FIFTY YEARS OF COCONUT RESEARCH

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INTRODUCTION

Organized plantation activities in tea, rubber and coconut started with the dawn of the 20th century. The British Colonial Government had a considerable interest in these spheres and made significant contributions towards the establishment and maintenance of these plantations which were geared for export. Planters associated with these crops were influential and organized and were able to impress upon the Government the need for Research Institutes devoted to these crops. This became a reality in the 1920s with the establishment in rapid succession of the Tea, Rubber and Coconut Research Institutes.

A definite proposal for a Coconut Research Scheme under the Ministry of Agriculture was entertained in 1923 and resulted in the Coconut Research Ordinance No. 29 of 1928. The first meeting of the Board of Governors took place on 27 April 1929. The finances for the Scheme were made available through a cess. The Coconut Research Scheme was upgraded to the Coconut Research Institute in 1950 in accordance with the Coconut Research Amendment Act, No. 31.

Consequent upon the establishment of the Ministry of Plantation Industries in 1970, the Coconut Development Act. No. 46, of 1971 was promulgated. Under this Act the Coconut Development Authority was established, which co-ordinated the activities of four Boards: Cultivation (Extension) Marketing, Processing and Research. A further organizational change occurred in 1978 when the Government established a separate Ministry of Coconut Industries.

The Coconut Research Institute began in its activities with just three technical Divisions—Genetics, Chemistry and Soil Chemistry. Since then there has been a progressive enlargement of activities resulting in the creation of more technical divisions and reorganizations. In 1951, a programme for improving Sinhala cattle was undertaken, resulting in the creation of the Agronomy Division in 1955.

The need for a statistical service was felt at this time and in 1953 the first staff member was recruited. Sometime prior to this the Government had launched a massive coconut replanting programme, which was operated largely through an organization of Coconut Producers' Co-operatives. The Institute geared itself for the production of the required seedlings with the establishment of the Planting Division.

Initially, all matters related to pests and diseases of coconut were handled by the Department of Agriculture. Subsequently, the Botany Division attended to these matters for a short while, until the creation of the Crop Protection Division in 1955.

For purposes of extension an Advisory Division was set up during the early stages of the Institute. With the establishment of the Coconut Cultivation Board in 1972 for extension and advisory functions, the Institute's own Advisory Division was transferred to it.

The Coconut Development Act No. 46 of 1971 defines the functions of Coconut Research Institute as conducting and furthering scientific research in respect of the growth and cultivation of coconut palms, growing other crops and practising animal husbandry in coconut plantations, preventing and controlling pests and diseases, establishing pilot plants for the processing of coconut products, training extension workers, and advising the coconut industry on all matters of a technical nature.

To achieve these objectives the Institute has Divisions of Agronomy, Botany, Plant Breeding, Crop Protection, Coconut Processing Research, Soils and Plant Nutrition. These technical divisions are serviced by a Library, Publications and Coconut Information Centre, Analytical Chemistry Unit, Biometry and Agricultural Economics Unit and Administrative, Financial and Engineering Services.

The main laboratories of the Institute are located at Bandirippuwa Estate, Lunuwila. Additionally, its activities are carried out at five sub-stations, two seed gardens and 14 nurseries.

GENETIC IMPROVEMENT

Some of the pioneering work for the genetic improvement of the coconut palm was initiated with the inception of the Coconut Reseach Scheme. Initial studies were directed to identify suitable criteria for selection of a seed parent in order to provide improved planting material. Long term observations and analysis of data of 300 progenies led to the evaluation of heritability value of some characters (yield of copra, weight of husked nut) of the palm. In the field of mass selection one of the earliest experiments on selection criteria for coconut was laid down in 1939. Selected and unselected seedlings from "high yielders", "low yielders" and "bulked nuts", were planted and their progenies evaluated over a long period. Subsequent analysis showed that there was a marked response to both mother palm and seedling selection with a substantial genetic gain for each generation of selection.

In order to identify palms of breeding value several progeny trials have been carried out. The first of this series was laid out at Marandawila

Estate, followed by Walpita and Bandirippuwa. An interesting observation of practical use is that leaf production of the progeny during the first 40 months of their growth is correlated with the breeding values of their parents.

Based on the accumulated data analysed, the genetical information then available was translated into a vast programme of mother palm and seednut selection. It was possible to build up a collection of over 50,000 mother palms for seed purposes.

It is on record that nursery trials on age of nuts, storage of nuts, effect of soaking before planting, orientation of nuts, depth of planting etc. were laid down to determine the best possible method of raising seedlings.

The three main coconut varieties, *Typica, Nana,* and *Aurantiaca* were identified during the early fifties. This classification was based mainly on the growth habit of the palm (tall or dwarf), floral biology (cross-fertilizing or self-fertilizing) and the colour of epicarp of the nut.

Studies on floral biology and on the collection, processing and storage of pollen were carried out during the late 40s and early 50s. Starting with a few experiments on hybridization which were of an exploratory nature, a programme of both intra and intervarietal crosses was attempted. In intravarietal crosses the outstanding achievement has been the *Typica* x *Typica* (CRIC 60) cross. *Typica* x *Aurantiaca* and *Nana* x *Aurantiaca* hybrids are commercially unacceptable. On the other hand, *Typica* x *Nana* form *pumila* and its reciprocal hybrids are recognized in almost all coconut growing countries. The first coconut seed garden for mass production of improved planting material was established in 1955. Initially, this seed garden produced *typica* x *typica* seednuts (mean yield about 6000 nuts/acre/year) but subsequently dwarfs were introduced in order to produce *typica* x *pumila* (CRIC 65) hybrids. These hybrids planted at Ratmalagara Research Station, Madampe, gave a mean nut yield of 160/palm/year during the period 1962–66. These materials have been planted in many districts to study their response under "normal" management. It would appear that CRIC 65 hybrid makes a greater demand on soil moisture and can be recommended only for those areas receiving at least 100 mm (60 inches) of annual rainfall, suitably spread over the year. Furthermore, it is better suited for sandy loans, sandy clay loams and is a comparative failure on the harder soil types, even if rainfall is adequate.

By relating hybrid performance with soil characteristics and rainfall patterns it has been possible to make a broad classification of land areas suitable for hybrids. It would appear that not more than 110,000 ha can be effectively brought under hybrids.

PLANTING PRACTICES

Along with plant breeding research, experimentation on planting practices has been carried out. Our present knowledge on some of the planting practices has been derived from experiments on size of planting pit and depth of transplanting commenced in 1955 and 1956 respectively. A long-term experiment on planting systems and planting densities was also commenced during this period. Traditional planting systems, such as triangular and square systems, were evaluated along with the novel "hedge system" which consists of a wide between row spacing and narrow within row spacing giving initially about 90 palms/acre, which are then thinned out on growth and yield to give the conventional 64 palms/acre at an "unconventional" and irregular planting distance.

In addition, work on underplanting as a means of rehabilitating senile coconut palms has been completed. More recent work involved clonal propagation, some aspects of the physiology of the palm and anatomical studies.

FERTILIZER STUDIES

Methods of foliar analysis have been intensively studied; attempts were made to establish critical levels to relate nutrient contents to visual disorders, and to compile balance sheets for nutrient uptake and utilization.

The first properly designed fertilizer field experiment was laid down in the 30s, resulting in the recommendation in 1933 of a mixture containing mineral fertilizers only.

During this period much work was done in the analyses of locally available organic manures. These experiments clearly established the beneficial effects of fertilizers.

Some of the long-term fertilizer experiments indicated that potassium was the dominant nutritional requirement of coconut. The response to potassium was reflected not only in increased nut production but also in better copra out-turn. Nitrogen and phosphorus tended to increase the number of female flowers and nuts.

The first fertilizer experiment on young palms commenced in 1940. This clearly showed that when palms are neglected during the early stages they continue to yield poorly for a considerable period of time in spite of subsequent proper nutrition. Based on the early results on this experiment, a fertilizer mixture for young palms was recommended in 1963.

Around 1950 the first experiment on placement of fertilizer was commenced. After about 10 years field experimentation the results indicated that the cheaper method of surface application was as good as the then traditional trench method. Several elegant experiments on uptake of fertilizers using

radio-active materials were carried out in the 60s with the assistance of the International Atomic Energy Agency. Along with these experiments, several field trials on the frequencies of application of fertilizer to adult palms were carried out.

Some of the other aspects under experimentation included the use of locally available organic fertilizers, evaluation of forms of nitrogen in view of the local manufacture of urea; suitable forms of phosphorus in view of the discovery in Sri Lanka of an apatite deposit and magnesium nutrition of coconut.

During this period attention was focussed on the effect of nitrogen, phosphorus, potassium and magnesium. Recent lines of research have included the study of trace elements and the feasibility of using soil and leaf analyses as methods of determining the fertilizer requirements of coconut.

PRODUCT TECHNOLOGY

Laboratory studies on the chemistry and technology of coconut products were started in 1931. The early work centred around alcoholic and acetic fermentations of coconut sap and on improvements in the technique of copra processing. A chemical laboratory was equipped in 1950 to work in Plant Chemistry. Special attention was paid to studies on uptake and distribution of nutrients in the seedling and productive phases of the coconut together with other complementary studies. During this period the technique of sand pot-culture was successfully employed in studying the physical and visual symptoms of seedlings grown under absolute deficiencies in each of the major elements.

During the early period considerable attention was given to the soap industry and to the dry distillation of coconut shells. During the war years, a variety of chemicals was made by dry distillation of shells. In collaboration with the Government Analyst and the Excise Commissioner several trials on the production of an improved grade of arrack by double distillation were carried out. Research work on copra making, copra kiln and other attendant problems was also carried out during this period. An important contribution of product research is the development of the "generator process" for the conversion of coconut toddy into high grade vinegar. Methods for the preparation of treacle, jaggery and sugar on a cottage scale have been successfully concluded. High quality treacles have been obtained through various techniques of clarification. Preparation of non-alcoholic and alcoholic beverages with coconut sap as the base material has opened up an entirely new and fertile field of research.

Techniques of tissue analyses as a diagnostic tool for fertilizer recommendation have been worked out. Comprehensive studies on sampling procedures were carried out to evolve a correct sampling procedure for the

application of chemical diagnostic procedures for the assessment of the mineral nutritional status of the coconut palm. The ultimate objective of these studies is to rationalise fertilizer usage which is becoming a costly commodity.

Varietal evaluation for tapping has indicated that tall (*typica*) and hybrid varieties are suitable for the fermentation industry.

PASTURE AND LEGUME RESEARCH

With the establishment of the Division of Agronomy in 1955 the feasibility of improving the cattle population through a cross-breeding programme was examined. There had been a considerable effort on a pasture development programme. Several pastures from similar ecological regions of the world had been introduced. These were initially tested at Lunuwila and subsequently subjected to more rigorous testing in the field at different locations in the coconut growing areas. Based on these studies it was possible to recommend *Brachiaria miliformis* as a suitable pasture for the intermediate and wet zones of the coconut triangle. Several other pasture grasses such as *Brachiaria ruziziensis, Brachiaria dictyoneura* and fodder grasses such as *Panicum maximum, Setaria* sp have been identified as suitable for growing under cocount in the wetter areas. Attempts have also been made to establish legume based pastures with *Centrosema pubescens* and *Macroptilium atropurpureum.* More recently shrub legumes such as *Leucaena leucocephala* and *Gliricidia* have received greater attention.

CROP PROTECTION

In the early stages pest and disease problems of coconut were referred to the Department of Agriculture. With the launching of extensive coconut replanting programmes in the mid-fifties a greater awareness of crop protection was evinced resulting in the establishment of the Crop Protection Division in 1955. The initial major task of the Division was to identify and catalogue the various pests of coconut in the country. Wherever necessary pests were also listed for legislative control.

Difficulties in spraying tall coconut palms for pest control were evident from the early stages. In view of this special attention was given to the study of natural enemies of coconut pests. As a result in 1958 a pupal parasite of the coconut caterpillar was bred in captivity and released in the field for the control of this pest. Since then crop protection activities have been very strongly in the direction of biological control. This is desirable from the points of view of effectiveness, safety and economy.

The value of this technique was aptly demonstrated recently when the coconut leaf miner, *Promecotheca cumingi,* was inadvertently introduced to the country in 1970. An estimated 30,000 acres were rapidly invaded by the

pest. Nucleus cultures of two parasites were imported and these were mass-multiplied in an insectary established in Colombo. Within a few months, the spread of the pest was effectively checked by the introduced parasites. In a few years the pest had all but disappeared as dramatically as it had come.

Similar but less spectacular success has been achieved in other biological control programmes. After two decades of parasite liberations the coconut caterpillar pest still does serious damage to plantations. Fortunately, the coconut scale pest (*Aspidiotus destructor* appears to be kept well under control by the predatory lady bird beetles, which are now well established in the field.

Promising results have been obtained with the use of a virus and a fungus for the control of the Black Beetle (*Oryctes rhinoceros*).

A novel method of weed control was used in Sri Lanka when the defoliator insect *Parauchaetus pseudoinsulata* (= *Ammalo insulata*) was introduced to control the pernicious weed podisinghomaran (*Chromolaena odorata*). The insect is well established in most of the country causing defoliation of the plant.

Recent pest control research is centred around integrated control, where cultural, chemical and biological methods, when necessary, are used judiciously.