4	545.8	291.7	148.1
Nov	319.0	228.4	195.9	230.1	298.7	434.6	175.8	505.5	393.5	204.4	298.6	584.3
Dec	104.4	95.9	53.2	88.8	24.4	76.7	82.2	56.4	197.6	6.4	78.6	22.5
TOTAL	1483.5	1246.4	1510.9	1528.5	1437.6	1465.5	1448.0	1867.9	1763.6	1717.7	1546.9	1629.7

Table 9. *Rainfall (mm) for the last 10 years and in 1995 (Isolated Seed Estate)*

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	85-94 Ave	1995
Jan	38.3	59.1	5.9	3.3	58.4	221.6	44.0	0.0	9.4	110.5	55.1	51.2
Feb	113.4	65.8	0.0	135.0	0.0	0.0	0.0	0.0	2.0	71.6	38.8	32.6
Mar	94.6	55.3	21.7	77.4	29.5	34.0	116.0	0.0	53.5	79.6	56.2	59.5
Apr	100.0	104.9	141.1	233.3	81.7	38.8	147.9	217.8	164.0	141.4	137.1	348.2
May	171.4	121.9	100.2	71.7	16.0	145.6	182.5	207.3	136.3	184.3	133.7	337.7
Jun	88.8	74.5	49.8	129.7	112.2	8.4	236.5	239.5	2.4	85.5	102.7	81.1
Jul	17.9	4.2	4.5	91.4	72.1	67.7	29.2	116.9	35.0	39.4	47.8	27.7
Aug	10.7	47.4	48.1	60.1	1.7	0.0	17.1	28.4	17.5	4.9	23.6	13.8
Sept	107.4	37.4	270.8	272.2	34.0	9.5	25.8	62.3	89.3	115.9	102.5	2.7
Oct	108.7	199.9	467.6	61.3	221.9	288.6	221.6	342.3	239.6	274.6	242.6	178.2
Nov	334.8	236.1	143.2	319.5	214.7	306.7	208.1	406.0	242.8	165.5	257.7	666.5
Dec	118.6	7.6	49.5	64.8	8.0	59.2	151.5	75.9	304.5	12.8	85.2	34.9
Total	1304.6	1014.1	1302.4	1519.7	850.2	1180.1	1380.2	1696.4	1296.3	1286.0	1283.0	1834.1

REPORT OF THE TISSUE CULTURE DIVISION

Officer-in-Charge - L K Weerakoon, Ph D

1. GENERAL

During the year, greater attention was given to research on clonal propagation of coconut. However, the research progress was impeded due to problems encountered in obtaining calli and somatic embryos from immature embryo, leaf, and root explants. Therefore, efforts to overcome these problems were given high priority.

Ms. L K Weerakoon was appointed Officer-in-Charge with effect from 27 September, 1995.

2. RESEARCH PROJECTS

PROJECT 18: STUDIES ON THE VEGETATIVE PROPAGATION OF COCONUT

Experiment 18.1: *In-vitro* culture of embryos of local forms and varieties of coconut

Experiment 18.1.1: Propagation of *dikiri pol* using embryo culture technique (1992)

Propagation of *dikiri pol* using the embryo culture technique was continued. As a step towards mass propagation of *dikiri pol*, the number of *dikiri* embryos cultured *in vitro* was increased (Table 1). The number of *dikiri* seedlings produced this year (169) was much higher than that of last year (58).

Further investigations are underway to improve germination of *dikiri* embryos and transplanting of seedlings *ex-vitro*.

V R M Vidhanaarachchi, C K A Gamage & E S Santha

Experiment 18.1.2: Application of embryo culture technology to select drought tolerant coconut germplasm (1986)

The use of Sodium chloride as a water stress simulant was discontinued. The drought screening experiments using polyethylene glycol (PEG) as the water stress simulant were continued. Seedlings developed from zygotic embryos of Ambakelle

Table 1. Production of *dikiri seedlings in 1995*

Month	Number of *dikiri* embryos cultured	Number of embryos germinated	Number of seedlings obtained
Jan	31	18	08
Mar	60	51	22
May	82	57	38
July	82	57	38
Sept	66	44	26
Nov	59	38	37
Total	380	265	169

Special, D x T and *San Ramon* were used as experimental material. Some of the seedlings that survived the stress conditions caused by different concentrations of PEG (from 3% to 7% of PEG) were transplanted in soil and transferred to screen house for hardening. After hardening, these seedlings will be planted at Pothukulama Research Station for evaluation of their performance under field conditions.

V R M Vidhanaarachchi & E S Santha

Experiment 18.1.3: Studies on improvement of the coconut embryo culture technology (1994)

The effect of progressive reduction of sucrose content in the embryo culture medium on the survival of *In vitro*-raised seedlings during acclimatization was investigated. The sucrose content of the embryo culture medium was progressively reduced by 25% at monthly intervals.

The results indicated that the survival rate of seedlings grown in culture media containing 25% less sucrose than in the original concentration was not significantly different from those of the controls. However, when the sucrose content of the culture medium was reduced by more than 25% of the original concentration, the survival rate of seedlings decreased significantly.

V R M Vidhanaarachchi

Experiment 18.1.4 Studies on mutagenesis of coconut zygotic embryos (1995)

Preliminary investigations were carried out to estimate the lethal dosage (LD_{50}) value for zygotic embryos of coconut using gamma radiation as the mutagen.

Different dosage levels of gamma radiation were applied to coconut zygotic embryos and the estimated lethal dosage ($LD_{50)\ value}$ was found to be 0.5 kr.

V R M Vidhanaarachchi

Experiment 18.2: Studies on clonal propagation of coconut

Experiment 18.2.1: *In-vitro* culture of immature zygotic embryos of coconut (1986)

Investigations on the development of a technique for clonal propagation of coconut were continued, using immature zygotic embryo explants. Complete inhibition of callus formation from immature embryo explants was observed. Several experiments were carried out to identify the factor/s responsible for this situation. These investigations revealed that inhibition of callus formation was due to a change in the culture medium composition (particularly in the exogenous hormone levels) caused by using a different batch of activated charcoal. Activated charcoal is an essential component of coconut tissue culture media and it was reported that activated charcoal plays a significant role in maintaining the concentration of plant growth hormones and growth factors present in the medium. It was also reported that the particle size, age, and origin of activated charcoal affect the composition of the culture medium.

Since the failure to obtain calli was attributed to a charcoal effect, a number of different brands of charcoal (neutralized and acid-washed) as well as different lots of the same brand of charcoal were tested for their ability to induce callus formation. A factorial experiment with different concentrations and combinations of activated charcoal and 2,4-D was also conducted. After rigorous testing of various culture media, callus formation from immature embryo explants was achieved with one particular batch of acid-washed charcoal in a reproducible manner.

V R M Vidhanaarachchi & C K Gamage

Experiment 18.2.2: Culture of leaf explants (1983)

Experiments were conducted to improve culture conditions for direct somatic embryogenesis and subsequent germination of the somatic embryos. However, complete inhibition of somatic embryogenesis from tender leaf explants was observed. Investigations revealed that this was due to a change in the culture medium composition brought about by a change in the activated charcoal used in the medium.

V R M Vidhanarachchi & E S Santha

Experiment 18.2.3: Culture of root explant (1991)

Culture of root explants was continued and attempts were made to increase the incidence of direct somatic embryogenesis from root explants. Direct somatic embryogenesis from root explants was inhibited. Similar to leaf culture experiments, this was attributed to a change in the culture medium composition brought about by activated charcoal present in the medium.

V R M Vidhanaarachchi

Experiment 18.2.4: Culture of floral meristem explants (1995)

Recent studies have indicated that immature inflorescence is a promising source of explants for clonal propagation of coconut. Immature inflorescence explants were cultured into two of the recently published media. These media will be evaluated for their ability to induce callus proliferation, somatic embryogenesis, and subsequent plant regeneration from floral meristems.

V R M Vidhanaarachchi & L K Weerakoon

3. ACKNOWLEDGEMENTS

The assistance and co-operation of the staff of the Tissue Culture Division in conducting the experiments and compiling this report are gratefully acknowledged. Thanks are due to the Head and staff of the Biometry Division for statistical analysis of data.

REPORT OF THE PLANT PHYSIOLOGY DIVISION

Head - C Jayasekara, Ph D

1. GENERAL

The division continued its studies on drought tolerance and water-use-efficiency of Ambakelle special palms and their F_2 progeny with the use of stable carbon isotope discrimination technique. Studies on physiology and biochemistry of different varieties/cultivars of coconut revealed some useful differences that will be useful in the classification of varieties/cultivars and for breeding purposes. A series of new experiments were commenced to understand the role of anatomical, morphological and physiological differences of the root system on the overall performance of young and adult coconut palms in different soil types, and with different varieties. A study was conducted to determine chemical and physical changes taking place during storage of tender king coconuts. The long-term goal of this strategic-basic study is to develop a suitable storage technique to extend shelf-life of king coconuts for 6-8 weeks in order to meet export market requirements.

2. RESEARCH PROJECTS

PROJECT 16: PHYSIOLOGY OF THE COCONUT PALM

Experiment 16.4: Studies on heritability of drought tolerant characters into open pollinated seedlings from selected drought tolerant palms [Glass house study] - 1987

A new experiment was started to determine evapo-transpiration, dry matter increase and rate of photosynthesis of seedlings from selected Ambakelle Special palms for drought tolerance. Seed nuts from ten selected palms from Isolated Seed Garden were laid in the nursery to be used for the glasshouse experiment. Seedlings from nine palms will be transferred into plastic containers prior to the application of watering treatments.

C Jayasekara, A Nainanayake & R D N Premasiri

Experiment 16.7: Studies on physiology and biochemistry of different varieties and forms of coconut - 1989

Thirty nine seedlings have been planted from 13 cultivars *viz. DG x T, DY x T, T x T, Dwarf Green, Dwarf Yellow, Dwarf Red, Typica Green, Typica Red, Kamandala, Nawasi, Bodiri, San Ramon, Thembili* in large cement pots, with three

seedlings from each cultivar. Collection of data on these seedlings was commenced in March, 1995, which included quantitative measurements of growth parameters (*viz.* girth at collar, height, number of new leaves and length and width of new leaves); physiological parameters (*viz.* rate of photosynthesis, stomatal conductance, rate of transpiration, leaf water potential); biochemical parameters (*viz.* total soluble sugars, reducing sugars, starch and chlorophyll) and anatomical parameters (*viz.* stomatal density, leaf and cuticular thickness and cuticular wax content) at three-monthly intervals. Further, RuBP Carboxylase and Nitrate Reductase assays would be carried out at six-monthly intervals.

Differences in rate of photosynthesis were observed among cultivars with San Ramon showing the least seasonal fluctuation . Among varieties, *DGxT, TxT, DG, TG* and *Bodiri* recorded a high concentration of chlorophyll. The rate of transpiration and stomatal density of last open mature leaf were high in dwarf varieties and crosses.

R Wimalasekara, C Jayasekara, L R S Silva & P S A de Saram

Experiment 16.9: Studies on vegetative growth and physiology of Ambakelle special seedlings grown under field conditions - 1988

Results on physiological and biochemical parameters were presented in the Annual Report for 1994. At the end of seventh year, forty three out of eighty three Ambakelle Special seedlings and fifty out of eighty one Ordinary Tall seedlings came into flowering. A comparison of the yield between two types of the seedlings will be made.

A Nainanayake, C Jayasekara, P S A de Saram & R D N Premasiri

Experiment 16.10: Studies on the effect of canopy and root modification on yield of coconut - 1990

The canopy size and root volume were maintained according to the designed treatments and a count of button nuts was taken at bimonthly intervals. As in the previous year (1994) significant changes in button nut setting and development in response to treatment were not observed. Therefore, canopy pruning pattern was modified to remove the distal portion of the frond instead of the proximal half. In addition, fruit component parameters such as fresh weight of nut, husked nut weight, split nut weight, fresh and dry weight of kernel were measured.

C Jayasekara, A Nainanayake & L R S Silva

Experiment 16.11: Evaluation of field performance of embryo - cultured seedlings - 1987

All embryo-cultured young palms have come into flowering, which include five palms of yellow dwarf, two red dwarfs, one green dwarf and nine open pollinated tall. Open pollinated tall palms have taken seven years to initiate flowering whilst dwarf palms have taken only six years and five months. Results showed that there was no appreciable difference in flower initiation and development of reproductive structures of embryo - cultured seedlings due to hormonal treatments during *in vitro* growth of excised embryos compared to ordinary seedlings. The experiment was terminated.

C Jayasekara & R D N Premasiri

Experiment 16.12: Studies on assimilate partitioning pattern of seedlings and bearing young coconut palms with the use of $^{14}CO_2$ - 1992

The experiment was terminated and final results were reported in the Annual Report 1993.

C Jayasekara & A Nainanayake

Experiment 16.13: Studies on water-use efficiency of different ecotypes of coconut in relation to the stable carbon isotope discrimination ratio - 1992

Leaf samples were collected from twenty Ambakelle Special palms selected for drought tolerance based on their yield characteristics and from their controlled pollinated F_2 progenies selected from a field trial conducted by the Genetics and Plant Breeding Division at the Isolated Seed Garden, Ambekalle. The main objective of the existing progeny trial is to test the inheritance of stable yield character of the putative drought tolerant palms by the performance of their progenies, using stable yield as the parameter. The carbon isotope discrimination and high Water Use Efficiency (WUE) could be used as physiological parameters to reconfirm the above selection criteria based on the yield stability and also to determine the heritability of carbon isotope discrimination character from parents to F_2 generation. The leaf samples have been sent to IAEA Seibersdorf laboratory, Vienna for analysis of $^{13}C/^{12}C$ ratio to determine the carbon isotope discrimination characters of putative drought tolerant palms and the F_2 progeny.

C Jayasekara & N P A D Nainanayake

PROJECT 22: ROOT SYSTEM OF THE COCONUT PALM

Experiment 22.1: Anatomy and morphology of roots in different varieties of coconut and under different growth conditions - 1995

A new experiment was started with four cultivars *viz. Ordinary tall, Ambakelle Special, Dwarf x Tall,* and *San Ramon* to study root anatomy, morphology, and growth performance under different soil types. Seedlings were planted in four CRI Estates; Bandirippuwa, Isolated Seed Garden, Rathmalagara and Walpita. Three age groups *viz.* 1-3 years, 3-5 years and adult palms have been included under four major land suitability classes S1, S2, S3 and S4. Parameters such as number of primary and secondary roots, root colour, number of live and dead roots, anatomy of different roots, root number, root length and dry weight will be measured at six monthly intervals using soil core samples.

N P A D Nainanayake, R D N Premasiri & C Jayasekara

Experiment 22.2: Studies on root carbohydrate reserves and root respiration in young coconut seedlings in relation to root growth and soil type - 1995

Seedlings of *Ordinary Tall, Ambakelle Special, Dwarf x Tall* and *San Ramon* were established in four major land suitability classes S1, S2, S3 and S4. Parameters such as root length and diameter, root carbohydrates and root respiration during wet and dry periods, soil temperature and soil water content at different depths will be measured, using soil core samples.

N P A D Nainanayake, R D N Premasiri & C Jayasekara

Experiment 22.3: Root carbohydrate reserves, root respiration and root growth in different varieties of coconut (bearing palms) and soil types - 1995

Experiment was commenced with the adult palms of cultivar TxT grown under four major land suitability classes S1, S2, S3 and S4. Collection of data on root morphology was started.

N P A D Nainanayake, R D N Premasiri, P S A de Saram & C Jayasekara

PROJECT 23: BIOCHEMISTRY OF COCONUT

Experiment 23.1: Biochemical changes associated with harvested young king coconut - 1995

Twenty five king coconut palms were selected from field no. four at Bandirippuwa Estate. As a preliminary study, seven month old nuts were picked and following treatments were imposed for a period of one to four weeks. The liquid endosperm was analyzed for sugars using High Performance Liquid Chromatography to determine the biochemical changes occurring during storage of fresh young nuts.

Treatments:

* Stored at room temperature, 29°C and 20°C with and without waxing the perianth region.

* Stored at 16°C with waxing whole surface of the nut.
  Hot water treatment

* Dipped in 100°C water for five, ten, fifteen and twenty minutes and stored at room temperature.

* Dipped in 60°C water for five minutes, waxed the entire surface of the nut and stored at room temperature.

* Dipped in 60°C water for five minutes, immediately cooled by dipping in cold water, waxed the entire surface of the nut and stored at room temperature.

* Dipped in 70°C water for one minute, waxed the surface and stored at room temperature and 16°C.

The preliminary results showed that hot water treatment did not improve the keeping quality of harvested young king coconut. It was indicated by discoloration of the skin and separation of perianth from the nut earlier than untreated nuts. The waxing and cold storage treatment gave favorable results by extending the keeping quality of young fruits for about 16 days. This study will be continued to identify the most suitable age for picking tender nuts and to develop appropriate storage method.

R Wimalasekara, W P K K Fernando & 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 number of leaves were recorded at quarter yearly intervals. Both types of seedlings received young palm mixture (YPM) as split applications.

Four years after transplanting in the field, significant differences were not apparent between amputated and bare rooted seedlings for vegetative growth measurements. For further confirmation, another set of amputated and bare rooted coconut seedlings would be transplanted to identify differences in vegetative growth and flowering patterns in the field.

A Nainanayake, C Jayasekara & L R S Silva

3. ACKNOWLEDGEMENTS

The assistance provided by the staff of the Plant Physiology Division in conducting experiments and in the preparation of this report is gratefully acknowledged.

Thanks are also due to Head/Genetics & Plant Breeding Division for allowing to use experimental palms for water-use efficiency studies and providing data on vegetative growth for analytical purpose and to Mr D T Mathes and staff for statistical analysis of data.

MULTIDISCIPLINARY PROJECTS

PROJECT 17: PREMATURE DECLINE OF PALMS

(Project Co-ordinator - L C P Fernando, Ph D)

Divisions participated: Agronomy Division
Plant Physiology Division
Survey Group (Agronomy Division, Crop Protection Division, Genetics and Plant Breeding Division, Soil and Plant Nutrition Division and Plant Physiology Division)

General Remarks

The cause for Leaf Scorch decline still remains unknown despite continued research. A group consisting of several research divisions was set up to initiate survey on the incidence and distribution of LSD-affected palms in the estates of the Coconut Research Institute and in outside estates. The multi-disciplinary research programme was continued with studies on the root system, secondary metabolites and effect of agronomic practices on LSD-affected palms.

Survey : The incidence and distribution of LSD-affected palms in CRI estates (1995)

A survey was carried out in Bandirippuwa estate, Rathmalagara estate, Poththukulama Research Station, Isolated Seed Garden at Ambakelle and Walpita estate to estimate the percentage incidence and distribution pattern of LSD-affected palms. All palms over 15 years of age were surveyed and the affected palms were categorized into three groups according to the severity of the visual symptoms.

The categories were:

1. Mild - Less than half of the total leaves show scorching, scorching may have extended up to the middle region of the leaflets, no tapering of trunk, crown size and nuts normal.

2. Moderate - About half or more than half of the total leaves show scorching, scorching has extended beyond the middle region of the leaflets, tapering of trunk may or may not have initiated, crown size and nuts normal.

3. Severe - The number of leaves reduced, scorched leaves may or may not be

present, tapered trunk, crown size reduced, number of nuts reduced, elongated nuts.

The distribution of affected palms were mapped only in Walpita estate and Poththukulama Research Station.

The incidence of LSD was between 2.7% and 12.2% (Table 1). Highest proportion of the palms were in the mild and moderate stages of LSD. The data extracted from the survey at Isolated Seed Garden where both tall and dwarf varieties are present, indicated that LSD incidence was much less (0.97%) in dwarf variety than in the tall variety (3.2%). The distribution of affected palms seemed to be scattered. Any neighbour infection, focus of origin or directional spread was not evident.

Table 1. *The incidence of LSD-affected palms in CRI estates*

Estate	% incidence	LSD status(%) (proportion in each category)		
		Mild	Moderate	Severe
BE	4.1	46.2	47.3	6.0
ISG	2.7	64.3	31.1	4.6
PRS	6.5	42.3	42.7	14.9
RE	3.0	35.5	49.4	15.1
WE	12.1	36.4	40.7	23.4

L C P Fernando, W M U Fernando, N P A D Nainanayake, H T R Wijesekara, K F G Perera, M Bastian, G D George, R D N Premasiri, M H L Padmasiri, W E A Fernando, P D B Silvan, E Perera, A Jayatilake & D M Sarathchandra

Experiment 17.2: Studies on the root system of LSD-affected palms (1987)

Root regeneration pattern of palms in incipient, mild, moderate and severe stages of LSD and in healthy palms were studied using soil core samples along a transect up to a distance of 2 m from the bole and down to a depth of 1.5 m. The rate of root regeneration was low in moderately and severely affected palms compared to the healthy palms (Table 2). The experiment is being continued.

Table 2. *Regeneration of roots of healthy palms and palms at different stages of LSD in a period of one year*

Root regeneration	Dry weight (gm/unit volume)				
	healthy	incipient	mild	moderate	severe
Total live roots	30.24	23.56	26.67	19.78	13.63
Total dead roots	6.80	3.48	3.40	2.77	6.35
% live roots	81.65	87.13	88.69	87.73	68.23
% regeneration (total)	100.00	73.03	81.20	60.88	53.93
% regeneration (live)	100.00	77.93	88.20	65.41	45.06

A D Nainanayake, C Jayasekara, R D N Premasiri & L R S Silva

Experiment 17.3: Determination of net assimilation rate and foliar organic and inorganic nutrients in LSD-affected palms (1987)

Contents of total polyphenolic compounds were quantified in palms of incipient, mild, moderate and severe stages of LSD and in healthy palms. Since the results were inconclusive, the experiment will be continued with modifications on the analytical methods.

A D Nainanayake, R Wimalasekara, C Jayasekara & P S A de Saram

Experiment 17.4: Studies on the effect of root pruning and incorporation of organic manure on LSD-affected palms (1989)

During the year, yield records and data on size, shape and the kernel thickness were collected at alternative picks. The results indicated that treatments have no effect on nut production.

D N S Fernando, M Bastian & N P A D Nainanayake

REPORT OF THE EXTENSION SERVICES DIVISION

Head - P A H Nimal Appuhamy, M Sc

1. GENERAL

With the increasing demand for extension and advisory services from the Information Services Division, the name was changed to Extension Services Division. A new extension strategy was developed in which in particular holdings of absentee landlords were visited with a view to persuading and promoting them to adopt CRI technologies for increasing productivity. This activity is called the Persuasive Extension Prqgramme (PEP). A questionnaire was sent out to prepare a register of land owners, for this purpose. The response was very encouraging. Due to lack of resources, the visits were limited to those estates requiring immediate attention. Up to the end of December, 1995, 40 estates were inspected and comprehensive estate development plans were submitted for implementation.

The Division conducted a preliminary survey on toddy tapping, jointly with the Soils and Plant Nutrition Division. The main objective was to assess its economic potential, and deficiencies that need to be corrected for uplifting the industry. The survey revealed that toddy tapping generates more income than nut production, and there is a necessity to train more toddy tappers.

The Division also carried out a basic survey on coconut land fragmentation, as a considerable area of prime coconut lands are being lost each year in the coconut triangle. Over 60 Lands and Property Sales agents were interviewed to collect the required information.

2. PUBLICATIONS

2.1 Occasional Publication Series No. 3 on "Land Suitability Assessment of Coconut Growing Areas in the Coconut Triangle"

2.2 Occasional Publication (Sinhala) on "Land Suitability Assessment of Coconut Growing Areas in the Coconut Triangle"

2.3 Short Annual Report -1993(submitted to the Parliament)

2.4 Short Annual Report of the Director/CRI for 1994

2.5 Reprinting of the Book on "Coconut Cultivation" (Sinhala & English)

2.6 "COCOS" Volume 10 and Annual Report, 1992 were compiled for printing.

3. ADVISORY ACTIVITIES

Many coconut estates were inspected by the staff and appropriate advice given. Problems requiring specific attention were referred to relevant research divisions.

Advisory materials were provided to many students and to the coconut growers.

4. TRAINING PROGRAMMES AND STUDY TOURS

4.1 Training Programmes

The following training programmes were conducted during the year.

(i) Two students from the National Apprenticeship and Industrial Board, who commenced attachment training in 1994 and completed in February, 1995.

(ii) Two students from the school of Agriculture, Pelwehera- attachment training from April to September and one NAB trainee from March to June, 1995.

(iii) One student from the School of Agriculture Kundasale from March to June, 1995.

(iv) Two National Apprentice and Industries Training Authority (NAITA) trainees from July to October, 1995.

(v) Two further NAITA trainees commenced their training on 01 November 1995 for a period of four months.

(vi) Six students from the Affiliated University, Makandura commenced a three months attachment training on Estate Management in December, 1995.

(vii) Several students from Universities and Colleges of higher education were assisted in the collection of data on coconut for compilation of their reports.

(viii) The following six one day training programmes were concluded successfully during the year for coconut estate owners and management staff of coconut estates:

Programme 1 - 28 April

Replanting of coconut - conducted at the CRI, Bandirippuwa Estate

Programme 2 - 02 June

Soil and moisture conservation in coconut lands - Ratmalagara Estate, Madampe

Programme 3 - 23 June

Use of organic and inorganic fertilizer in coconut lands - CRI, Bandirippuwa Estate

Programme 4 - 21 July

Intercropping under coconut, Walpita Estate, Kotadeniyawa

Programme 5 - 15 Sept

Pests and diseases of coconut at CRI, Bandirippuwa Estate, Lunuwila

Programme 6 - 27 Oct

Rehabilitation of low yielding coconut plantations - Ratmalagara Estate, Madampe

The above training programmes were well attended by coconut land owners and the management staff of private and estate sectors. The participants had the opportunity to discuss their problems with the research and extension staff of the Institute.

4.2 Study Tours

The following familiarization tours were organized by the Division.

(i) Members of the Coconut Research Board - 31 January

(ii) Foreign participants of the Regional workshop of the National Productivity Office (NPO) - 18 February

(iii) A group of officials from the Coconut Cultivation Board (CCB), Colombo - 17 March

(iv) A group of students from the Eastern University, Vantharamoolai - 02 March

(v) A group of Agriculture students from University of Peradeniya - 22 March

(vi) A group of officials of the Estate Division of the CCB - 24 March

(vii) A group of students from the Kuliyapitiya Technical College - 29 March

(viii) A group of farmers from the Dambadeniya Development Foundation - 14 June

(ix) A delegation from the Coir Board of India - 05 July

(x) Editorial staff of 'Vidurasa' - 09 August

(xi) Two junior scientists from Ethiopia - 09 August

(xii) Two scientists from Ruhunu University Matara - 21 and 22 August

(xiii) Group of delegates from the Technical Exchange Mission from Plant Genetic Resources Institute, Pakistan - 31 August

(xiv) Hon. Ratnasiri Wickramanayake, Minister of Public Administration,Home Affairs, Parliament Affairs and Plantations Industries - 09 October

(xv) Group of members of the Alawwa Coconut Land Owners Co-operative Society -15 November

(xvi) Editorial staff of 'Desatiya' - 19 October

(xvii) Batch of 50 final year students from the School of Agriculture,Puliyankulama,Anuradhapura-24 July

(xviii) Batch of 71 students from the School of Agriculture, Angunakolapelessa - 27 July

(xix) Batch of students from the School of Agriculture, Labuduwa - 15 August

(xx) Two batches of final year students from the Aquinas College of Higher Education on 11 and 18 September

(xxi) Group of students from the School of Agriculture,Wariyapola - 15 September

In addition, students from a number of schools visited the Institute. They

were given comprehensive briefing on scientific coconut cultivation by using audio and visual aids.

6. SEMINARS/LECTURES/FIELD DAYS/EXHIBITIONS

The Division coordinated two Research Extension dialogues between the Research Staff of the CRI and the extension personnel of the CCB during the year. One was held at the Coconut Development Training Centre (CDTC) on 09 November where the main theme was the revision of the CRI recommendations based on the feedback received from the extension personnel. The other was held in the Regional Office of the CCB, Galle on 15 December.

The Division coordinated the following seminars:

i. Review of GTZ-CARP Research Management Project - 18 January

ii. Review seminar of Premature Decline of coconut palms - 13 February

iii. Seminar on Increasing income from coconut lands - The Persuasive Extension Programme - 11 March

iv. Problems and constraints limiting coconut production in Sri Lanka - 28 May

v. Development of coconut estates for increased production and productivity - 10 November

vi. Discussion/Dialogue on coconut production, processing and marketing - 21 December

The Division participated in the following field days in collaboration with the CCB.

Bakamuna	- Polonnaruwa District	- 02-03 January
Kobeigane	- Kurunegala District	- 01 September
Bandaragama	- Kalutara District	- 01 October

The Division organised and participated in the following exhibitions:

St Martin de Porres School, Wennappuwa - 30 June

Pamunugama M M Vidyalaya, Bopitiya - 05-06 October

Coconut Week Exhibition held at the BMICH, Colombo, 12-15 October

8. PHOTOGRAPHY

Transparencies and photographs for audio visual equipment for research divisions and for the CCB were made available.

9. MUSEUM

A number of new exhibits were added to the Museum.

10. AUDITORIUM

Auditorium facilities were provided for seminars, workshops and meetings held at CRI. These facilities were also extended to outside organization at a nominal charge.

REPORT OF THE LIBRARY & COCONUT INFORMATION CENTRE

Acting Librarian - P A H Nimal Appuhamy, M Sc

1. GENERAL

The Library and the Coconut Information Centre carried out its routine activities satisfactorily. Requests for information received from both the staff and outsiders were met using available resources.

Mr. M J C Perera, Head Library Services retired from service on 08 March 1995 and Mrs. P A S F Perera was appointed Acting Librarian with effect from 10 March 1995.

Mrs. P A S F Perera was appointed Librarian with effect from 06 July 1995 and later left for Postgraduate Diploma/MA/M Sc. in Librarianship and Information Studies at the Robert Gordon University on 22 September 1995. Mr. P A H N Appuhamy was appointed Acting Head, Library Services from 27 September 1995, until the return of the Librarian.

2. ACQUISITIONS

The library accessories recorded 4954 books as at 31 December, 1995. Number of books accessed during the year was seventeen. Four books were donated by the Agricultural Research Project (ARP) and eleven more books were received as donations from other sources. The Library subscribed to 27 journals and 45 journal titles were received on exchange and on complimentary basis.

Database on coconut recorded 6821 references as at 31 December and the additions during the year were 552.

3. SERVICES

The staff of the institute was provided with regular reference, lending, interlibrary loan (ILL) and literature alert services. The new additions of the literature collection on coconut were brought to the attention of the staff through a regular current awareness service. Literature search services were also provided to outsiders, on request.

The library received 86 requests for ILL from outside libraries and research staff and 65 have been satisfactorily responded. CRI staff received 202 contents pages of 30 journals from other member libraries of the Agricultural Information Network (AGRINET).

After the retirement of Mr. M J C Perera, the activities of the AGRINET were transferred to Council for Agricultural Research Policy (CARP) in March 1995.

3.1 Training

Mrs. P D U C Dharmapala, Library Assistant participated in a two day workshop on Data Communications and Database Access in the Information Age conducted by the Arthur C Clarke Centre for Modern Technologies, Katubedda, Moratuwa from 28th to 29th November 1996.

REPORT OF THE ESTATES MANAGEMENT DIVISION

Manager (Estates) - A M Kurukulasooriya, Dip Agric

1. GENERAL

The following seven units were administered by the Division.

1. Bandirippuwa Estate, Lunuwila
2. Rathmalagara Estate, Panirendawa
3. Poththukulama Research Station, Pallama
4. Walpita Estate, Walpita
5. Isolated Seed Garden, Ambakelle
6. Makandura Seed Garden, Gonawila
7. Maduru Oya Seed Garden, Kasyapapura

The Differential Fertilizer Recommendations (DFR) based on foliar and soil analysis were used for the manuring programme in all properties during 1995.

Out of the total planted extent of 572.14 ha., about 225 ha. remained immature.

A general increase of rainfall was experienced in all estates, a marked increase was shown at Walpita, Makandura, Ambakelle, and Poththukulama Estates.

An overall increase of yield by 27.18 % than the last years was shown.All the properties showed an increase of the crop, except Bandirippuwa Estate, where there was a slight yield drop of 5% compared to 1994. ISG, Ambakelle has shown an increase of yield by 58%. Maduru Oya Seed Garden has responded well showing an increase of yield by 88%.

Satisfactory performance may be due to favourable weather conditions coupled with efficient management and cultural practices.

The total production of seed nuts in all three seed gardens was 1454656 during the year which recorded an overall increase of 40 % over the previous year. All the estates were maintained in good order by adopting recommended cultural practices. Emphasis had always been placed on soil and moisture conservation methods. Satisfactory rainfall with a good distribution promoted increased yield, generally in all estates.

2. PERFORMANCE OF INDIVIDUAL UNITS

2.1 Bandirippuwa Estate, Lunuwila

Superintendent	*: Mr. A N Ekneligoda*
District	: Puttalam
Electorate	: Wennappuwa
Agro-climatic zone	: Semi wet intermediate zone

60% of the total planted area was in production, while the rest was in immature stage. (Table 01)

Rainfall: The total precipitation was 1943.9 mm during 135 days, increase of 2.5% than previous year. There was no significant difference in rainfall and number of wet days as well. (Table 01)

Nut yield: Total yield was 600478, a decrease of 5% compared to the yield of 1994, however, there was a 50% increase over the estimated figure of 400000 nuts. (Table 02).

Disposal of crops: Crops were disposed through Coconut Development Authority auctions (CDA) mainly as husked nuts. (Table 3)

Field operations:

Manuring: Mature plantation was manured during Yala season. A total of 10360 palms received Differential Fertilizer Recommendation (DFR) mixture for 1994, and 893 palms received APM. A total of 4062 young palms below 04 years were treated with optimum level of Young Palm Mixture (YPM), in two split doses during the year.

Weed control: Ground conditions were maintained satisfactorily by periodical weeding programmes launched with the use of manual,mechanical, and chemical methods. Weed trash was used as a mulch in the manure circle. Cover crop areas were cheddy weeded and about 60 % of the total area was under the legume covers and, this prevented reemergence of noxious weeds like Illuk, Couch, Pennisetum Grass. Weedicide Glyphosate was used to control growth of Illuk.

Soil and moisture conservation: Periodical mulching programmes were done with the fallen fronds to all palms and coir dust was applied to bases of palms in field 9. Husks were spread in the manure circle in field 01, 5, 7, 8, and 9.

Removal of palms: 73 senile palms were uprooted and infillings were done.

Livestock: Herd strength by the end or the year was as below.

(a)	Cows	31
(b)	Heifers	43
(c)	Bull calves	19
(d)	Bulls (Studs)	02
	Total	**95**

Milk production and sales:

(a) Sold to staff at subsidized rate	12798.00
(b) CRI Canteen	464.00
(c) Sold to milk collecting center	21523.55
Total	**34785.55**

About 62% of the total production was sold to Haldanduwana Co-operative, and the rest supplied to the staff and canteen.

Other production activities:

1. No of palms tapped for sweet toddy field No. 07 - for treacle.- 20
2. Amount of sweet toddy produced 2041.75 l.
3. Amount of treacle produced 449.00 l.

Composed pits: Three pits were prepared (dimensions 15'x 4' x3') to produce compost manure. This work is in progress.

Cost and returns: Cost of production for 1000 nuts was Rs. 2693.00 (excluding staff salaries and vehicle maintenance. Net sales average 1000 nuts Rs. 3944.00.

2.2 Rathmalagra Estate, Panirendawa

Superintendent	*: Mr. M L L A Perera*
District	: Puttalam
Electorate	: Chilaw
Agro-climatic zone	: Semi dry intermediate zone

Out of the total extent of 110.5 ha were under coconut, about 50% is in production. (Table 4)

Rainfall: The total rainfall recorded for 1995 was 1629.7 mm and showed a 5% decrease than that of 1994. Generally a satisfactory distribution was shown with no long dry spells during the year .

Nut yields: The total nut yield for the year was 498372, which was 28 % more than that in the previous year, (Table 2). A decrease of 0.32% was shown when compared with the estimated figure 500000 nuts. (Table 2)

Disposal of crops: Crop was disposed through CDA mainly as husked nuts (Table 4)

Field operations:

Manuring: During the year 11192 bearing palms were manured according to the differential fertilizer recommendations of 1994. Among the immature population 3167 young palms and 297 seedlings were treated with recommended level of the young palm mixture in two split doses.

Weed control: Ground condition of the property was maintained satisfactorily . Weed growth was kept under control with the use of rota-slashers, manual and chemical control methods.

Soil and moisture conservation: Husks were buried in the following fields. Field No 1 . 792 pits, Field No 02, 138 pits. The pits were open to the dimension of 8'x4'x2'. All adult and young palm manure circles were mulched with weed trash, fallen fronds and other biomatter available.

General: The experimental area under the soils and Plant Nutrition Division was damaged by the wild elephants on rampage, causing high casualties in field No 5.

Cost and returns: Cost of production per 1000 nuts was Rs. 1687.00. Net sales average per 1000 nuts was Rs. 3982.00.

2.3 Poththukulama Research Station, Pallama

Officer-in-charge:	*Mr. W T H C Fernando - till 10.11.95*
	Mr. W M U Rathnayake - 10.11.95 to 31.12.95
District	: Puttalam
Electorate	: Anamaduwa
Agro-climatic zone	: Semi dry intermediate zone

Out of the total planted area of 73.23 ha. about 56.11 ha. was in bearing as a percentage of 76.62 ha. (Table 4)

Rainfall: The total rainfall experienced during the year was 1635.78 mm. distributed in 60 wet days, which was an increase of 462.48 mm. over the previous year. The distribution remains same when compared with the last year. (Table 1)

Nut yields: The nut yield was 22% more than that of 1994 and an increase of 11 % over the estimated number of 600000 nuts. (Table 2)

Disposal of crops: The entire harvest was sold through the CDA as husked nuts (Table 3)

Field operations:

Manuring: A total of 7763 bearing palms were manured in accordance of the DFR for 1994, whereas 5264 young palms and 155 seedlings were treated with recommended dose of young palm mixture in two split doses during the year.

Weeding: Ground conditions of the property were maintained satisfactorily with the use of the rotar-slashers. Glyphosate was used to control Illuk in field No 1,2,12,14 and 15. Noxious weeds like Mana, Guinea grass, and others were controlled by manual weeding. Three weeding rounds were completed during the course of the year.

Soil and moisture conservation: A total of 358 husk pits of the dimensions 5'x 3 x'3' and 8'x 4'x 2 were completed in field 11 A, in addition 147 pits open during the previous year and were closed using the husks of the year 1995. Periodical mulching programmes were carried out using whatever material available.

Plantation improvements: Ant hills were destroyed in field 1,4, 11 B and 12. Total average was 199.8 Sq.m. of the NFTs planted and 500 Acacia, 250 Gliricidia planted along road sides.

Cost and returns: The Cost of production was Rs. 2064/- per 1000 nuts and the net sales average was Rs. 4157/- per 1000 nuts.

2.4 Walpita Estate, Walpita

Officer-in-charge	*: Mr. Newton Gamage*
District	: Gampaha
Electorate	: Divulapitiya
Agro-climatic zone	: Semi wet zone

The total available area was in production. (Table 4)

Rainfall: The total rainfall experienced was 2495.6 mm which was 31% more than previous year. It was distributed over 114 days compared to 109 days in the previous year.

Nut yields: Crop in 1995 was 21% more than the previous year and about 7.38% higher than the estimated figure. (Table 2)

Disposal of crops: The Entire crop was sold as husked nuts to buyers through the CDA. (Table 3)

Field operations:

Manuring: A total of 2254 bearing palms were manured according to the DFR of 1994.

Whereas 101 young palms were treated with 1.8 kg of young palm mixture, in two split doses.

Weeding: Ground conditions were maintained satisfactorily with regular weeding. Noxious weeds like Pennisetum, Chromolaena, were uprooted manually at early stage of growth to prevent further propagation.

Intercropping: In addition to coconut, the following intercrops were grown under the guidance of the Agronomy Division. Cocoa, coffee, cinnamon, pepper grown under coconut and mixed crops banana and ginger.

Land distribution on intercrop

	Extent (ha)	**Production (kg)**	**Total Income**
Cocoa	2.10	469,990	21058.19
Coffee	0.06	940,340	13602.24
Cinnamon	0.18	27,050	5338.19
Pepper	0.98	394,600	34966.53
Mixed crops			
Banana	00.56	572,100	10706.40
Ginger			
Cocoa Pods		280 Nos	980.00
Banana suckers		10 Nos	100.00
Income			86751.55
Expenditure			72641.84
Profit (from 3.8 ha)			14109.71

Soil and moisture conservation: Extensive mulching programmes were carried out before the onset of dry periods. Fallen fronds, weed trash and other biomatter were

Cost and returns: Cost of production per 1000 nuts was Rs. 2350.00 and net sales average per 1000 nuts was Rs. 4350.00.

2.5 Isolated Seed Garden, Ambakelle, Rajakadaluwa

Superintendent	*: Mr. S M Wijeratne Banda*
District	: Puttalam
Electorate	: Chilaw
Agro-climatic zone	: Semi dry intermediate zone

Out of the total extent of 456.3 ha 139.5 ha, were planted with coconut and 29% remained as immature plantation.

Rainfall: The total rainfall for the year was 1834.1 mm distributed among 97 days. An increase of the wet days 42% of over the last year. There was no significant difference in the distribution. (Table 1)

Nut yield: The total nut yield for the year was 1534369. This was an increase of 58% over the previous year and an increase of 2.29% over the estimated figure (Table 2). Seed nut production of TxT and DxT are given in Table 5, 6, 7 and 8.

Disposal of crops: About 65% of the total crop was disposed as seed nuts and the rest was cured (Table 3).

Field operations:

Manuring: A total of 15957 matured palms were manured, according to the DFR for 1994, whereas 6747 young palms were treated with the Young Palm Mixture in two split doses during the year. Dolomite was applied to young palms at the rate of 1 kg per palm.

Organic manure (Cow dung) was applied at rate of four 04 gallon tins per palm, in addition to the DFR.

Weed control: Four successful weeding rounds were completed during the year. Illuk patches were lightly harrowed to control weed growth and to promote growth of cover crop. Rotar-slasher was used sparingly as there was a tender growth of covers, in every field.

Soil and moisture conservation: Cover crop Pueraria sp. was established in an area of about 20 ha, in fields 4, 9 and 14 showed a successful growth.

11590 meters of drains were maintained and desilted.

During the year 2331 husks pits of the dimension (2.5 m x 1.2 m x 0.6 m) were completed in field Nos. 4, 11 A, 12 and 13. Regular mulching programmes were carried out using fallen fronds, weeded trash and whatever biomatter that was available. All young palms were watered during the drought.

Pests and diseases: Routine inspection for pest attacks specially for Red-weevil, was carried out in the areas where young palms were predominant. Pests and diseases were controlled satisfactorily.

Young plantation: The immature area was maintained satisfactorily. The seedlings were irrigated at the rate of 40 Lt once in every 10 days during dry season. Mortality rate was negligible.

Cost and returns: Cost of production per 1000 nuts was Rs. 2058/- and net sales average per 1000 nuts was Rs. 6696/-.

2.6 Makandura Seed Garden, Makandura

Superintendent	*: Mr. M R L A 'Perera*
District	: Kurunegala
Electorate	: Katugampola
Agric-climatic zone	: Semi wet intermediate zone

The total available land of 58.2 (ha) was planted (Table 4). About 26% of the planted area was immature.

Rainfall: The total rainfall experienced during the year was 2473.9 mm distributed among 120 wet days. An increase of 49% than the previous year was indicated. There was no significant increase in the distribution. (Table 1)

Nut yield: The total production of nuts showed an increase of 25 % than that of previous year. (Table 2)

Disposal of crops: About 82 % of the total harvest was disposed as seed nuts and the rest was cured and sold locally. Nut allowance to the residence staff was issued out of the crop. (Table 3)

Field Operations:

Manuring: A total of 8516 bearing palms were manured according to the Differential fertilizer recommendation of 1994. Whereas 420 young palms were treated with 1.2 Kg of YPM in two split doses .

Weeding: Three weeding rounds were done during the year, periodical cheddy weeding programmes were done to control the reemergence of Guinea grass and other noxious weeds.

Soil and moisture conservation: Regular mulching programmes were done to maintain the manure circles using fallen fronds, weed trash, NFT loppings to conserve moisture levels in the root zone of the palms. During the year 228 husk pits of dimension of 2.4 m x 1.2 m x 0.6 m were completed.

2.7 Maduru Oya Seed Garden, Bogaswewa

Officer-in-charge	*: Mr. Nimal Hemasiri*
District	: Polonnaruwa
Electorate	: Polonnaruwa
Agro-climate zone	: Dry zone

Out of the total extent of 85 Hectares, about 67.17 planted with coconut. About 80% of the planted area was immature. (Table 4).

Rainfall: The total rainfall for the year recorded was 1346.8 mm distributed over 94 wet days, a decrease of 39.49% than that of the previous year. Distribution dropped by 19 days.

Disposal of crops: About 85% of the total harvest was disposed as seed nuts. The rest was used for nut allowance to the staff, balance cured for copra sold locally.

Field operations:

Manuring: A total of 3068 bearing palms were manured according to the DFR for 1994. All young palms were manured with young palm mixture according to recommended level in two split doses during the year.

Weeding: About 28 ha. of the total land extend was under cover crop, and there seemed to be no necessity for an extensive weeding programme. Weed control in the rest of the area was done by the use of the rotarslahers.

Table 1. *Rainfall (mm) with number of wet days in parenthesis*

Month	Bandirippuwa Estate		Rathmalagara Estate		Poththukulama Estate	
	1994	1995	1994	1995	1994	1995
Jan	122.4(11)	49.3(07)	101.5(10)	16.6(04)	115.6(07)	91.0(04)
Feb	195.7(08)	51.6(05)	63.4(07)	55.7(03)	48.6(03)	16.8(02)
Mar	71.4(09)	100.8(05)	21.0(05)	85.6(04)	27.8(02)	12.5(01)
Apr	132.9(13)	276.6(19)	218.2(08)	287.03(14)	112.1(07)	323.77(13)
May	262.9(19)	399.1(21)	281.8(17)	257.9(11)	120.2(08)	449.5(08)
June	70.4(09)	207.2(18)	64.5(08)	121.0(13)	44.4(02)	88.41(08)
July	60.6(08)	35.2(05)	55.9(07)	19.9(02)	15.2(02)	-
Aug	37.5(08)	35.4(09)	22.1(08)	17.3(04)	-	6.3(01)
Sept	279.6(18)	41.1(08)	132.7(14)	13.5(03)	94.4(04)	-
Oct	378.3(21)	194.5(21)	545.8(18)	148.1(16)	391.3(17)	116.08(10)
Nov	284.4(13)	538.3(15)	204.4(12)	584.3(09)	161.4(10)	494.05(10)
Dec	9.1(03)	118.8(02)	6.4(01)	22.5(03)	6.3(01)	36.2(03)
TOTAL	1905.0(140)	1943.9(135)	1717.7(115)	1627.7(86)	1137.3(63)	1635.78(60)

Table 1. *Contd.*

	Walpita Estate		Isolated Seed Garden, Ambakelle	
	1994	1995	1994	1995
Jan	58.0(06)	95.5(05)	110.5(10)	51.2(05)
Feb	99.4(07)	10.2(02)	71.6(08)	32.6(07)
Mar	97.7(07)	92.4(04)	79.6(05)	59.5(03)
Apr	215.1(09)	397.0(18)	141.4(08)	315.6(16)
May	328.2(11)	449.6(19)	184.3(11)	370.3(14)
Jun	53.4(09)	330.9(20)	85.5(06)	58.1(14)
July	67.5(10)	97.5(03)	39.4(07)	50.7(03)
Aug	49.3(04)	119.0(07)	4.9(04)	0.5(01)
Sep	115.0(11)	79.0(08)	115.9(10)	16.0(03)
Oct	459.7(19)	288.1(16)	274.6(15)	127.07(15)
Nov	345.6(14)	536.4(12)	165.5(17)	717.0(13)
Dec	5.9(02)	-	12.8(03)	34.9(03)
Total	1894.8(109)	2495.6(114)	1286.0(104)	1834.1(97)

Table 1. *Contd.*

	Makandura Estate		Maduru Oya Seed Garden, Ambakelle	
	1994	1995	1994	1995
Jan	68.6 (09)	134.0 (06)	428.77 (11)	247.0 (11)
Feb	59.5 (05)	117.0 (03)	368.76 (11)	125.4 (07)
Mar	63.3 (06)	43.3 (03)	112.00 (05)	4.8 (01)
Apr	213.4 (10)	461.5 (16)	40.00 (04)	162.7 (14)
May	278.8 (15)	391.9 (19)	28.00 (01)	48.7 (09)
June	68.8 (07)	238.6 (17)	-	6.9 (01)
July	70.2 (06)	98.6 (04)	-	7.2 (02)
Aug	39.2 (05)	94.09 (07)	28.00 (01)	69.4 (04)
Sept	131.8 (12)	55.8 (07)	153.80 (09)	248.3 (07)
Oct	462.9 (17)	233.9 (17)	342.00 (26)	82.2 (08)
Nov	194.4 (11)	585.7 (13)	454.60 (23)	174.2 (12)
Dec	9.2 (02)	18.7 (08)	269.90 (22)	176.0 (18)
Total	1660.1 (105)	2473.9 (120)	2225.83 (113)	1346.8 (94)

Table 2. *Crop data (nuts)*

	BE	RE	PRS	WE	ISG	MSG	MOSG	Total
Pick 1	90138	56477	82474	30938	220114	35804	12962	528907
Pick 2	99737	72264	149778	39706	246453	40211	11384	659533
Pick 3	136101	115413	129527	25815	329918	124555	23095	884424
Pick 4	123959	113473	118480	35968	295516	74138	30790	792324
Pick 5	102001	89568	106730	21954	258482	96206	29762	704703
Pick 6	48542	51177	78888	6687	183886	46083	16566	431829
Total-1995	600478-	498372-	665877-	161068-	1534369-	416997-	124559-	4001720
Total-1994	630908	390125	547288	203414	975902	332483	66327	3146447
Difference + - %	05 -	28 +	22 +	21 +	58 +	25 +	88 +	
Estimate 1995	400000	500000	600000	150000	1500000	-	-	
Average (1990-94)	459540	370075	480389	161941	855036	-	-	
Nuts/Palm - 1994	71	44	82	93	59	39	26	
Nuts/Palm - 1995	57	45	85	71	97	54	41	
Yield/ha - 1994	8607	7410	8241	12556	9877	6841	5222	
Yield/ha - 1995	7975	10007	11867	9942	15590	10692	10235	

Table 3. *Crop disposal (nuts)*

	BE	RE	PRS	WE	ISG	MSG	MOSG	Total
Sold	391938	412357	540248	121494	-	57057	6414	1529508
Converted to Copra	15302	11211	11335	7483	234540	-	6202	286073
Research	3052	-	-	11968	8119	-	-	23139
Seed Nuts	4707	-	-	-	1001772	343236	104941	1454656
Staff issues	33733	10900	4237	2350	13237	5043	2644	72144
Rejections	14200	15767	31809	3079	41140	11661	4358	122014
Awaiting sale	135046	48138	78248	14694	222631	-	-	498756
Others	2500	-	-	-	12930	-	-	15430
Total (nuts)	600478	498372	665877	161068	1534369	416997	124559	4001720
COP (Rs/1000 nuts)	2693/-	1687/-	2064/-	2058/-	2058/-	-	-	
NSA (Rs/1000 nuts)	3944/-	3982/-	4157/-	4350/-	6696/-	-	-	

Table 4. *General performance of the estates, seed gardens etc.*

	BE	RE	PRS	WE	ISG	MSG	MOSG	Total
A. Coconut extent (ha)								
Mature	75.30	49.80	56.11	16.20	98.80	39.00	12.17	347.38
Immature	48.60	48.54	17.12	-	40.70	14.80	55.00	224.76
Total	123.90	98.34	73.23	16.20	139.50	53.80	67.17	572.14
Nursery	1.60	-	-	-	1.00	-	-	2.60
Other Crops	-	-	6.05	-	-	-	-	6.05
Jungle	-	3.24	-	-	309.80	-	13.79	326.83
Vacant Land	0.30	6.88	-	-	-	-	-	7.18
Reservoir	-	-	-	-	3.00	2.40	-	5.40
Roads & buildings	22.30	2.02	2.50	1.60	3.00	2.00	4.04	37.46
Total	148.10	110.48	81.78	17.80	456.30	58.20	85.00	957.66
B. Census of palms								
Bearing palms	10574	11192	7763	2254	15957	7767	3068	58575
Young palms	2792	3167	5264	101	6492	1092	6688	25596
Seedling	1769	297	155	-	255	-	-	2476
Dud palms	492	39	61	37	238	40	-	907
Vacancies	3629	800	1480	148	3847	37	2086	12027
Total	19256	15495	14723	2540	26789	8936	11842	99581

Table 5. *Total number at nuts harvested from T X T in D X T in 1994 and 1995*

Pick	1994 T X T	D X T	Total	1995 T X T	D X T	Total
01	101167	16841	118008	191213	28901	220114
02	107570	20587	128157	215600	30853	246453
03	170397	25529	195926	281122	48796	329918
04	164490	20948	185438	247643	47873	295516
05	155299	16818	172117	213213	45269	258482
06	157050	19206	176256	161559	22327	183886
Total	855973	119929	975902	1310350	224019	1534369
B/P	13213	2644	15857	13331	2626	15957
N/P	65	45	62	98	85	96

(B/P - Bearing palms; N/P - Nuts per palms)

Table 6. *Pick wise cropping patterns for D X T Green and D X T Yellow palms at ISG In 1994 and 1995*

Pick	Dwarf x Tall Green		Dwarf x Tall Yellow	
	1994	1995	1994	1995
01	5705	17346	11136	11445
02	7036	18682	13551	11890
03	8894	27195	16635	21547
04	6032	22797	14916	24789
05	7128	20018	9690	24978
06	12545	8861	6661	13040
Total	47340	114899	72589	107689
B/P	1508	1473	1135	1153
N/P	31	78	63	93

(B/P - Bearing palms; N/P - Nuts per palms)

Table 7. *Seed nuts production (number of nuts)*

Pick	1994	1995	Increase percent
01	105870	164054	54.95
02	105297	192774	83.07
03	163904	255891	56.12
04	161369	234210	45.13
05	151416	191889	26.72
06	153320	137350	11.62
Total	841176	1176168	277.61

Table 8. *Seed nuts production (T x T and D x T)*

Pick	T x T		D x T	
	1994	1995	1994	1995
01	91255	163741	14615	23830
02	87707	166843	17590	25411
03	142099	218251	21805	37089
04	142684	192945	18685	40786
05	136271	155674	15145	36033
06	136635	120964	16685	18200
Total	736621	1018418	104525	181349

REPORT OF THE AGRICULTURAL RESEARCH PROJECT

Project Co-ordinator - D T Mathes, FIS

PROJECT OBJECTIVES

The principal objectives of the project were , to raise farmers income by increasing Agricultural production through the introduction of improved varieties, improved farming systems, animal husbandry practices, with a focus on addressing farmers specific problems.

In order to achieve these objectives, financial assistance was identified to cover the following project activities;

* Civil works
* Procurremnet of goods
* Manpower development
* Incremental operations, such as appointment of incremental staff.
* Contract research

1. ACTIVITIES

1.1 Manpower Development Programme

1.1.1 Long-term training

Ms. L K Weerakoon Assistant Botanist (Tissue Culture Division) returned to the Island in September, after successfully completing the Ph.D. programme at the University of Illinois, U.S.A.

Mr. M T N Fernando, Assistant Agric. Economist, returned to the Island in March, to commence the local component of field research, as part of his PhD programme at the University of Aberdeen, U.K.

Ms. C S Ranasinghe, Assistant Plant Physiologist, returned to the Island in December, having successfully completed the Ph.D programme, at the University of Sussex, U.K.

Mr. K B Dasanayaka, Assistant Agronomist, left the country in August, after completing the local component and field research, to continue with his Ph D Programme in U.K.

Mr. D M D T Everard,Assistant Geneticist/Plant Breeder, Mr I R

Wickramananda, Assistant Crop Protection Officer and Ms. S C Fernando, Assistant Botanist, continued their Postgraduate studies, at the University, of New England, Australia, University of Aberdeen, UK and Universtity of Notingham, UK, respectively.

Ms. P A S F Perera, Acting Librarian, left for U.K. in August, to pursue postgraduate training in Information and Library Studies, leading to M.Sc. degree at the University of Aberdeen, U.K.

Long-term training (Local)

Mr. T S G Peiris, Senior Biometrician and Mr L P Vidana Arachchi, Assistant Soil Scientist continued their postgraduate studies at the University of Colombo and Sri Jayawardenapura, respectively.

Short-term training

Following short-term training was offered to the staff during the year.

Mr. R D N Premasiri, Technical Assistant, received one month training field on 'Soil Plant Water Relations' in the Land Use Division, Irrigation Department of Sri Lanka.

Mr. L P Vidana Arachchi, Soil Scientist, received three months (04 September - 04 December 1995) training on "Soil Physics", at the Asian Institute of Technology, Thailand.

Dr. (Mrs.) C Jayasekera, Deputy Director (Research) attended a two weeks training course in "Research and Development Management" in Australia.

Mrs. D M D I Wijebandara, Technical Assistant attended a training programme at the Faculty of Agriculture and Forestry of University of Melborne, Australia from 03 February - 16 March 1995.

1.2 Strengthening of Research Station Facilities

1.2.1 Laboratory/Field Equipment and vehicles

Equipment/spares	-	A 'Flow Injection Analysis System' was installed in May, at the Soils & Plant Nutrition Division
Library Books	-	Thirty Seven books were presented to the library.
Vehicles	-	A six seater van was purchased in June.

1.3 Civil Works

Feild laboratory, office and chemical stores at the Isolated Seed Garden, Rajakadaluwa and chemical and fertilizer stores at Ratmalagara were completed.

Construction work on overhead tank, water distribution system at Makandura and Maduruoya Seed Garden continued.

1.4 Field Days, Workshops and Seminars

Field days, training programmes, and research-extension dialogues were held during the year.

1.5 Diagnostic Team (Research & Extension linkage)

Periodic Diagnostic surveys to assess the efficiency of dissemination of research findings and to identify growers problems are recommended under the project. As a result the CRI carried out its second Diagnostic Survey in 1993 covering the small holder sector, to find out, (a) the acceptability of the CRI recommendations, (b) constraints if any, for such acceptances, (c) feed-back from the growers on areas requiring special attention.

In view of the interesting results surfaced by this survey, it was decided to conduct a similar survey to cover the Estate sector, which however had to be postponed due to lack of funds.

1.6 Management Information System/Programme Budgeting System (INFORM)

The MIS/PBS system has been installed, 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 priorities.

2. CONTRACT RESEARCH PROGRAMME (CARP AWARDS)

2.1 Adaptive Research Trials on Coconut Based Cropping/Farming Systems (12/283/17)

The award granted in January 1994, was terminated.

2.2 Intercropping of Coconut with selected Medicinal Plants (12/167/136)

The award granted in December, 1992 in support of the collaboration

research with the Ceylon Institute of Scientific and Industrial Research (CISIR), was terminated.

2.3 Characterization of physical properties of soils and studies on the development of coconut roots (12/175/149)

The award granted in April, 1993 was terminated.

2.4 Collection of Coconut Germplasm for physiological adaptation and their characterisation using quantitative traits and biochemcial markers (isozymes) (12/195/179)

The work is progressing satisfactorily.

2.5 Economic analysis of coconut based cropping/farming system (12/201/174)

The award granted in January, continued satisfactorily.

2.6 Study of the microbiological and other related properties of different coconut soils (12/247/214)

The work commenced in March, continued satisfactorily.

REPORT OF THE ADMINISTRATION DIVISION

Deputy Director (Adm & Fin) - H S Herath, SLAS II/I

1. GENERAL

The Division continued to assist the research and support staff of the Institute in routine administrative and financial matters and related activities including maintenance work.

2. CADRE

The staff position of the Coconut Research Institute at the end of December, 1995 is given in Table 1.

Table 1. *Staff position as at 31.12.1995*

Grade	Ungraded	sp cl.	cl 1	cl 11	cl 111	cl 1V	Total
Executive	02	-	05	11	21	13	52
Technical	-	27	08	27	-	-	62
Intermediate	-	02	00	04	-	-	06
Clerical & Allied	-	19	06	18	-	-	43
Operative	-	20	07	22	-	-	49
Minor	-	54	09	40	-	-	103
Driver	-	10	04	17	-	-	31
Watcher	08	-	-	-	-	-	08
Grand Total	**10**	**132**	**39**	**139**	**21**	**13**	**354**

3. WELFARE

3.1 Financial Aid

Welfare facilities extended towards the employees of the Coconut Research Board were continued in 1995. Financial assistance given to the employees are given below.

Provident Fund Loans: The loans granted from the provident fund to the 49 employees amounted to Rs. 3,108,373/-

Distress Loans: Distress loans paid to 76 employees amounted to Rs. 2,590,433/-.

Transport Loans: Transport loans paid to 16 employees amounted to Rs. 670,000/-.

Loans to Relive Indebtedness: Loans granted to relieve indebtedness to 10 employees amounted to Rs. 75,000/-.

Refrigerator Loans: Refrigerator loans granted to 08 employees amounted to Rs. 96,000/-.

Education Loans: Education loans granted to 01 employee amounted to Rs. 10,000/.

3.2 Other facilities to employees

Financial assistances were also granted to Multi-purpose Co-operative Society, Recreation Club, and Lalithakala Kawaya to support their activities during the year 1995.

The amount of Rs. 237,360.00 was distributed among members of the Medical Aid Scheme and the sum of Rs.1,452,616.60 was reimbursed for medical expenses incurred by members during the year 1995.

STAFF MATTERS

1. APPOINTMENTS

Fifty four appointments were made during the year 1995 and the details are shown in Table 2.

TABLE 2. *Appointments made during the year 1995*

Name	Designation	Division	Date
Mrs P A S F Perera	Librarian	Library	06.07.95
Mr D R C M Handalage	Chief Accountant	Accounts	17.07.95
Mr A M Kurukulasooriya	Manager (Estates)	Estates Management	01.08.95
Mr A L D K Amarasinghe	Work Superintendent	Engineering	01.09.95
Mr B M D Bandara	Chief Clerk	Establishment	01.09.95
Mr S A D Richard	Accounts Clerk	Accounts	01.09.95
Mrs Neetha Ubaysekara	Accounts Clerk	Accounts	01.09.95
Mr N M H Wijewardena	Clerk/Typist	Establishment	01.09.95
Mr M A M Perera	Clerk/Typist	Establishment	01.09.95
Mr W A L Raj Fernando	Clerk/Typist	Establishment	01.09.95
Mr K T J N W Perera	Clerk/Typist	Establishment	01.09.95
Mr M A D M F Appuhamy	Clerk/Typist	Engineering	01.09.95
Mr M Somasiri	Clerk/Typist	Engineering	01.09.95
Mr D M Jayawardena	Clerk/Typist	Estates Management	01.09.95
Mr V S Jayamanna	Asst. Agronomist	Agronomy	20.09.95
Miss K K I C K Kannangara	Asst. Soil Scientist	Soils & Plant Nutrition	20.09.95
Mr A D Samarajeewa	Asst. Agronomist	Agronomy	20.09.95
Mr W A Hemawardena	Lab/Field Attendant	Accounts	27.09.95
Mr J H Ubayratne	Lab/Field Attendant	Biometry	27.09.95
Mr E A Chandradasa	Lab/Field Attendant	Soils & Plant Nutrition	27.09.95
Mr M M Nimal Jayatissa	Lab/Field Attendant	Soils & Plant Nutrition	27.09.95
Mr W Wimalasiri	Lab/Field Attendant	Soils & Plant Nutrition	27.09.95
Mr P A B A Caldera	Lab/Field Attendant	Agronomy	27.09.95
Mr K M G C Kumarasinghe	Lab/Field Attendant	Crop Protection	27.09.95
Mr N A Wasantha Jayasiri	Lab/Field Attendant	Extension Services	27.09.95
Mr H Kapila Prasanna	Lab/Field Attendant	Tissue Culture	27.09.95
Mr R M N Sandasiri	Lab/Field Attendant	Soils & Plant Nutrition	27.09.95
Mr M S Abaytissa	Office Attendant	Library	27.09.95
Mr H N M Jayaratne	Electrical Helper	Engineering	27.09.95
Mr K J J Appuhamy	Building Helper	Engineering	05.10.95
Mr M G D Flacidus	Supervisor	Estates Management	05.10.95
Mr M P D Benet Silvan	Superintendent	Estates Management	05.10.95
Mr A M R B Attanayaka	Superintendent	Estates Management	05.10.95
Mr S M U D Singhabahu	Watcher	Estates Management	05.10.95
Mr W Sebastian Fernando	Watcher	Estates Management	05.10.95
Mr A Wasantha	Watcher	Estates Management	05.10.95

TABLE 2. *Contd.*

Name	Designation	Division	Date
Mr D M L Jayarathna	Watcher	Estates Management	05.10.95
Mr W H M Wickramasinghe	Watcher	Estates Management	05.10.95
Mr R P S L Abeyrathna	Watcher	Estates Management	05.10.95
Mr U A R P Calister	Watcher	Estates Management	05.10.95
Mr J K U Abeyrathna	Watcher	Estates Management	05.10.95
Mr A M N Kularathna	Watcher	Estates Management	05.10.95
Miss S M Mallawarachchi	Technical Assistant	Genetics & Plant Breeding	16.10.95
Mr P H P Roshan de Silva	Technical Assistant	Crop Protection	16.10.95
Mr D A Sidath Diyagoda	Technical Assistant	Biometry	16.10.95
Mr S K Gunarathna	Technical Assistant	Soils & Plant Nutrition	16.10.95
Mr M R Dharshana Perera	Technical Assistant	Soils & Plant Nutrition	16.10.95
Mr T W Fernando	Asst.Information Officer	Extension Services	11.10.95
Mr H S Herath	Deputy Director (A & F)	Establishment	01.11.95
Mr K K Piyatissa	Tractor Driver	Estates Management	07.11.95
Mr J A Henry Nevil	Tractor Driver	Estates Management	07.11.95
Mr R P Somasiri	Driver	Establishment	01.12.95
Mr H N Tikiribanda	Driver	Estates Management	01.12.95
Mr R K Gunawardana	Driver	Establishment	01.12.95

1.1 RESIGNATIONS, RETIREMENTS & DEATHS ETC.

Details of resignations, retirements, deaths, vacation of posts and dismissals during the year 1995 are given in Table 3.

TABLE 3. *Resignations, retirements, deaths, vacation of posts and dismissals during the year 1995*

Name	Designation	Division	Date
Resignations			
Mr M L Amarasena	Tractor Driver	Estates Management	01.02.95
Mr W K K R Ariyarathna	Technical Assistant	Biometry	01.03.95
Mrs H P L Jayathilaka	Clerk/Typist	Establishment	10.04.95
Mr A S M Premalal	Lab/Field Assistant	Crop Protection	27.07.95
Mr P Edward Silva	Pollination Labourer	Estates Management	01.08.95
Mr M M P Wijesekara	Internal Auditor	Establishment	01.08.95
Mr D G Manamudali	Deputy Director (A & F)	Establishment	01.09.95
Mr J D J Abeysekara	Technical Assistant	Genetics & Plant Breeding	31.10.95

TABLE 3. *Contd.*

Name	Designation	Division	Date
Retirements			
Mr D W Piyasena	Watcher	Estates Management	10.01.95
Mr J Wijedasa	Lab/Field Assistant	Biometry	10.02.95
Deaths			
Mr W H M Senarathne	Pollination Labourer	Estates Management	30.06.95
Mr D M Sumanasena	Cangani	Estates Management	16.11.95
Vacation of posts			
Dr H P S Jayasundara	Agronomist	Agronomy	30.12.94
Dr T G L G Gunasekara	Agronomist	Agronomy	16.05.95
Dismissals			
Mr T Upasena	Electrician/Power house Operator/Plumber/Fitter	Engineering	04.12.95
Mr Anura Kumara	Watcher	Estates Management	08.12.95

2. PROMOTIONS

2.1 Promotions in Executive Grades

One promotion was made during the year and details are shown in Table 4.

TABLE 04. *Promotions from executive grades Cl. III to II during the year 1995*

Name	Designation	Division	Date
Mr L P Vidhanarachchi	Research Officer	Soils & Plant Nutrition	09.09,94

2.2 Promotions in Non Executive Grades

Following internal promotions in Non-Executive Grades were implemented during the year 1995 as shown in Table 5. The effective date of these promotions was 01 January, 1994.

TABLE 05. *Promotions in non executive grades during the year 1995*

Name	Designation	Division
Technical Grade from Class I to Special Class		
Mr M D B Plaxidus	Foreman (Electrical)	Engineering
Mr M E R Fernando	Lab/Field Assistant	Biometry
Mr D M Jayakody	Lab/Field Assistant	Crop Protection
Mr A A Fernando	Lab/Field Assistant	Soils & Plant Nutrition
Clerical & Allied Grade Class I to Special Class		
Mrs W J M D M A Fernando	Typist	Establishment
Operative Grade Class I to Special Class		
Mr U V M Fernando	Lab/Field Assistant	Estates Management
Mr W P Fernando	Lab/Field Assistant	Biometry
Mr M Victor	Lab/Field Assistant	Genetics & Plant Breeding
Technical Grade from Class II to Class I		
Mr E Sunil Santha	Technical Assistant	Tissue Culture
Mr M J M D S Jayawardena	Foreman (Mechanical)	Engineering
Mr R M Dayaratne	Foreman (Building)	Engineering
Clerical & Allied Grade Class II to Class I		
Mrs U I Abeysinghe	Clerk/Typist	Biometry
Operative Grade Class II to Class I		
Mr T M Keerthiratne	Supervisor	Estates Management
Mr M P W Fernando	Supervisor	Estates Management
Mr K D T K Liyanage	Building Caretaker	Engineering
Drivers Grade Class II to Class I		
Mr W C M Fernando	Driver	Estates Management
Mr M A S Dharmasiri	Driver	Estates Management
Minor Grade Class II to Class I		
Mr M A L K Udayananda	Office Attendant	Crop Protection
Mr D M Ratnayaka	Pollination Labourer	Estate Management
Mr D M Sumanasena	Cangani	Estate Management
Mr R A Chandrasekara	Office Attendant	Establishment

3. TRANSFERS

Mr W G L Rodrigo, Machine Operator from Library to the Establishment Unit on 01 January.

Mr H A Gunadasa Perera, Office Attendant from Establishment Unit to the Plant Physiology Division on 17 January.

Mr H A D Rexy, Office Attendant from Plant Physiology Division to the Establishment Unit on 17 January.

Mr G K Ekanayaka, Technical Assistant from Genetics and Plant Breeding to the Isolated Seed Garden on 25 January.

Mr K S A J Fernando, Lab/Field Attendant from Agronomy Division to the Bandirippuwa Estate on 01 February.

Mr A I F Fernando, Clerk from Engineering Unit to the Establishment Unit on 10 April.

Mr R Wijethunga, Lab/Field Assistant from Estates Management to the Engineering Unit on 19 April.

Miss M G Karunawathi, Clerk/Typist from Estates Management Division to the Establishment Unit on 19 April.

Mr T M C Peiris, Tractor Driver from Maduruoya Seed Garden to the Bandirippuwa Estate on 20 April.

Mr W C Marcus, Tractor Driver from Bandirippuwa Estate to the Maduruoya Seed Garden on 20 April.

Mr K P W Perera, Clerk from Establishment Unit to the Estate Management Division on 24 April.

Mr A Sugathadasa, Supervisor, from Pottukulama Research Station to the Makandura Seed Garden on 12 May.

Mr A G B G Silva, Supervisor from Makandura Seed Garden to the Pottukulama Research Station on 23 May.

Mr A Thawaratneraja, Assistant Manager (Farm) from Estates Management Division to the Genetics and Plant Breeding Division on 14 August.

Mrs Dilani Jayasundara, Clerk/Typist from Establishment Unit to the Extension Division on 01 September.

Mr K P de Silva, Assistant Manager(Farm) from Internal Audit Unit to the Estates Management Division on 11 September.

Mr Roshan Jayathilaka, Technical Assistant from Genetics and Plant Breeding Division to the Isolated Seed Garden on 01 October.

Mr G K Ekanayaka, Technical Assistant from Isolated Seed Garden to the Genetics and Plant Breeding Division on 01 October.

Mr R Wijetunga, Lab/Field Assistant from Engineering Unit to the Estates Management Division on 02 October.

Mr W G L Rodrigo, Machine Operator from Establishment Unit to the Library on 02 October.

Mr P D Benet Silvan, Superintendent from Estates Management Division to the Makandura Seed Garden on 25 October.

Mr W M U Ratnayaka, Field Officer from Ratmalagara Estate to the Pottukulama Research Station on 25 October.

Mr R B Attanayaka, Superintendent from Estates Management Division to the Maduruoya Seed Garden on 26 October.

Mr M R L A Perera, Superintendent from Makandura Seed Garden to the Rathmalagara Estate on 26 October.

Mr R A Swarnathilaka, Supervisor from Maduruoya Seed Garden to the Isolated Seed Garden on 29 October.

Mr I A N Hemasiri, Lab/Field Assistant from Maduruoya Seed Garden to the Agronomy Division on 31 October.

4. FINANCE

The Budget Expenses

The Budget expenses during the year was 84 million, made up of 61.5 million as Recurrent Expenditure and 20 million as Capital Expenditure. The total revenue (excluding transport) for the year was 19.5 million. The Government grant

was Rs. 46.5 million.

The Finance Unit managed to handle entire accounting activities of the whole Institute with eleven officers (as in the year 1994) in the year 1995 too. Final Accounts were produced as Computer Prints. Apart from this, there were several achievements in the year 1995. Using the little Computer knowledge gathered from the Text Books the following areas were computerized.

(a) E.P.F. & E.T.F of daily paid workers
(b) Advance Accounts
(c) Certain Statistical Reports to Outsiders
(d) Management Reports

Due to this exercise, overtime and some other allowances in the Finance Unit were cut down bringing a cost benefit to the Institute.

Engineering Unit

Maintenance work of buildings electricity, vehicles and machinery were carried out by the Engineering Unit.

For the year 1995, the Engineering Unit has attended to rehabilitation work of three staff quarters, one research building and construction work of the toilet complex at Bandirippuwa Estate under Capital Expenditure.

5. TRAINING IN SRI LANKA

Name	Designation	Period	Place/field
Mr D R C M Handalage	Chief Accountant	30.03.95-06.07.95	Sri Lanka accounting standards in Sri Lanka Institute of Charted Accounts of Sri Lanka
Miss H D Mangalika	Administrative Assistant	27.09.95 (one day)	Seminar on Termination of Personal Employment in the Institute of Managements of Sri Lanka
Mrs Anoma de Alwis	Accountant	03.03.95-03.08.96 (Fridays only)1461X	Scholarships Diploma in Computer studies in Ceylinco Institute of Management
Mrs Ramanie Fernando	Audit Clerk	11.12.95-15.12.95	Training of Accounts and Audit Clerk at National Institute of Business Management

Mr T S G Peiris, Senior Biometrician continued his PhD programme at the University of Colombo.

Mr L P Vidhana Arachchi, Soil Scientist continued his PhD programme at the University of Sri Jayawardenapura, Nugegoda.

Mr H P de Zoysa, Programme Analyst continued his MSc programme at the University of Colombo.

Mrs D M D I Wijerabandara, Technical Officer Soils and Plant Nutrition Division continued her MSc degree programme at the Postgraduate Institute of Agriculture, Peradeniya.

Ms P H A P Siriwardena, Technical Assistant, Crop Protection Division continued her B Sc Agric. degree programme at the University of Peradeniya with effect from 20 March.

Mr J D J S Kularatne, Technical Assistant, Biometry Division followed a training course on personal computer hardware maintenance at the Arther C Clerk Centre for Modern Technology in Moratuwa from 21 - 24 March.

Dr N A Tennakoon participated in the workshop on "Soil Biology" held at the Hector Kobbekaduwa Agrarian Research & Training Institute, Colombo, from 23-24 March.

Dr L L W Somasiri participated in the International Workshop on "Direct application of Rock Phosphate and appropriate technology held at the IFS, Kandy from February 20 to 24.

Dr L L W Somasiri attended a three-day workshop on training laboratory accessories organised by the Sri Lanka Standards Institution from 7 to 9 August.

Dr (Mrs) M N Fernandopulle participated in the International Workshop on direct application of Rock phosphate and appropriate technology, held at the IFS, Kandy from February 20 to 24.

Mr H T R Wijesekara, Assistant Crop Protection Officer received training on laboratory techniques of pathological studies in the Department of Botany, University of Colombo from 29 August to 14 September.

Mr S P Manohar, Technical Assistant, Crop Protection Division attended a workshop on repair of scientific instruments in the Faculty of Science,

University of Peradeniya from 28 November to 08 December.

Mr L R S Silva, Technical Assistant, Plant Physiology Division attended a workshop on repair of scientific instruments in the Faculty of Science, University of Peradeniya from 28 November to 08 December.

Mr E Sunil Santha, Technical Assistant, Tissue Culture Division attended a workshop on repair of scientific instruments in the Faculty of Science, University of Peradeniya from 28 November to 08 December.

Mr R D N Premasiri, Technical Assistant, Plant Physiology Division received training in Soil-Plant-Water Relations, in the Land Use Division, Irrigation Department from 20 June to 15 July.

6. OVERSEAS TRAINING

Dr (Mrs) C Jayasekara, Deputy Director (Research) attended the fourth International R & D Management Course held in Australia from 20 November to 02 December.

Dr L L W Somasiri, Soil Scientist attended the FAO/IAEA Regional Training Course on Soil Plant Analysis in Thailand from 06 March to 07 April.

Mr H P de Zoysa, Analyst Programmer received training on PC Based System Analysis and Design in Japan from 07 August to 25 November.

Mr L P Vidhana Arachchi, Soil Scientist received training on 'Soil Physics' at the Asian Institute of Technology in Thailand from 04 September to 04 December.

Mrs D M D I Wijebandara, Technical Officer, Soils and Plant Nutrition Division, participated in a training programme on soil plant analysis at the University of Melbourne, Australia from 03 February to 04 March.

Mrs W B S Fernando, Technical Assistant, Genetics and Plant Breeding Division participated in a training programme in Biotechnology at the Institute of Horticulture Development, Australia from 06 February to 21 April.

Mr A A F L K Perera, Assistant Geneticist and Plant Breeder attended the Regional Training Course in Plant Breeding in Indonesia from 18 September to 01 October.

Mr M Bastian, Senior Technical Officer, Agronomy Division received practical training at the Central Plantations Crops Research Institute in India from 16 to 26 January

Mr D P Panditharatne, Technical Officer, Soils and Plant Nutrition Division received practical training at the Central Plantations Crops Research Institute in India from 16 to 26 January

Mr M H L Padmasiri, Technical Officer, Genetics and Plant Breeding Division received practical training at the Central Plantations Crops Research Institute in India from 16 to 26 January.

Mrs M G F S Jayasundara, Assistant Soil Scientist continued her postgraduate studies at the University of Western Australia, Perth.

Mr K B Dassanayake, Assistant Agronomist continued his postgraduate studies at the University of Aberdeen, UK

Mr M T N Fernando, Assistant Agricultural Economist continued his postgraduate studies at the University of Aberdeen, UK.

Mr J M D J Everard, Assistant Geneticist and Plant Breeder continued his postgraduate studies at the University of New England, Armidale, Australia.

Mrs W N I S C Fernando, Assistant Botanist (Tissue Culture) continued her postgraduate studies at the University of Nottingham, UK

Mrs L K Weerakoon, Assistant Botanist (Tissue Culture) continued her postgraduate studies (until September) at the University of Illinois, USA

Ms C S Ranasinghe, Assistant Plant Physiologist, continued her postgraduate studies at the University of Sussex, UK.

Mr I R Wickremananda, Assistant Crop Protection Officer continued his postgraduate studies at the University of Aberdeen, UK.

Mrs P A S F Perera, Librarian left for postgraduate studies at the University of Aberdeen on 20 September

7. OVERSEAS VISITS

Dr M de S Liyanage, Director attended the International Workshop on

Nitrogen Fixing Trees for fodder held in India from 20 to 25 March.

Dr M de S Liyanage, Director attended the Third FAO/IAEA Research Co-ordination Meeting in Vienna from 05 to 12 May.

Dr (Mrs) L C P Fernando, Entomologist attended a workshop on Lethal Yellowing-like disease of coconut held in Ghana from 02 to 11 November.

Dr D N S Fernando, Head, Agronomy Division attended the 32nd COCOTECH meeting held in India, organised by the Asian Pacific Coconut Community from 17 to 21 July.

Dr H A J Gunathilake, Agronomist visited Abu-Dhabi, UAE on a short-term consultancy assignment from 04 to 12 December.

Mr T S G Peiris, Senior Biometrician attended the Sixth International Conference on Environmetrics in Malaysia from 06 to 09 December.

Dr K R R A Peries, Head, Genetics and Plant Breeding Division visited Pakistan and Myanmar on a COGENT/IPGRI consultation from 17 to 28 April.

Dr K R R A Peries, Head, Genetics and Plant Breeding Division visited India on a COGENT/IPGRI consultation from 24 to 27 July.

Dr K R R A Peries, Head, Genetics and Plant Breeding Division attended a COGENT/IPGRI Technical Committee Meeting held in India from 11 to 15 November.

Dr (Mrs) W M U Fernando, Geneticist and Plant breeder attended the Second International Plant Tissue Culture Conference from 10 to 12 December in Dhaka, Bangladesh.

8. PARTICIPATION OF CRI STAFF IN OTHER STATUTORY BODIES, COMMITTEES ETC.

Dr M de S Liyanage

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

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

Chairman, Technical Committee, National Institute of Plantation Management, Athurugiriya.

Member, Advisory Committee, Atomic Energy Agency, Sri Lanka.

Visiting Lecturer, Department of Crop Science, University of Ruhuna, Matara.

Dr (Mrs) C Jayasekara

Member, Board of Management, Atomic Energy Authority, Colombo.

Member, Extension Committee, Coconut Cultivation Board.

Member, Editorial Board, Kapruka, published by the Coconut Cultivation Board.

Dr R R A Peries

Member, Committee to monitor the progress of selection and re-selection of plus palms for the National Replanting Programme.

Committee member (Section B) and General Research Committee, Sri Lanka Association for the Advancement of Sciences, and GRC.

Member, Steering Committee of the Coconut Genetics Resources Network (COGENT) of the International Plant Genetic Resource Institute (IPGRI) representing South Asia.

Member, Estate and Nursery Committee, Coconut Cultivation Board.

Mrs C N K Rajapakse

Member, Pesticide Technical and Advisory Committee.

Dr (Mrs) L C P Fernando

Member, National Plant Quarantine Committee.

Dr L L W Somasiri

Committee Member, Soil Science Society of Sri Lanka for the period 1995/96.

Visiting lecturer, Dept of Chemistry, University of Colombo.

Visiting Scientist, Institute of Fundamental Studies, Kandy.

Dr N A Tennakoon

Committee Member (Section B) Sri Lanka Association for the Advancement of Science.

Visiting lecturer, Faculty of Natural Science, University of Kelaniya.

Dr (Mrs) M N Fernandopulle

Member, Fertilizer Co-ordinating Advisory Committee of the National Fertilizer Secretariat, Colombo.

Member, Fertilizer Committee.

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

Mr T S G Peiris

External Examiner, Biometry and Crop Experimentation, Eastern University, Batticaloa.

Mr H P de Zoysa

Visiting Lecturer, Affiliated University College, Kuliyapitiya.

Dr W M U Fernando

Member, Committee to monitor the programme of selection and reselection of plus palms for the National Replanting Programme.

Member, Estate and Nursery Committee, Coconut Cultivation Board.

Member, programme for seedling certification of improved varieties of coconut, Seed Certification Unit, Department of Agriculture, Peradeniya.

Mr A A L Perera

Member, Nursery Committee, Coconut Cultivation Board.

Dr D N S Fernando

Assistant Editor, Council of the Institute of Biology, Sri Lanka.

Dr H A J Gunathilake

Member, Operational Committee, Agricultural Technology Transfer Centre, IRDP, Gampaha.

Member, Agric Extension Implementation Project, Gampaha (JAICA Project).

Mr P A H Nimal Appuhamy

Member, Extension Committee, Coconut Cultivation Board.

9. ACADEMIC AND PROFESSIONAL ACHIEVEMENTS

Dr (Mrs) L K Weerakoon, Assistant Botanist (Tissue Culture) was awarded the PhD degree by the Illinois State University, USA.

Dr (Miss) C S Ranasinghe, Assistant Plant Physiologist was awarded the Ph D degree by the University of Sussex, UK.

Dr (Miss) C S Ranasinghe, won the annual prize awarded by the Graduate Centre for Biology, University of Sussex, U K, for presenting the best student paper for 1995.

Dr M de S Liyanage, Director,Coconut Research Institute was awarded one month fellowship by the International Atomic Energy Agency, Vienna to undertake an expert mission in Vietnam, Bangladesh and Myanmar.

STAFF PUBLICATIONS AND COMMUNICATIONS AT SCIENTIFIC MEETINGS

(CRI members are shown in bold type)

THESES

Dr (Miss) C S Ranasinghe - The Impact of Elevated CO_2 and Light on leaf growth, cell production and cell expansion in *Phaseolus Vulgaris* and *Phaseolus phaseoloides*. Ph D thesis, University of Sussex, UK

Dr (Mrs) L K Weerakoon - Molecular analysis of the upstream region of a lysin gene (lyt + A) of bacteriophage Phi ii of *Staphylococcus aureus*. PhD Thesis, Illinois State University, USA.

JOURNALS AND SCIENTIFIC MEETINGS

Abeygunasekera P, Abeyratne F and **Fernando M T N** (1995) Economics of soil moisture conservation in coconut lands using coconut husk and coir dust, COCOS, 10, 25 - 45.

Fernando S C and **Gamage C N K** (1995). Recent advances in cloning of coconut in Sri Lanka - Improved culture conditions for rhyzogenesis, COCOS, 10. 20 - 25.

Fernando, L C P; Kanagaratnam, P and Narrangoda N K (1995) Some studies on the use of metarhizium anisopliae for the control of Oryctes rhinocerus in Sri Lanka, COCOS, 10, 46 - 52.

Fernando, W M U, Abeysekera, J D J and **Jayathilake R** (1995) Pattern of isozyme variation in *Cocos nucifera* Pro. Sri Lanka Assoc, for the advancement of Science 51, 82-84.

Fernando W M U; Fernando S, Peries R R A; Periyapperuma K; Everard, J M D T and Karunaratne S (1995) Coconut biotechnology research work emphasis on tissue culture: the Sri Lanka experiences. Paper presented at the Second International Plant Tissue Culture Conference, Dhaka, Bangladesh 10 - 12 December.

Gamage, C K A (1995) Dikiri Coconut, Coconut Bulletin 10 (1/2), 26 - 27.

Gunathilake H A J (1995) Growing banana as an intercrop under coconut in Sri Lanka. Coconut Bulletin 10 (1/2), 08 - 14.

Gunathilake H A J (1995) Arecanut as an intercrop in coconut lands. Coconut Bulletin 10 (1/2), 22 - 23.

Gunathilake, H A J and **Liyanage M de S** (1995) Coconut-based agroforestry research in Sri Lanka. Paper presented at the sixth Regional Workshop on Multipurpose trees held in Peradeniya, 17 to 18 August, 1995.

Jayasekara C and **Jayasekara K S** (1995) Photosynthetic characteristics of tropical tree species with special reference to palms. Energy Cons. & Mgmt 36 (6-9) 919-922.

Liyanage M de S (1995) Use of nitrogen fixing trees as fodder for cattle in Sri Lanka. Paper presented at the International workshop on fodder for livestock, Pune India, 20 - 25 March.

Liyanage, M de S (1995) Use of Isotopes in studies of biological nitrogen fixation in tree legume. Paper presented at the Third FAO/IAEA Research Co-ordinating meeting held in Vienna, 08 - 12 May.

Mathes, D T (1995) Harvesting coconut at monthly intervals will provide large scale benefits. Coconut Bulletin, 9 (1/2) 29 - 33.

Peiris T S G, Thattil R O and Mahindapala R (1995) An analysis of the effect of climate and weather on coconut. J Expl. Agric., 31, 451 - 460.

Peiris T S G and Thattil, RO (1995) The analysis of climatic system: Parsimonious crop weather models. Paper presented at the Sixth International Conference on Environmetrics held in Malaysia, 6 - 9 December.

Peries R R R A (1995) Dikiri Pol: Fallacies, Facts and the Future: Coconut Research & Development (CORD) 11 (2), 50 - 58.

Rajapakse, C N K and **Wijesekara H T R** (1995) Ganoderma bole and root rot in Coconut. Coconut Bulletin 10, 28 - 31.

Rajapakse, C N K, Wijesekara H T R and **Norman A H** (1995) A Preliminary study on immature nutfall of coconut in reference to pest damage, COCOS 10, 53 - 54.

Rajapakse, C N K and **Fernando, L C P** (1995) Leaf Scorch Decline of coconut in Sri Lanka: A review paper presented at the International Workshop - Lethel Yellowing like disease of coconut held in Ghana, 5 - 9 November, 1995.

Somasiri L L W (1995) Improving sub-optimal soil classes for high yields: Land classification for coconut paper presented at the In-house seminar held at CRI on 10 November.

Somasiri L L W and **Fernandopulle M N** (1995) Fertilizer research and current recommendations - review paper presented at the in-house seminar held at the CRI on 15 September.

Tennakoon N A (1995) Role of organic manures on soil biological properties. Paper presented at the workshop on soil biology, Hector Kobbekaduwa Agrarian Research & Training Institute, Colombo, 23 - 26 March.

Tennakoon N A (1995) Improving sub-optimal soil classes for high yields: Use of organic waste material. Paper presented at the in-house seminar held at the CRI on 10 November.

Tennakoon N A (1995) Organic manures: A potential magnesium source, Coconut Bulletin 10 (1/2), 24 - 25.

Tennakoon N A and **Fernandopulle M N** (1995) Organic manuring of coconut. Paper presented at the in-house seminar held at the CRI on 07 June.

Tennakoon N A and **Pinto J L J G** (1995) Toddy tapping survey in Sri Lanka. Coconut Bulletin 10 (1/2), 15 - 16.

Tennakoon N A; Mahindapala R and Widhanpathirana, S (1995) Effect of organic manure on the quality of coconut soils. J National Science Council Sri Lanka 23 (4) 171 - 182.

Vidhana Arachchi L P (1995) Effect of soil physical conditions and moisture stress on coconut root growth. Paper presented at the Asian Institute of Technology, Thailand, 15 November.

Vidhana Arachchi L P and Mohd Nor (1995) Emission of nitrogen oxide, nitrogen and methane from palm oil sludge amended soil. Trop Agric Res. 5, 145 - 157.

Weerakoon, L K and Jayaswal, R K (1995) Sequence analysis of the region upstream of a peptidoglycan hydrolase - encoding gene from bacteriophage phil of Staphylococcus aurous. FEMS Microbial Let. 133, 9 - 15.