

ACTIVITIES OF THE COCONUT RESEARCH INSTITUTE

GENERAL

The year 1990 was a significant one in view of the unprecedented drought experienced in the coconut triangle, in particular in the northern areas of the Kurunegala and Puttalam districts. The loss of coconut trees has not been estimated but it is believed that about 30,000 palms have been severely affected, together with about a similar number of seedlings and partially productive palms. The consequences of this drought are already evident.

The climate in the northern areas of Kurunegala and Puttalam districts has been gradually deteriorating over the last two decades. There is not only a reduction in the total annual rainfall but also in the number of wet days. The dry zone appears to be shifting southwardly converting more of the intermediate zone into the dry zone. The experiences of this year calls for a concerted effort in soil moisture conservation, particularly in the dry and intermediate zones for long-term rehabilitation of plantations.

Over the years, it has become obvious that parts of the dry zone in Puttalam and Hambantota districts have experienced very harsh climatic conditions, causing heavy mortality of coconut seedlings and young palms. Much of the efforts of replanting in these areas have been wasted, and a more cautious approach is required in expanding coconut lands in these areas. Perhaps planting of coconut should be discouraged and a more adapted plant for these conditions, such as cashew, should be encouraged.

The CRI continued to provide technical assistance to the estates sector. Although the area under the estates is relatively small compared to the overall coconut area in the country, it was revealed that the production per unit area was much higher in the estates sector.

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The staff maintained a close liaison with the managerial staff in the estates sector and it was obvious that this sector was quite responsive to accept new technology. Their better managerial capacity together with access to capital make them an attractive target group for 'selling' research findings. An encouraging aspect was that the number of enquiries made by the estates for technical assistance and their awareness of new developments.

The estates sector continued to draw CRI assistance for providing Differential Fertilizer Recommendations based on foliar analysis.

The CRI conducted a very successful COCONUT DAY on 25 November, 1990. The main objective of the event was to popularize fertilizer usage in coconut but an opportunity was provided for the participants to visit laboratories and discuss with staff their field problems. Also, an opportunity was given to the trade involved in fertilizer, farm implements, agrochemicals, irrigation equipment etc. to exhibit their products and to interact with coconut growers.

The newly-established seed gardens continued to perform satisfactorily. Seednut selection commenced at the Makandura Seed Garden and the first consignment was issued to the Coconut Cultivation Board towards the end of the year. The Institute continued to provide seednuts to the estates sector who have necessary infrastructure to establish nurseries and raise seedlings to meet their own requirements.

The number of coconut-based farm models in small-holdings was increased with the addition of several models in the intermediate zone.

An Inter-Institutional Research Programme on

intercropping and animal husbandry was launched at the beginning of the year. The participating institutions of this project, funded by the Council of Agricultural Research Policy (CARP) are: the Coconut Research Institute, Veterinary Research Institute, Dept. of Export Agriculture and the Makandura Regional Research Centre of the Dept. of Agriculture. The project was subsequently expanded to include a further component of a coconut-based farm model with free-grazing cattle, jointly conducted by the CRI, Faculty of Agriculture of the University of Ruhuna and Dept. of Veterinary Medicine, University of Peradeniya.

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

Agronomy Division

Research projects on moisture conservation, rehabilitation of low-yielding plantations, establishment and management of replantings/newplantings and coconut-based farming systems progressed satisfactorily. At the end of the year, there were 22 ongoing experiments managed by the division.

Of the several long-term experiments on soil moisture conservation in coconut lands in dry areas, ploughing treatments continued to show no significant effect on coconut yield despite some improvement in soil moisture status at 25 cm depth. In contrast, placement of husks and coir dust in 2.4 x 1.2 x 0.9 m pits between two palms or husk alone in single pits of 1.2 x 1.2 x 0.9 m on one side of each palm, or a layer of husk mulch, produced a substantial increase in coconut yield and improved the moisture content in lateritic gravel soil. On the other hand, palms in sandy soil benefited most from husk pits of 2.4 x 2.4 x 0.9 m located between two palms or from single pits of 1.2 x 1.2 x 0.9 m placed on one side of the palm.

In trials to test the effect of management practices on cover crops, *Pueraria phaseoloides* performed well in the wet zone and produced the highest top dry matter yield of 4500 kg/ha/year. In the dry zone, *Centrosema pubescens* and *Macroptilium atropurpureum* (Siratro) recovered well after the drought period and produced a satisfactory dry matter yield of 3200 and 3900 kg/ha/year, respectively. In biomass production trials of *Gliricidia sepium* intercropped with coconut, trees raised from

seedlings produced a higher leaf biomass (1.27 kg/tree) than those from cuttings (0.76 kg/tree) at 12 months after planting.

In the rehabilitation of low-yielding palms, quarter circle trenches filled with either green manure or organic manure were found to be effective for improving the yield of such palms in lateritic gravel soil.

In the integrated farming systems involving pasture/tree fodder and cattle, yield of palms continued to benefit from nutrients recycled through animal excreta, leading to a substantial reduction in the cost of fertilizer. In the fuelwood trial, intercropping with *Leucaena leucocephala* did not affect nut and copra yield.

A new trial was established to study the management practices in new plantings. A ground cover and two bush covers were established in the trial area.

Long-term studies on intercropping cacao consistently revealed that 100g nitrogen/tree/year and 120g K₂O/tree/year would be the optimum requirement for obtaining the highest bean yield of cocoa. The implementation of the on-farm trials was monitored closely, which continued to show that it is the most satisfactory method of utilizing coconut land to generate additional income.

Several collaborative trials were established with the assistance from the Dept. of Agriculture (Makandura Research Centre), Dept. of Export Agriculture, Veterinary Research Institute and the University of Ruhuna. These trials form part of the Inter-Institutional Coconut Intercropping Research Programme, funded by the Council for Agricultural Research Policy.

A long-term experiment to study Biological Nitrogen Fixation (BNF) by *Gliricidia* and *ipil ipil* using ¹⁵N technique was initiated with funds from the International Atomic Energy Agency in Vienna.

Genetics and Plant Breeding Division

Four multi-locational field trials for the evaluation of five improved cultivars at Bandirippuwa estate (Lunuwila), Thammenna estate (Puttalam), Dambakande estate (Kurunegala) and Suriyapura estate (Gampaha) were maintained satisfactorily.

Both Bandirippuwa and Thammenna trials achieved 72% flowering. At Dambakande, flowering was slow and only increased from 6.5% to 21.5% during the year. The ability of dwarf green x tall to perform better than dwarf yellow x tall under increasing soil water deficit conditions was discernible at Dambakande.

The six progeny trials (1986/87) and the three observational trials (1989) were satisfactorily maintained. In most trials the tall x dwarf green hybrid maintained its superiority over the other progenies.

A total of 2.5 million seednuts were supplied during the year. This consisted of 2,264,093 plus palm seednuts, 249,053 CRIC 60 and 50,855 CRIC 65 seednuts. Only about 10% of the total seednut requirement was supplied from the seed gardens. The pool of plus palms (seed palms) was increased from 47,181 to 54,213 during the year.

Pollen production was continued and 560 ampoules of pollen were produced. Of this, 170 ampoules were issued for hand pollination programmes.

Soils and Plant Nutrition Division

Four field experiments and two laboratory experiments on nutritional, soil physical and water use aspects of coconut progressed satisfactorily. Three long-term field trials were terminated as scheduled and six new experiments on fertilizer usage commenced.

Heavy leaching losses of potassium (K) and magnesium (Mg) in soil were found to be a major problem in coconut nutrition requiring adoption of more efficient methods of fertilizer use. Coloured organic compounds in coir dust and leached potassium were found to contaminate ground water resources. This requires a cautious approach to large-scale use of coir dust.

Analysis of some common weeds in coconut plantations revealed a preferential uptake of micro-nutrients, namely iron, zinc and manganese by some species of weeds.

Studies on K-Mg interaction demonstrated the importance of K and Mg balance in soil to avoid the adverse effects arising from K-Mg antagonism. The importance of the use of dolomite as a prophylactic measure for the supply of Mg was evident even after the use of kieserite to correct

Mg deficiency, especially in high rainfall areas where soluble Mg could be leached.

Several important new trials on efficient use of fertilizer and on cheaper methods of fertilizer application began during the year. Also, preliminary work on a field trial to determine the nutrient requirements of seedlings and young palms was completed.

The division provided the Differential Fertilizer Recommendation (DFR) to 83 coconut estates covering an area of about 6,000 ha. The status of foliar nutrients in plantations indicated the order of priority as K, Mg, N and P which confirms the results obtained in 1989.

Analysis of data on yield, leaf nutrients and income and expenditure from the FAO Fertilizer Demonstration Plots indicates that the Value Cost Ratio (VCR) of most plots to be above 2.5, which is an acceptable return. However, few plots show VCR of less than 1 or negative returns for the application of NPK fertilizer, which is perhaps attributable to the reduced crop due to Mg deficiency, soil water deficit, etc. Analysis shows the necessity to use location-specific General Fertilizer Recommendations (GFR) for the small-holder sector to provide an acceptable VCR. It is also necessary to examine the constraints for the low fertilizer use by the growers, even under a high VCR of four or more, as evident from the data collected.

A demonstration irrigation system for a 2 ha coconut plot was established at Ratmalagara Estate. Studies on hydrological and other aspects of this system are in progress.

Crop Protection Division

The division continued the laboratory and field investigations on integrated pest management.

Studies on the effect of potassium deficiency on the susceptibility of coconut to *Opisina arenosella* (coconut caterpillar) did not give statistically significant results. However, the data indicated that potassium deficiency in the plant encouraged the survival and development of the coconut caterpillar.

Out of the 18 plant extracts tested for insecticidal properties under the collaborative project with the University of Peradeniya, extracts

from *Phyllanthus debilis* and *Melia dubia* only showed significant insecticidal properties.

Preliminary analysis of the survey data so far collected on the distribution and variation of earthworm population indicated that populations in the centre of the planting square were significantly higher than populations within the manure circle. Near significant differences were also recorded for earthworm population between different agroclimatic zones, with highest records in the wet lowlands having red yellow podzolic soil.

During the year, outbreaks of the coconut caterpillar infestations in the western and north western provinces were low, compared to the previous year but a considerable number of outbreaks of the coconut scale pest was recorded from these provinces.

Tissue Culture Division

Preliminary investigations on vegetative propagation from immature embryo explants of coconut yielded satisfactory results. Some factors influencing the production of large numbers of somatic embryos were identified. A breakthrough in the germination of somatic embryos derived from immature embryo callus was made and three plants about 25 cm tall and a number of smaller plantlets have been produced. Experiments on culture of immature embryos derived from improved cultivars of coconut were also commenced during the year.

Investigations to improve the establishment of in vitro-developed seedlings in soil were also commenced.

The experiments on the development of an in vitro technique for selecting drought-tolerant material gave encouraging results. The technique, when tested on genotypes having different stress-tolerant potentials, responded differently. Stress-susceptible cultivars were eliminated early. The 'putative' drought-tolerant cultivars exhibited their tolerance to varying degrees. The lower level of NaCl to eliminate drought-susceptible material may be set between 200-250 mM. Experiments to refine the technique and to reduce the cost of screening were commenced towards the end of the year.

Plant Physiology Division

The glass house experiment on the effect of nitrogen, potassium and chlorine on drought tolerant characteristics of coconut seedlings was continued with good progress. Studies on photosynthesis and water use efficiency of these seedlings revealed that increase in nitrogen and potassium increased the rate of photosynthesis while increase in chlorine reduced the rate of photosynthesis as well as the water use efficiency of seedlings. Potassium exerted a significant influence on assimilate partitioning within the seedlings. Both potassium and chlorine positively influenced the water economy of the seedlings.

Screening of drought tolerant palms in field nos. 1 and 2 at the Isolated Seed Garden, Ambakelle was continued. The selected palms proved to be drought tolerant, as was evident at the end of the severe drought prevailed during the latter part of the year. Preliminary studies from the glass house experiment conducted with self-pollinated seedlings obtained from drought tolerant palms further revealed the heritability of drought tolerant characters in the seedlings. In order to screen more drought tolerant palms, further 650 palms were selected from field nos. 4 and 8 at ISG.

A new experiment to determine the effect of canopy and root pruning (plant modification) on the yield and water relations of coconut palms was initiated during the year at Bandirippuwa Estate.

The trials on physiological studies of Leaf Scorch Decline (LSD) progressed satisfactorily. Water relations studies of healthy and LSD-affected palms from the same site at Bandirippuwa Estate continued to show an internal water deficit in LSD-affected palms. A similar trend was observed at Walpita Estate too.

Anatomical studies of the root vascular system of healthy and LSD-affected palms were carried out during the year. No significant anatomical differences in the vascular tissues or physical blockages in them were observed. Folia analyses for three micro-nutrients, namely chlorine, sulphur and boron, did not show any deficiencies of these nutrients in leaves of LSD affected palms. However, with increasing leaf age and severity of symptoms, chlorine level wa

decreased. Perhaps, due to the free mobility of these ions, they may have moved to other parts of the plant. Leaf boron level increased with increasing severity of LSD.

A new field experiment was commenced to compare the vegetative growth and flowering time of amputated poly-bagged seedlings and ordinary nursery-raised seedlings. The field experiment established to study the vegetative growth of embryo-cultured seedlings was continued.

Two new experiments under the multi-disciplinary research programme on immature nut fall were commenced.

Preliminary studies on light interception pattern of the coconut canopy revealed that 60% of the intercepted light are taken up by the upper canopy. Part of this light may be utilized for photosynthesis and the rest may be reflected. Middle and lower whorls of the canopy receive 30% of the sunlight. As part of this study a statistical method to measure the leaf area and the total photosynthetic area of the whole canopy by sampling a minimum number of leaflets was developed.

Water relations studies of young palms were carried out under different soil moisture conditions. The daily loss of water from a coconut palm canopy by transpiration under soil moisture saturated conditions, without taking into consideration the incidental environmental effects was estimated to be in the range of 75 - 100 l. However, transpiration is dependent on sunlight, wind velocity as well as other environmental and plant factors.

Biometry Division

The division continued to assist the research divisions in designing field experiments, analysis of data and their interpretation.

The computer facilities were expanded by increasing the hardware capability and by acquiring further software packages. A number of computer programmes was developed during the year.

The calibration trial recorded an increase of 11.5% for number of bunches and a reduction of 15.8% for nuts per palm. The number of nuts per hectare was 15,414 compared to 18,329 recorded in 1989. The copra yield was 3266.5 kg/ha and

recorded a decrease of 12.7% over 1989.

The observational trial on immature nutfall indicated a nutfall rate of 38 female flowers per bunch during the 16 hour period (16.00 to 8.00 hr) as against 30 during the eight hour period (8.00 to 16.00 hr).

The three agri-meteorological stations at Bandirippuwa Estate, Ratmalagara Estate and Isolated Seed Garden were maintained satisfactorily. The distribution of rainfall during the first half of the year was much lower than in the second half. A reduced crop is expected in 1991.

OTHER PROGRAMMES

Estates Management Division

Administration of the Isolated Seed Garden was handed over to the Estates Management Division in January. With this, the division managed five estates, two research and demonstration farms and three seed gardens.

The general condition of the properties was very satisfactory. The agricultural standards at Bandirippuwa Estate continued to improve and the profitability of the properties was sustained. The use of cost-effective agricultural practices such as herbicides for manure circles and roadways became increasingly popular.

The Differential Fertilizer Recommendations based on foliar analysis were used in all estates and seed gardens in determining the fertilizer requirements. Soil moisture conservation measures continued to receive priority attention during the year.

Bot.1 Makandura Seed Garden (MSG) and Maduru Oya Seed Garden (MOSG) were maintained in good order. Flowering at MSG and MOSG at the end of the year were 52% and 5% respectively. A total of 17,500 seednuts were produced at MSG.

Information Services Division, Library and the Coconut Information Centre

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

The publications programme had to be curtailed owing to the shortage of funds. One issue each of Pol Powath and Coconut Bulletin and COCOS (Volume 7) were published. An inordinate delay with the printer was encountered in the publication of the Annual Report for 1988. This was only ready at the end of the year. Two issues of the Coconut Bulletin and three issues of Pol Pawath had to be reprinted due to heavy demand.

Four new Advisory Circulars were issued during the year.

The CRI participated in the Ministry Mobile Secretariats held at Puttalam, Kegalle, Ratnapura and Hambantota and in the Presidential Mobile Secretariats at Puttalam and Kegalle. The CRI also participated in the 'Gam Udawa' exhibition held at Pallekelle. The division also coordinated in holding a 'Coconut Day' at the CRI.

A Field Day was conducted at Ratmalagara

Estate for Plantation Managers of the National Livestock Development Board.

During the year, several training programmes, including the CRI component of the Induction Course of the National Institute for Plantation Management for trainee Assistant Superintendents of the Janatha Estates Development Board and the Sri Lanka State Plantations Corporation were conducted. The CRI also conducted a two-week residential training programme in coconut cultivation techniques for the middle-level management staff of coconut estates. The Division coordinated the training programmes.

The Library continued to provide its normal services satisfactorily. Routine work such as book acquisition, classification, cataloguing and indexing were carried out effectively. It also provided a current awareness service and an inter-library loan service to the CRI staff. A booklet entitled 'Easy Access to Coconut Information' was published and distributed amongst concerned agencies and individuals.

PUBLICATIONS OF THE CRI

Technical Publications

Annual Report of the CRI - Gives details of experiments and research findings of the CRI.

COCOS - Contains technical articles and research notes on all aspects of coconut.

Occasional Publications Series - Contains technical reviews.

Non-Technical Publications

Coconut Bulletin (english) and Pol Pawath (sinhalese) - Contains advice to growers, based on research findings. Written in a simple form, this is a valuable source of information for the grower.

Advisory Circulars - Contains information on coconut cultivation