SOUVENIR

1976

Diamond Jubilee of Coconut Research in India

International Symposium on Coconut Research and Development

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD 670 124 KERALA — INDIA

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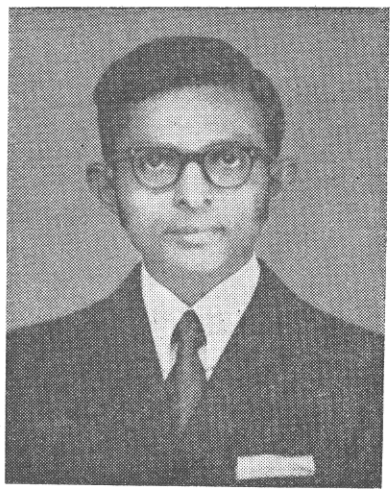

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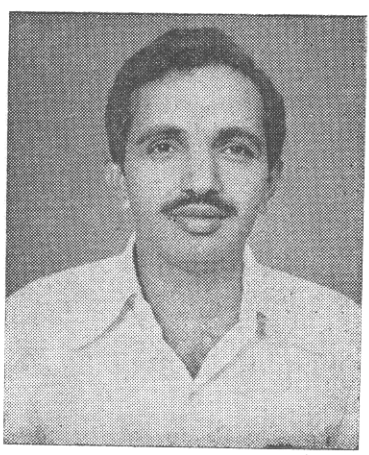

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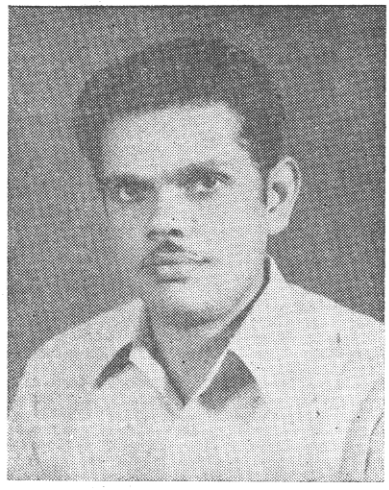

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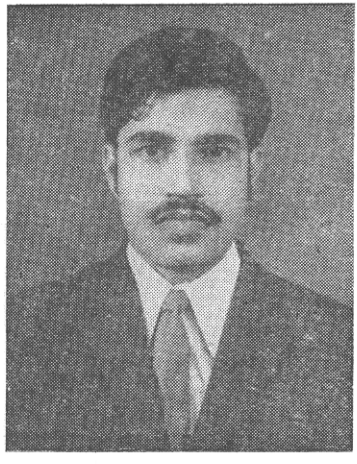

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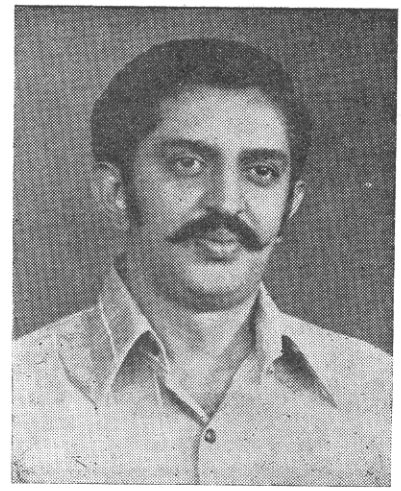

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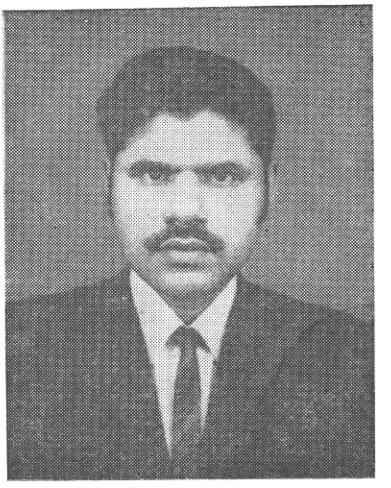

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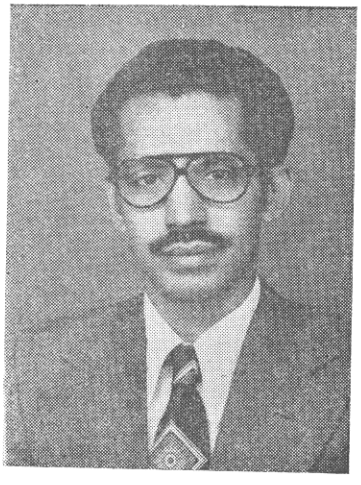

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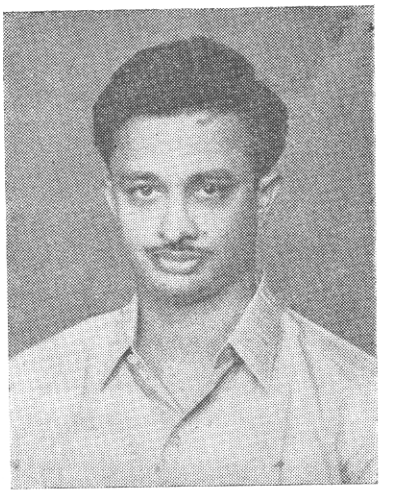

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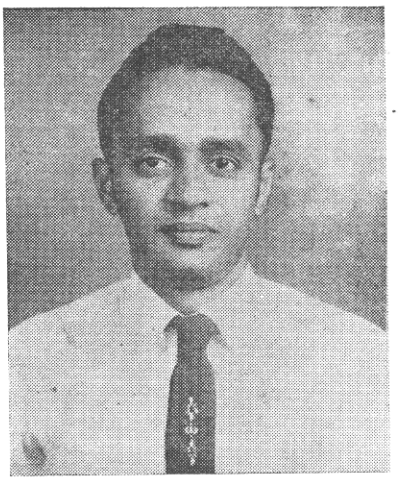

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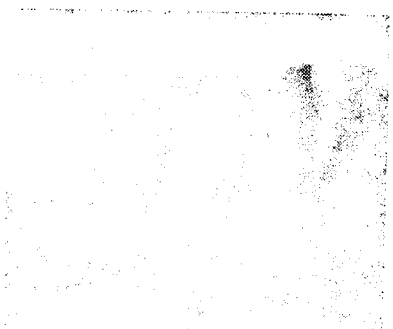

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Madras Fertilizers Limited, Manali, Madras 600 068
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Recipients of the DIAMOND JUBILEE AWARD FOR OUTSTANDING CONTRIBUTIONS TO COCONUT RESEARCH

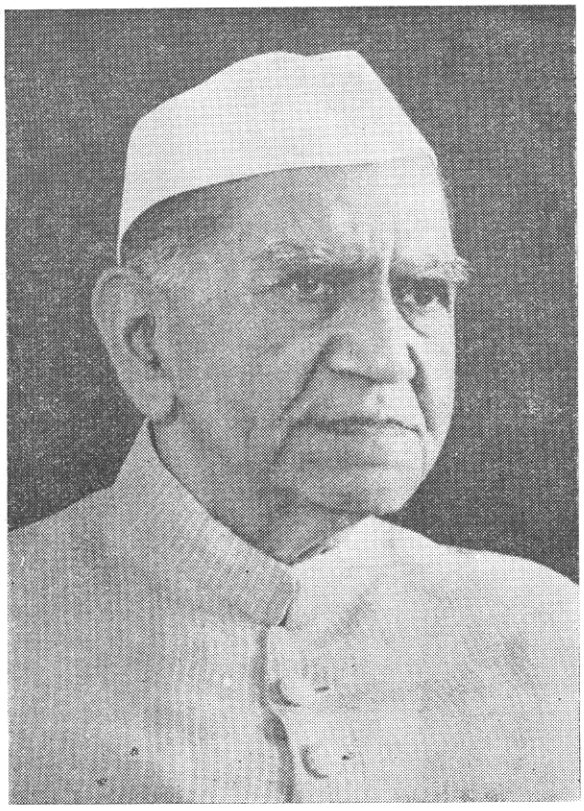
The Diamond Jubilee Award will be presented by the President of India, Shri Fakhruddin Ali Ahmed on January 6, 1977 to six scientists in recognition of their outstanding contribution to the advancement of research in coconut. These are the men who laid the foundation for basic and applied research in coconut, working with limited facilities and manpower. Their contributions will always be a source of great inspiration to the present and future generations.

JS Patel
CM John
KPV Menon
KM Pandalai
AP Anandan
EJ Varghese

Recipients of the DIAMOND JUBILEE MEDAL FOR TWENTYFIVE YEARS OF SERVICE IN COCONUT

The Diamond Jubilee Medal is being presented by Shri A C George, Union Minister of State for Civil Supplies and Co-operation on January 8, 1977 to twentysix men who have steadfastly served the cause of coconut in various capacities for a quarter of a century.

K Ambunhi
J Antony
MT Ayyappan
C Baby
ND Chakiar
KM George
TP Gopalakrishnan
N Gopalakrishna Pillai
KR Gopalakrishan Nair
P Govinda Pillai
TG Jayarajan
CA Kunhiraman
K Kunhiraman
VG Lily
K Malinga Naik
KV Madhavan Nair
A Mohamed Kunhi
MC Nambiar
CC Narayanan
EV Nelliat
PK Pavithran
PL Ramanandan
Rama Varma
Sabas Crasta
TA Thankappan
V Velayudhan



Rashtrapati Bhavan New Delhi 110 004
INDIA

November 26, 1976

I am glad to know that the Central Plantation Crops Research Institute, Kasaragod, will celebrate the Diamond Jubilee of Coconut Research from the 27th December, 1976 and on this occasion is organising an International Symposium on Coconut Research and Development in India.

The coconut industry not only occupies an important place in the economy of the State but also provides employment to a large number of people, especially in the countryside. I hope the various aspects of production, protection and processing of coconuts will be discussed in the Symposium and a new approach for improving the yield of coconuts and controlling pestilence will be evolved.

I send my best wishes for the success of the Diamond Jubilee Celebrations.

(FAKHRUDDIN ALI AHMED)

MARCHING TO PROSPERITY

1. Continuance of steps to bring down prices of essential commodities. Streamlined production, procurement and distribution of essential commodities. Strict economy in government expenditure.
2. Implementation of agricultural land ceilings and speedier distribution of surplus land and compilation of land records.
3. Stepping up of provision of house sites for landless and weaker sections.
4. Bonded labour, wherever it exists, will be declared illegal.
5. Plan for liquidation of rural indebtedness. Legislation for moratorium on recovery of debt from landless labourers, small farmers and artisans.
6. Review of laws on minimum agricultural wages.
7. Five million more hectares to be brought under irrigation. National programme for use of underground water.
8. An accelerated power programme. Super thermal stations under central control.
9. New development plan for development of handloom sector.
10. Improvement in qualities and supply of people's cloth.
11. Socialisation of urban and unurbanisable land. Ceiling on ownership and possession of vacant land and on plinth area of new dwelling units.
12. Special squads for valuation of conspicuous construction and prevention of tax evasion. Summary trial and deterrent punishment of economic offenders.
13. Special legislation for confiscation of smugglers' properties.
14. Liberalisation of investment procedures. Action against misuse of import licences.
15. New schemes for workers' association in industry.
16. National permit scheme for road transport.
17. Income tax relief to middle class—exemption limit placed at Rs. 8,000.
18. Essential commodities at controlled prices to students in hostels.
19. Books and stationery at controlled prices.
20. New apprenticeship scheme to enlarge employment and training, especially of weaker sections.

Prime Minister's Secretariat
New Delhi 110001
November 8, 1976

The Prime Minister sends her good wishes for the success of the diamond jubilee celebration of coconut research which is being organised by the Central Plantation Crops Research Institute, Kasaragod, Kerala, in collaboration with some other State Governments from December 27, 1976.

HY Sharada Prasad
Information Adviser

GOVERNOR OF KERALA

RAJ BHAVAN
Trivandrum

November 14, 1976

I am happy to learn that the Central Plantation Crops Research Institute, Kasaragod, in collaboration with Governments of Kerala, Karnataka, Andhra Pradesh, Tamil Nadu, various Agricultural Universities of South India and the Indian Council of Agricultural Research will celebrate the Diamond Jubilee of Coconut research from the 27th of December, 1976, that it will be inaugurated by the President of India and that an International Symposium on Coconut Research and Development will also be conducted as part of the celebrations. Coconut is an important cash crop of India. Of the world area of 3.2 million hectares under coconut and an annual production of 14,000 million nuts, Kerala accounts for 7.2 lakh hectares and 3,981 million nuts per annum. This means, 25 per cent of the net area sown in Kerala and nearly one-third of the value of agricultural commodities. In fact, coconut is the back bone of the agricultural economy of the State and a source of marketable surplus to the farmers for meeting their cash requirements. The area under this crop has been steadily increasing right from the year 1956–57 – from 4.6 lakh hectares to 7.19 lakh hectares in 1970–71, registering an increase of 56 per cent in area and 22 per cent in production. But the yield per hectare has declined which calls for immediate measures to be taken up by the Institute. The price of coconut has been steadily on the increase during the last two decades but in the year 1975 there had been fluctuations in the price which adversely affected the small farmers to some extent. It is a source of raw material for the coir industry which employs about five lakhs of people and for the cosmetics and edible oil industries. One of the important problems facing the farmers is the root(wilt) disease which should be suitably dealt with at any cost. I am glad to know that this point also is going to be discussed at the International Seminar. Considering the importance of the crop to the State's economy and to industrial production in general, it is highly essential that the delegates discuss all aspects of the problem facing the farmers viz., root disease, declining yield, marketing, fluctuation of prices, adoption of modern techniques and high cost of replantation and formulate proposals for long term development of the coconut crop. I hope the discussions in the Seminar will throw light on the difficult problems faced by the growers and lead to effective solutions for increasing production in the long run. I send my greetings and good wishes to all concerned for the success of the celebrations and for the future endeavours of the Institute.

(N N WANCHOO)

Chief Minister, Kerala

TRIVANDRUM

October 23, 1976

I am happy to know that an International Symposium on Coconut Research and Development is organised in connection with the Diamond Jubilee of Coconut Research in India.

Kerala is the land of coconuts. So the success of your deliberations is of great importance in the development of the State's economy and the well being of its people.

I convey my cordial greetings to all participants and wish all success to the Symposium.

(C Achutha Menon)

Minister of Agriculture & Irrigation
GOVERNMENT OF INDIA
New Delhi 110 001

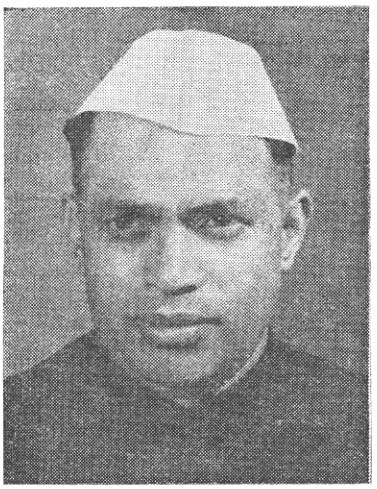
November 25, 1976

I am happy that the ICAR is celebrating the Diamond Jubilee of Coconut Research in India by organising an International Symposium on Coconut Research and Development, a Travelling Seminar and an exhibition. Coconut means much more to the life and culture of the people of this country than is popularly known. Coconut is a part of culture of the people even in areas where it is not grown. No religious ceremony or auspicious occasion is observed without the use of coconut in one form or the other even in plains and high Himalayan ranges of India. I, therefore, hope that this occasion will be utilised to make an assessment of the achievements of 60 years of research in this field and to identify the problems of research that need the immediate attention of scientists working on coconut.

I wish the scientists involved in this programme much success.

Jagjivan Ram

(Jagjivan Ram)



Minister of State for Agriculture and
Irrigation INDIA

New Delhi,
November 29, 1976

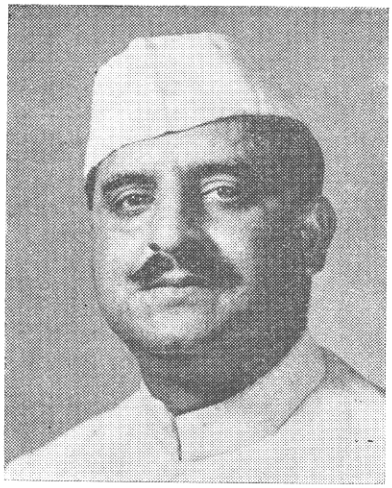
I am glad to learn that the ICAR is celebrating the Diamond Jubilee of Coconut Research in India. Coconut is one of the most useful trees for the people of this country. Every part of the coconut palm finds some economic use. Its oil is of particular importance. I trust that the scientists celebrating the Diamond Jubilee will make a realistic assessment of the progress of research in this field achieved so far and also think of the problems facing the cultivators of coconut palm. One of the most important problems of this crop is the root wilt disease, which is responsible for losses amounting to millions of rupees to the cultivators in this country.

I am also glad to note that the Diamond Jubilee celebrations include an International Symposium on Coconut Research and Development, a Travelling Seminar and an exhibition. I trust that some solutions will be found for the problems faced by this crop.

I wish the celebrations all success.

Annasaheb P. Shinde

(Annasaheb P. Shinde)



Rajya Mantri
Krishi aur Sinchai Mantralaya
NEW DELHI 110 001

November 25, 1976

I am glad to learn that the Central Plantation Crops Research Institute is celebrating the Diamond Jubilee of Coconut Research in India. Coconut research was first begun in India at Kasaragod, Nileshwar and Pilicode in the old Madras Presidency 60 years ago. The Kasaragod Station has since been reorganised as the Central Plantation Crops Research Institute.

Coconut is not only important for the oil that it provides, but is one of the most important economic crops of India. Every part of the tree has some economic use. Research on this crop, therefore, needs high priority.

I am also happy to learn that during the Diamond Jubilee Celebrations, an International Symposium on Coconut Research and Development, and a Travelling Seminar will be organised. I hope the scientists assembled on this occasion will take a view of the progress of scientific research in respect of the coconut palm and try to find solutions for the problems facing the cultivators of this important crop. The exhibition being organised should educate a large number of farmers about the latest research findings for improving the productivity of the coconut palms.

I wish the functions all success.

Shahnawaz Khan

(SHAH NAWAZ KHAN)

Minister of Agriculture
KERALA
Trivandrum
December 3, 1976

Coconut cultivation plays a vital role in the economic life of the farming community in the country and particularly in Kerala. Kerala accounts for 67.7% of the total area under coconuts in the country. It is also a poor man's crop and offers wide variety of employment to thousands of people. While the extent of coconut holdings in the State varies from a few ares to a few hectares, the vast majority are small gardens of less than 0.5 hectares. There are as many as 2.5 million coconut holdings in Kerala State.

Of late, there has been a decline in the yield of coconuts in Kerala. Though arrangements have been made by the Government to supply planting materials, provide irrigation facilities particularly during summer and fertilizers through different schemes, the declining trend in production could not be arrested as a vast area under coconuts in Kerala has been badly affected by root wilt, leaf rot, bud rot, leaf blight and stem bleeding diseases. This causes serious concern; and urgent solutions to remedy the situation are called for. The agricultural scientists should take up this as a challenge.

It is only appropriate that in connection with the Diamond Jubilee Celebrations of Coconut Research and Development in India, the organisers are sponsoring an International Symposium on coconut research and development. I am glad to know that the focal theme of the Symposium is "coconut diseases of uncertain etiology" which have so far eluded the ingenuity of research workers in their attempt to ameliorate the condition of the disease-affected palms. I am sure that the Symposium will devote time to discuss various aspects of coconut cultivation.

I have no doubt that the deliberations of the Symposium will prove to be very useful in focussing attention of the research workers and farmers to the problems confronting coconut cultivation.

I send my best wishes to the Diamond Jubilee Celebrations of Coconut Research and Development in India.

(Vakkom Purushothaman)

PROGRAMME

of

DIAMOND JUBILEE CELEBRATIONS OF COCONUT RESEARCH

(Abstract)

Monday, December 27, 1976

1. Release of Commemoration Postal Stamp
   Shri Chakkeri Ahamed Kutty, Minister for Education, Kerala
2. Opening of exhibition
3. Release of Diamond Jubilee Souvenir
   Shri Chikke Gowda, Minister for Agriculture and Animal Husbandry, Karnataka
4. Release of "Six Decades of Coconut Research"
   Shri Hamid Ali Schemnad, M.P.

Tuesday, December 28, 1976

1. Opening the Diamond Jubilee Building
   Inauguration of the International Symposium on Coconut Research and Development
   Keynote address: Coconut Research – next phase
   Dr MS Swaminathan
3. ISOCRAD Session I : Genetics and Breeding
   – Chairman : Dr B R Murthy
   Session II : Agronomy and Soil Science
   – Chairman : Dr H R Arakeri

Wednesday, December 29, 1976

1. Premiere, the Golden Palm, Special Documentary of the Films Division
2. Session III : Physiology and Biochemistry
   Chairman : Prof RD Asana
3. Session IV : Technology
   Chairman : Dr V Subramanyan
4. Session V : Basic studies
   Chairman : Prof H Y Mohan Ram
5. Popular lecture : Prof RD Asana

Thursday, December 30, 1976

1. Session VI(A) : Diseases
   Chairman : Dr G Rangaswamy
2. Session VI(B) : Pests
   Chairman : Dr K K Nirula
3. Session VII : Diseases of uncertain etiology
   Chairman : Dr K Ramakrishnan
4. Popular lecture: Prof H Y Mohan Ram

Friday, December 31, 1976

1. Session VIII : Developmental Programmes in India and other countries
   Chairman : Shri A Venkataraman
2. Session : Plenary Session
   Chairman : Dr Y Fremond
   Co-chairman : Shri N Kaleeswaran

Saturday, January 1, 1977

1. Travelling Seminar on root (wilt) disease
2. Post Symposium tour through Kerala
3. Kisan Mela for the farmers of Kerala

Sunday, January 2, 1977

1. Travelling Seminar (Continued)
2. Post Symposium Tour (Continued)
3. Kisan Mela for farmers of Kerala

Monday, January 3, 1977

1. Post Symposium Tour (Continued)
2. Kisan Mela for Farmers from Karnataka and Tamil Nadu

Tuesday, January 4, 1977

1. Kisan Mela for farmers from Andhra Pradesh and Orissa

Wednesday, January 5, 1977

1. Kisan Mela (Continued)

Thursday, January 6, 1977

1. Inauguration of Diamond Jubilee Celebrations and presentation of awards to Retired Scientists
   Shri Fakhruddin Ali Ahmed, President of India
2. Presidential address:
   Shri N N Wanchoo, Governor of Kerala
3. Welcome address
   Shri Shah Nawaz Khan, Minister of State for Agriculture and Irrigation, Govt. of India
4. Speeches : 1. Shri K Karunakaran, Minister for Home Affairs, Kerala
   2. Shri Vakkom Purushothaman, Minister for Agriculture & Labour, Kerala
   3. Shri N K Balakrishnan, Minister for Public Health, Kerala

Friday, January 7, 1977

1. Seminar on Cardamom – Chairman : Dr M S Swaminathan
2. Kisan Mela (for farmers of Union Territories)

Saturday, January 8, 1977

Valedictory Function of the Diamond Jubilee

1. Presentation of Medals to Scientists
   Shri A C George, Union Minister of State for Civil Supplies & Co-operation, Govt. of India.

2. Valedictory address
   Dr V A Seyid Mohammed, Union Minister of State for Law, Justice and Company Law, Govt. of India

3. Speeches : 1. Dr K G Adiyodi, Minister for Forests & Irrigation, Kerala
   2. Shri K T Rathod, Minister of State for Fisheries and Horticulture, Karnataka
   3. Shri Kadannappalli Ramachandran, M.P.

Foreword

Perhaps no other crop plant in the tropics has so much to offer to mankind as the coconut palm. Equally great are the scientific challenges that this palm poses. For Kerala which has 70% of the total coconut area in India, it is both a way of life and a means of livelihood. The palm supports a vast multitude of people through its varied uses and ancillary cottage and small scale industries. No wonder the palm is aptly referred to as the *'Kalpa Vriksha'*

Organised research on coconut has now lasted for 60 years but in a palm whose life-span extends up to a century, this period is not so long as it may appear. During the early years, support for coconut research was meagre, both in terms of resources and technical manpower. The long time taken for research results to make an impact on production causes a lack of adequate interest among planners in extending the necessary support. However, thanks to the foresight and imagination of scientists like Dr. J. S. Patel, the Tall x Dwarf hybridisation programme was initiated at Nileshwar in 1932. This gave a fillip and momentum to research on coconut. Although handicapped for want of equipment and facilities, voluminous data on several aspects of coconut were gathered and brought out in the form of a monograph in 1938. The compendium, "The Coconut Palm – A Monograph" by Drs. Menon and Pandalai (1958) does not seem to age with time. The outstanding contributions of Shri C. M. John and of Drs. Menon and Pandalai are a source of inspiration to younger scientists.

With the taking over of research by the erstwhile Indian Central Coconut Committee from the Oilseeds Specialist of the then Madras Government in 1947 the Kasaragod Station came under the control of the Coconut Committee. The Kayangulam Research Station came into being in 1948 for carrying out research exclusively on diseases and pests, with accent on root (wilt) disease. In 1966 the Indian Council of Agricultural Research took over the Coconut Research Stations at Kayangulam and Kasaragod and established a unified Central Plantation Crops Research Institute in 1970. Since then, there has been steady progress in terms of manpower, physical facilities and quantum of research work. Today, the Institute is equipped with a multidisciplinary machinery

geared to tackle the urgent problems confronting the farming community.

A multipronged attack on root (wilt) is no doubt our first and foremost task and in this Diamond Jubilee year, I am happy that CPCRI and the Indian Society for Plantation Crops have jointly organised an International Symposium with special accent on the Coconut Diseases of Uncertain Etiology. It is my earnest hope that the deliberations of the Symposium will enable us to probe into the uncertainties and gain a greater insight into the maladies affecting this wonderful palm. We must find solutions speedily to maladies like root (wilt) disease. The oft-quoted saying of our late Prime Minister, Shri Jawaharlal Nehru, "everything else can wait, but not agriculture" applies to coconut with the greatest sense of urgency.

I am confident that with the eminent and talented team we now have, coconut research will open up a new arena full of hope for the future of this crop. It is gratifying that some of the pioneer scientists who had dedicated themselves to the cause of coconut research in the early part of this century have either contributed articles or given interviews for this Souvenir. Their nostalgic memories convey a great message of hope and inspiration to our younger scientists who are more advantageously placed in terms of facilities and support for serving the coconut industry. I offer my congratulations to Dr. Ahamed Bavappa and his band of devoted workers for bringing out this useful Souvenir and offer them my very best wishes.

M. S. Swaminathan

(M S Swaminathan)
Director General, ICAR

Introduction

The Diamond Jubilee of Coconut Research in India is being celebrated at the Central Plantation Crops Research Institute, Kasaragod to commemorate the sixtieth year of scientific investigations on coconut in the country.

Research on coconut in India was started with the establishment of four coconut research centres, one each at Kasaragod and Pilicode and two at Nileshwar in the erstwhile Madras Presidency. From this modest beginning in 1916, research on coconut has been gaining momentum over the last six decades and the country has achieved considerable progress in increasing production and productivity. At that time, coconut occupied less than half a million hectares in the country. Today it is cultivated over a million hectares in Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa, Maharashtra, Gujarat, Orissa, West Bengal, Assam, Lakshadweep and Andamans, and India ranks third in production among the coconut growing countries. The total annual output is 6000 million nuts worth more than Rs. 600 crores at current market price. The importance of coconut in the agricultural economy of the nation is evident from the fact that it provides a means of livelihood for over ten million people.

Coconut research had been the responsibility of only the State Departments of Agriculture until 1945 when the Indian Central Coconut Committee was constituted to coordinate research and development activities at the national level. The committee took over the Kassrgod research centre established by the State Department and started a new station at Kayangulam which they controlled until 1966 when the Indian Council of Agricultural Research was entrusted with the responsibility of coconut research also. The Central Plantation Crops Research Institute (CPCRI) was formed in 1970 to co-ordinate the research efforts in coconut as well as other important plantation crops like arecanut, oil palm, cashew, cacao, cardamom, pepper and other spices.

The establishment of CPCRI and the initiation of the All India Co-ordinated Research Project on Coconut and Arecanut heralded a new era of research activities on coconut. The Indian Society for Plantation Crops (ISPC) was formed in 1971 to provide the scientists working on coconut and other plantation crops a common forum for interaction and exchange of ideas. The first National Symposium on Plantation Crops was organised by the society in December 1972 at Trivandrum where coconut received the major attention of the participants. The first International Symposium on Coconut Research and Development (ISOCRAD) being held at CPCRI, Kasaragod from December 28 to 31, 1976 is the outcome of a decision taken at the National Symposium to mark the Diamond Jubilee of Coconut Research in India.

The Symposium, organised by the Indian Society for Plantation Crops and CPCRI with active collaboration from the Indian Council of Agricultural Research, the University Grants Commission, the Departments of Agriculture of Kerala, Karnataka, Tamil Nadu, Maharashtra, Goa and Andhra Pradesh, the Administration of Lakshadweep and the agricultural universities of the southern states is beign attended by about 350 scientists from India

and abroad.

The ISOCRAD discussions will cover all the aspects of basic and applied research including technology as well as development programmes in India and other countries of the world. The focal theme of this Symposium is "Coconut diseases of uncertain Etiology". A post Symposium Travelling Seminar has been organised to enable eminent scientists in different disciplines to make an on-the-spot study of the root (wilt) disease which is the most serious threat to this crop in Kerala. A special technical bulletin summarising available information on root (wilt) disease, Thatipaka disease, Thanjavur wilt and stem bleeding has been issued by the Institute for the benefit of the participants.

The Post and Telegraph Department of Government of India is bringing out a commemorative stamp on December 27 to mark the occasion. A philatelic exhibition as well as competition has been organised on the themes, "Coconut on Stamps" and "Plants on Stamps". On January 6, the President of India, Shri Fakhrudin Ali Ahmed will inaugurate the Diamond Jubilee Celebrations. On this occasion, the Rashtrapati will present Diamond Jubilee Awards instituted by the CPCRI and the ICAR to six pioneering scientists of the country for their outstanding contributions to coconut research. We also take pride in presenting Diamond Jubilee Medals to 26 persons who have completed 25 years of service in Coconut Research and/or development activities.

The participation of a large number of farmers in the Kisan Mela to be held from January 7, 1977 is expected to afford opportunities for a two-way communication between scientists and farmers which will help in the transfer of technology to the farming community and the feed back of problems to the scientists. An exhibition, "Sixty Years of Coconut Research in India", will highlight our achievements in this field. As a part of the large scale exhibition of all materials on coconut from all over the world, special incentive prizes will be awarded for new inventions that will find practical application in coconut cultivation or in allied processing industries. The Films Division of India has produced a colour film on coconut entitled "The Golden Palm" to be released during the celebrations. The film depicts the cultivation and the manifold uses which coconut products are put to, highlighting the role it plays in the life and culture of Kerala, the land of beckoning palms.

This Souvenir contains valuable information that is not presented elsewhere in our publications. We are proud to present here memorable reminiscences of some pioneers of coconut research along with a few articles of topical interest. We are presenting a "Who is Who in Coconut Research/Extension in India" listing all persons who have been at one time or the other associated with coconut research/extension activities in the country.

Planning and preparations for the Diamond Jubilee Celebrations and the International Symposium have been under way for the last two years. A large number of individuals and organisations has extended unstinted help and co-operation in our endeavours to make the celebrations a success. We are most grateful to these individuals and organisations. I take pleasure in recording my gratitude to the authors of the articles and the advertisers who have patronised several pages of this Souvenir. In particular, I thank Dr. M. S. Swaminathan, Director-General, Indian Council of Agricultural Research and Secretary to the Government of India, for readily agreeing to write a foreword for this Souvenir.

K V Ahamed Bavappa
Director
Central Plantation Crops
Research Institute
KASARAGOD

Kasaragod
December 27, 1976

Some reminiscences

Dr JS Patel

Agrl. Commissioner (Retd.)
Government of India

J S Patel had his post-graduate education at Cornell and took his Doctorate from Edinborough. He served in various capacities as Oil Seeds Speciallst,erstwhile Madras State, Jute Specialist, Principal, Agricultural College, Sabour, Director of Agriculture, Bihar, Agricultural Commissioner to the Government of India, and Vice-Chancellor, Agricultural University, Jabalpur. He authored "The Coconut–A monograph" published in 1938.

My association with coconut research started when I assumed the charge of the post of Oil Seeds Specialist at Coimbatore in 1930. Some time after my joining it was felt in the Directorate of Agriculture of the erstwhile Madras State that the work on coconut should be excluded from the sphere of the Oil Seeds Specialist who should concentrate on groundnut, castor and sesamum. The then Government, however, allowed the coconut to remain with other oil seeds.

In the thirties the price of 1000 coconuts was as low as rupees twenty and the Research Stations at Pilicode and Nileshwar II were problem stations because of poor productivity of the trees. Burying of coconut husks in trenches improved the trees and yields in later years. At Kasaragod the yields were satisfactory and detailed records of nuts harvested from each spathe of a tree were being maintained. Analysis of these data led us to study the floral biology of coconuts. Some of the staff members were not happy that well bearing palms had to be dissected.

Study of floral biology and growth and vigour of seedlings in nurseries led us to crosses between tall and dwarf coconuts. To test the performance of first generation crosses, room had to be made by cutting down the young coconut trees which caused a hue and cry in the neighbourhood as well as in the department. Shri AP Anandan who had taken a keen interest in the observations on floral biology, took a leading part in effecting the crosses.

The small rest house at Kasaragod, our camping spot during the visits, was the centre where data were scrutinized, discussions held and the programme of work chalked out. At that time no coconuts were planted between the rest house and the sea which was clearly visible from the verandha of the rest house. There were no laboratories at Kasaragod. When Shri T. Krishnamurti joined as a post-graduate student to work at Kasaragod he had to fit up his laboratory in a small store. He used 'idli-patram' for preparing distilled water.

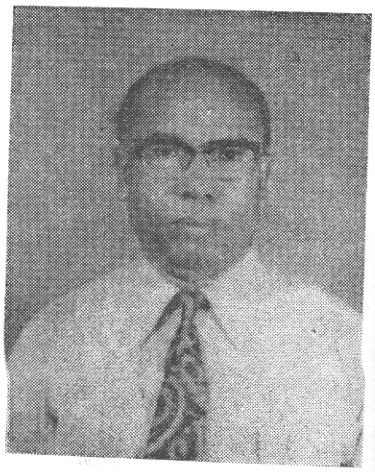
A great deal of compilation of voluminous data was very patiently carried out by Shri K. C. W. Chakrapani Marar, the then Farm Manager at Kasaragod.

"The Coconut — A monograph" was prepared at Coimbatore mostly dictated to Shri Ratnan straight on typewriter during the lunch-break. Shri G. V. Narayana very patiently checked the text and corrected.

My direct connection with the coconut ended in 1938 when I went over to Dacca as Jute Specialist. Later on during 1960–64 when I attended the meetings of the Indian Central Coconut and Arecanut Committees I was distressed at the small number of "hybrid" plants being distributed each year.

Coconut replanting: programme for the future

Industrial Crops Group
Plant Production and Protection Division
FAO, Rome



K J Gunawardene
(Contributor)

Replanting of coconut gardens involves removal of old low-yielding palms and replacement with better yielding seedlings. Replanting and new plantings are distinguished from rehabilitation in that the latter includes all measures of management improvement — thinning, cultural practices to remove undergrowth, application of fertilisers, provision of drainage where necessary and a host of other agricultural practices to increase yields in an existing crop. In some countries 50–60–year old palms have been rejuvenated to level up in yields with palms of half that age under intensive management improvements. However, with age, the inevitable fall-off in yields in spite of optimum inputs and management improvements does occur leaving no other alternative but to adopt outright replanting to restore the crop to its normal and economical potential. Often coconut plantations of over 60 years of age, subject to diseases and pests and grown under unfavourable conditions may advance the time for replanting.

In the near future, with considerably improved plant material and better utilization of coconut timber, replanting of coconut groves every 30 years or so may become an accepted feature. In the Asian and Pacific regions where most palms need replacement, a colossal extent of 65,000 ha will have to be dealt with every year even if the replanting rate is kept as low as 1%. This is evident from the existing coconut areas given for the following countries.

Country	Million ha
Philippines	2.10
Indonesia	1.80
India	1.10
Sri Lanka	0.50
Thailand	0.30
Papua-New Guinea	0.25
Malaysia	0.25
Fiji	0.07
Tonga	0.03
Vietnam	0.05
Western Samoa	0.02
Burma, Laos and Cambodia	0.03
Total	**6.50**

Replanting is necessitated by factors that cause unproductivity of the mature crop. It is therefore necessary to eliminate some of these obstacles to better production well before the re-planting commences. A detailed soil survey, if it has not already been done, is a pre-requisite to better planning for productivity. Selecting the more suitable soils for coconut will allow scarce land areas to be planted to other crops in this era of constant food shortages or allow for pasture development to carry a herd of milch or beef cattle. Drainage improvements need to be rectified if this has been faulty, as also the construction of contour drains, terraces, roadways and other infrastructural changes to facilitate efficient use of mechanical equipment, storage space and

processing facilities. Proper spacing to allow for intercropping in the future and movement of machinery between rows also needs due consideration.

More than 80 per cent of the coconut plantations in all the coconut growing countries of Asia comprise small holdings. Most of these plantings, which provide modest incomes to growers and their daily needs of edible oil and fresh nuts from home consumption, need replacement or rehabilitation. The larger plantations have become derelict and unproductive mainly with the afflux of time and neglect.

Taking these factors into consideration, it is obvious that national governments and the farming community have a vital part to play in framing successful plans of coconut replanting. The governments should programme for risk-free plans acceptable to growers with the least infringement on their meagre financial resources and the farming community should be encouraged to undertake short-term sacrifices for long-term benefits. In embarking upon replanting programmes, the extension officers should work very closely with the growers to win their confidence while at the same time helping them to obtain bank loans, seedlings and other necessary inputs.

Implementation of successful plans of large scale replanting programmes involves the solution of a number of inter-connected problems such as timber utilization, plant material supplies, cover crops, fertilizers and other inputs.

1. Efficient disposal of coconut timber: Besides the use of coconut timber as building material and firewood, large-scale felling of coconut trees for replanting will entail the need to explore other end-uses or economic disposal as rotting trunks harbour large colonies of coconut beetle.

IRHO experience shows that in West Africa a good growth of legume cover over the felled timber could reduce *Rhynchophorus* attack. Biological control of beetle, especially *Oryctes rhinoceros* by *Rhabdionvirus* in the South Western Pacific appears to be another remedial measure. More effective research into biological control of *Rhynchophorus* where large scale felling and replanting are contemplated seems necessary.

2. Nursery techniques and palm densities: Selection of good seeds and identification of vigorous seedlings in the nurseries should receive careful attention.

A variety of observations and results has been reported in the literature. Densities of 160 palms per hectare for talls and 250 for hybrids and 320 for dwarfs have been suggested as suitable maxima. More work is required on the question of palm spacings for different genotypes, soils, moisture and sunshine conditions.

3. Replanting systems, cover crops and intercropping: Three methods of replanting are: (a) removal of senescent palms and gap filling; (b) block planting over a phased number of years, and (c) felling and replanting the entire plantation.

The first method may be suitable to replace some unproductive, diseased or malformed palms in small holdings where a large number of palms is otherwise reasonably good yielding. If the palms are too old and consequently unresponsive to better management and inputs, block planting over a phased period is preferable. This method enables small holders to derive gradual but substantial yield increases from the new plantings. It would also not involve the governments with any undue share of the burden of providing credit facilities in promoting such development schemes. Felling and replanting entire plantations will certainly need high capital backing from individuals or governments.

Planting legume crops such as *Centrosema, Puereria* or *Calopogonium* adds much needed nitrogen to the soil while affording a degree of erosion control, moisture retention and soil structure improvement. As observed elsewhere the breeding of coconut beetles and their multiplication into pest proportions with newly felled trunks may be minimized with legume covers. Planting of cover crops can be insisted upon as a condition for continued credit availability to farmers in their replanting schemes.

Intercropping

Divergences of opinion among coconut growers exist with regard to intercropping with food and feed crops in the first 2–3 years in new replantings. Possible effects on the future growth and yield of the coconut palms in association with other crops need further study. Comparisons need to be made between pure stands of Talls and Dwarfs on the one hand *versus* intercropping of hybrids and Talls with food and feed crops on the other, bearing in mind that the main objective is the assessment of income per unit area of land.

Intercropping to perennial crops ensures the farmers to obtain stable incomes from several crops. In fact this pattern of agriculture is the most common among the small home garden lots with a few other annual food crops like yams and vegetable included. Some large coconut holdings have accommodated cacao and several perennial spices as intercrops and this association apparently seems to be productive in several Asian countries.

Fertiliser and nutrient sources

Studies on this high cost input item constitute a long term programme, but if leaf analysis is carried out in conjunction with fertiliser experiments particularly on hybrids, more effective fertiliser recommendations can be made available to the growers. In this respect, it must be stated that fertiliser studies on coconut hybrids planted with pastures will deserve utmost attention. The use of organic manures in the tropics to replace high cost mineral fertilisers will also need intensive study. Perhaps the modern concept of recycling organic material for the ultimate application to palms and the efficient utilization of residues of human and animal metabolism along with traditional systems of compost preparation and green manure incorporation will engage the greater attention of the scientists of the present day than in the past. The developing world, with a heavy burden to bear in having to import high cost fertilisers, will immeasurably benefit from successful research into these urgent needs.

Economic and other considerations

Small holders are financially weak since they own and manage only small lots of land comprising a few hectares or even fractions of hectares. Their yields are low, often less than 500 kg of copra per hectare and the trees often overaged with least inputs added. The farmer, therefore, needs financial assistance by way of cash loans or inputs in kind, or a combination of both, to enable him to participate in successful replanting schemes. Loans extended to him with no collateral, which he cannot afford to provide, should be mainly on the basis of his projected repayment capacity which in turn will be carefully programmed by the extension service. Wherever possible subsidies should be available to him in the purchase of fertiliser, pesticides and seedlings along with low interest rates on the loans taken out.

Fluctuating copra prices are not conducive to replanting intentions. A price support scheme for the duration of at least a number of years can do much to gain the confidence of the farmer in the Government's replanting scheme. The level of the copra support price depends on the expected yields per hectare, the type of intercrops grown, the size of the investment at the farm level and the level of net revenue the farmer should obtain for his extra effort and labour in joining the scheme.

In order to safeguard the expenditures and to ensure timely repayment, an alert and active extension service is indispensable. A large scale training programme, refresher courses, field demonstrations, additional expenditures to provide extension workers with adequate transport and travel funds, are some of the other measures that are needed in a successful replanting programme.

With more than 30 million ha of coconut out of a total of nearly 65 million requiring immediate replanting in the Asian region, the task facing the researchers, extensionists and the countries is formidable. In spite of difficulties, this is an undertaking which has to be taken in hand without much delay. The results of such efforts will be extremely rewarding and with attendant success, the enhanced crop yields in the eighties will be capable of meeting the ever increasing and insatiable needs of oils and fats in the world.

A Pioneer's Reveries

C M John served in various capacities asOil Seeds Specialists, Agricultural College & Research Institute, Coimbatore and Principal Agricultural Colleges at Bapatla and Coimbatore. He was the first Director of Central Coconut Research Station, Kasaragod. He also worked as Agricultural Advisor to the Potash Scheme and has travelled in France, West Germany and Switzerland to study the fertiliser use. Shri John is now Director, Central Agricultural Training & Servicing Institute, Vidhyanagar, Kottayam, Kerala.

CM John

Shri C M John, whose contributions to coconut research are unparalleled, is very active even at the age of 80, working on coconut in different capacities for nearly three decades and credited with a large number of publications. Shri John was responsible for organising coconut research at the national level and for starting the Central Coconut Research Station at Kasaragod, by drawing the technical programme for the first five years in different disciplines relating to coconut management. At present Shri John is very busy as the honorary Director of the Central Agricultural Training and Service Institute at Kottayam, Kerala.

(Interviewer: K Kunhikrishnan)

Question: How did you get into coconut research?

Answer: You know, that the coconut research in India started under Directorship of Dr H C Sampson, Deputy Director of Agriculture, Southern Region. He laid the foundation for coconut research by formulating a system of recording observations of coconut trees like production of leaves, flowers **etc.** The work of the Research Station at Kasaragod was managed by a farm manager and a field assistant. The work was mostly confined to manurial operations and cultural practices, introduction of varieties **etc.** The Madras Government created the oil seeds Section in 1930 with Dr J S Patel as head. I joined the Section as a Senior Assistant. The four Agricultural Research Stations doing work on coconut were attached to the above Section. I took up serious research in 1939 when Dr. Patel left coconut as Director of Jute Research and I took over as Oilseeds Specialist.

Q: What were the conditions then?

A: The area was very underdeveloped during my early period of service. We were badly in need of medical facilities, conveyance and school facilities. Even vegetables like potatos had to be purchased from Mangalore. To get electricity I had to wait for years. One of my colleagues died due to snake poisoning as we could not obtain the required medical help. In 1947, the Kasaragod Station was taken over by the Indian Central Coconut Committee, and I was appointed as Director in 1950. Being an inconvenient place nobody was happy in their day to day life but the research carried out was still substantial.

Q: Was there any social life?

A: We constructed a recreation club by using coconut stem and leaves in the vicinity of the Station and the staff of the Station met there every evening to spend sometime. My young colleagues used to call it 'John's Simla House'.

Who were all your first colleagues? I gratefully recall to the devoted work done by the late Shri Bhavani Shankar Rao, Shir T Gopalan Nair, Shri K P Anandan and others. The labourers who did the pollination work were really devoted to their work. That really counted for the hybridisation programme. One day a labourer fell down from a coconut palm. He was given the required medical aid and his wife was given employment till he was able to come back for work. We also gave him some financial help. Shri A K Gopalan M P , came to Kasaragod for conducting an enquiry into the incident. I explained to him what I had done for the labourer and his family. Shri Gopalan later met the labourer and was convinced of the good relationship that existed between the labourers and the officials.

Q: What is the secret behind your remarkably successful career?

A: My success could be mostly due to the co-operation, love and affection shown by my supporting staff, Heads of Sections and labourers. I personaliy feel that unless an atmosphere of co-operation and affection is created with the co-workers' one cannot achieve anything. Exceilent relations are essential.

Q: Could you recollect some intereting episodes during your service at Kasaragod?

A: An Israeli visitor came to the Station and when he was offered a tender coconut he was surprised to find so much sweet water inside the nut. One visitor from Puri area in Orissa came to the Station to consult me on the manuring schedule for coconut. When we explained to him the manurial doses per palm, per year he sat down, put his palm on his forehead and exclaimed, "Is it for all this that I came all the way from Cuttack?" He was under the impression that one palm may require at least 75 kg of manure per year. I had been deputed to Bengal to advise the Government on coconut cultivation. The average Bengali was not knowing then wherefrom coconut oil came. I explained to them the technicalities of preparation of copra, extraction of oil etc.

Q: Were you generally happy about your tenure of service as Director?

A: Yes. As Director and leader of the research group, I had the job satisfaction and recall to the period I spent at Kasaragod with sweet memories. However I may add that the service conditions under the erstwhile Indian Central Coconut Committee were not very conducive and helpful in promoting research.

Q: Which was the most significant work of your colleagues?

A: The work of the late Shri G V Narayana was outstanding. His analytical studies of the cabbage made us understand the reproductive phase of coconut. He had the patience ot dissect the crown and to locate the primordia in the cabbage nearly 10 months prior to appearance. This is very important. The manurial schedule was based on this fact that the response to manuring is after two years. And this made me to suggest tha

advances from banks should be recovered only three years after disbursing the money.

Q: Can you recollect the details of writing "coconut cultivation"

A: There was considereable need for popular articles on coconut rather than scientific monographs. This prompted me to write a popular publication. The book was well received; it has gone into eight editions, and was translated into several Indian languages. Both Hindi and English editions are revised from time to time. But the book is not advertised properly.

Q: Who helped you in writing it and in other scientific pursuits.

A: The late Shri M M Krishna Marar, Agronomist, Shri S R Gangolly, Shri S D S Albuquerque, Shri E J Verghese were persons who did good work. I could always count on their goodwill and co-operation, and they helped me a good deal.

Q: Is research work on a crop like coconut an easy job?

A: I compare coconut with a human being. Each one has its own individuality and is different from another. So much so each coconut palm reserves individual attention.

Research Institute for Oils and Oil Crops, Paris

Contributed by
J Fleury
Director General, IRHO

It was at the end of the Second World War that the Research Institute for Oils and Oil Crops was organised to undertake research for the development of tropical oil crops.

The INSTITUTE DE RECHERCHES POUR LES HUILES ET OLEAGINEUX (IRHO) activities concern mainly oil palm, coconut, groundnut and other oil crops. The research projects on coconut include breeding and seed production, agronomy and crop protection.

I. BREEDING AND SEED PRODUCTION

The objectives are first to obtain and then to extend hybrids that are highly productive and adaptable to the local environment in different parts of the world. The improvement programme includes:

1. **Collection of varieties:** Recognising that the genetic variability which is made available to the breeder is the outcome of surveys and exchanges of different materials, efforts are made to make available to breeders different varieties. For example, in 1975, 28 types of coconut palms were planted at Port Bouet in Ivory Coast. In this field, co-operation with the International Board for Plant Genetic Resources (IBPGR) should result in a better knowledge and exploitation of coconut palm populations.

2. **Improvement of copra and oil yield:** The scheme assures the revelation of the most productive hybrids through the study of the general combining abilities of the introduced origins, and their improvement by research for the best combinations between trees chosen from within the parental origins. For example, 43 hybrids, Dwarf x Tall, Tall x Tall and Dwarf x Dwarf, are at present under study in the comparative trials at Port Bouet in Ivory Coast and in Santo in the New Hebrides.

3. **Breeding for resistance against diseases:** This approach is realized by performance trials of varieties and hybrids in various countries conducted in strict liaison with agronomy, phytopathology and entomology departments of the Institute.

4. **Basic Research:** Tissue culture and biochemical methods are likely to open new vistas for the improvement of the coconut palm; this is done with the aid of the plant improvement laboratory of the University of ORSAY (Paris) and the Plant Physiology laboratory of ORSTOM (Office de la Recherche Scientifique et Technique Outre – Mer.).

II. AGRONOMY

Research in agronomy can be grouped under three headings: physiology, agronomic techniques and nutrition.

In physiology, the studies on water nutrition of the coconut palm and its consequen-

tial effects on yield are made. Experiments in agronomic techniques cover all aspects of coconut cultivation including preservation and germination of the nuts, maintenance of nurseries, land preparation, planting methods and management of the coconut garden. Research in mineral nutrition includes attempts to determine the critical levels of all the major elements as well as the essential of the synergistic and antagonistic relationships between them.

III. CROP PROTECTION

IRHO's research efforts have resulted in evolving suitable control measures for different insect pests and diseases and there are several projects in progress.

The development of a plant in monoculture nearly always leads to the intensification of phytosanitary problems, whether it be direct insect attacks or the development of disease transmitted by the insects.

The problem of *Oryctes*, which in numerous regions, appears to constitute a limiting factor to the coconut cultivation was able to be resolved thanks to the setting up of appropriate cultivation techniques. In several countries of Africa, whether in the West or the East, the bug *Pseudotheraptus* can cause wide-spread damage in attacking flowers and immature nuts. This coreid bug is controlled to some extent by predatory activities of the ant *Oecophylla*. This ant, however, promotes the development of the coccid *Aspidiotus destructor*, which is present in all regions where coconuts are grown. In effect, *Oecophylla* destroys the grubs and adults of the coccinellid predator of the coccid.

The mite, *Aceria guerreronis* which lives inside the calyx of the nuts, also is responsible for an yield loss of 10 to 25%. The chemical control evolved against this pest has been found to be effective only under certain conditions. Taking into account the extent of damage and the difficulty of the problem, an international effort should be agreed to in order to find a solution.

Numerous defoliator insects also attack the coconut throughout the world. In many cases, the only control at present fit for use is the chemical method, as over large areas insecticides are usually applied by aeroplane. However, since such treatments can lead to a serious imbalance of the entomofauna, endeavours are being made to find more selective methods (biological insecticides, and entomopathogenic diseases).

It has been shown that certain diseases of the coconut are transmitted by insects; it is the case with Red Ring disease transmitted through nematodes carried by *Rhynchophorus*. Olfactory trapping techniques against this insect are under study in collaboration with the chemical laboratories.

Diseases with different pathogenic agents can be transmitted by sucking insects. In certain ecological zones diseases develop at an early stage and notably in the nursery. Control of the species of Homoptera present has already made it possible to reduce the incidence of these diseases perceptibly.

Other diseases like Lethal yellowing type, appear especially on adult trees. As for control methods, they are mainly directed towards research for resistant varieties; this work is being done in collaboration with the Phytopathology (Virology) and Genetics Departments.

A Doyen pathologist recollects....

Dr K P V Menon

An eminent coconut pathologist who devoted his entire life for working on coconut diseases, especially the root (wilt), Dr. K. P. Velukutty Menon leads a quiet retired life at 'Zafari', near Puthiyangadi, a few kilometers away from the city of Calicut in Kerala. Being a voracious reader, keenly interested in literature, Dr. Menon's best friends are books – and a variety of them ranging from potboilers of Harold Robbins to serious works of Saul Bellow, Philip Roth and others. To a person inclined to literature it is a real pleasure to enjoy his warm hospitality. During the interview more than talking about himself and his achievements, Dr. Menon was always complimenting his colleagues, irrespective of their hierarchical positions.

(Interviewer: **K Kunhikrishnan**)

Question: Is there any specific reason for your working on coconut?

Answer: After finishing my doctorate degree from London University in 1932, I was working as Personal Research Assistant in the Rust Research Scheme of the ICAR at Agra College with Dr. K. C. Mehta, Botanist from 1935–37. I had to work for six months in Agra and another six months in Simla during summer. Then an advertisement came in the local papers inviting applications for the post of Plant Pathologist for investigating the diseases on coconut in Travancore under an ICAR Scheme for three years. But it was Dr. E. J. Butler who during my *viva voce* for Ph.D. "injected the germ into me".

Q.: How was that?

A.: You know Dr. Butler was the first person who worked on coconut diseases in India. During the *viva* he put some speculative questions on the diseases of coconut palm. So I got interested and sent an application. I took charge in March, 1937.

Q.: How about the physical facilities for scientific investigations at that time?

A.: I reported at Trivandrum for duty with Dr. Kunjan Pillai, Chief Secretary and Mr. K. R. Narayana Ayyar, Director of Agriculture. The State Research Laboratory was at Quilon The set up consisted of one Plant Pathologist, one Research Assistant, one Clerk, one Peon and one Lab. Attender. My first family, you see, we were just one family, included Shri U. Karunakaran Nair, Research Assistant, Shri K. K. Unnithan, Clerk and Shri V. Boniface, Lab. Attender. There was complete cooperation from each one.

Q.: What was the type of work that you carried out first?

A.: There was already a field Station at Kayangulam with a Mycologist in charge. Shri M. K. Varghese,a very knowledgeable person was the Mycologist then. We worked in close collaboration; Shri Varghese rendered whatever support I wanted.

Q.: How about the investigations?

A.: We carried out infection experiments on seedlings. Once a week we moved around and collected samples for laboratory analyses. Large number of samples was collected. Infection experiments were done on seedlings. Symptoms of the disease were reproduced in pot culture experiments, but not further.

Q.: Which were the areas where the root (wilt) disease was prevalent then?

A.: On the north at Ochenthuruthu in Cochin, Attingal in the South, and High Ranges in the East. River banks were the main sites of infection.

Q.: What happened to the scheme later?

A.: It was a three-year scheme. After 18 months we sent a proposal for extension, in which we requested for a chemical wing also to analyse soil samples. Dr. K. M. Pandalai was the first Chemist. He was Assistant Biochemist of Travancore before joining us. Investigations under the scheme went on for 10 years till 1947-48. In 1947 the liability of ICAR was transferred to the Indian Central Coconut Committee.

Q : What did the Committee do?

A.: Immediately after taking over, the Committee deputed Shri C. M. John and me to all the coconut-growing tracts of the country to assess the work being done and to suggest future lines of investigations. We travelled all over the country except Bengal and submitted a report suggesting to set up two Coconut Research Stations at Kayangulam and Kasaragod. By the time the root (wilt) disease had spread to Irinjalakuda in the north and Kulasekharam in the south. And the Kayangulam Station was set up in 1948.

Q:. How were the beginnings of Kayangulam Station?

A.: There were four sections each with a Section Head. The working of the scheme was being constantly reviewed by the scientific teams of the ICAR and the problem was suggested to be tackled simultaneously on all the four sides and thus the four sections of Plant Pathology, Plant Physiology, Soil Chemistry and Entomology came into being. The stone laying ceremony was in 1948 and the building was ready in 1949 and we moved from Quilon to Kayangulam.

Q.: Who were the first Section Heads?

A.: Dr. K. K. Nirula was in charge of Entomology Section, Prof. T. A. Davis in charge of Physiology, Dr. K. M. Pandalai in charge of Soil Chemistry and myself being the Joint Director looking after Pathology section.

Q : What were the initial problems?

A.: Paucity of funds was the major problem. The total cess fund for coconut was around Rs. 6 lakhs. Of this $1\frac{1}{2}$ lakhs usually were allotted for Kayangulam and 2 to $2\frac{1}{2}$ lakhs for Kasaragod in the Annual Budget. All the expenditure had to be met from this budget allocation. The Director's power for sanction was only Rs. 500/- at one time for one purpose. There was too much emphasis on the Administrative set up and too little on the Scientists.

Q.: How about the status of investigations?

A.: The plant virus had by then assumed sufficient importance and there was a shift from fungus to virus as no investigation was conducted anywhere on these. Later, a Virology subsection was set up in Plant Pathology. Dr. A.N. Nagaraj, Senior Research Assistant, was the first Virologist. Root sap and leaf sap inoculations were the first virological investigations. At his time though, there was no insect proof house and the experi ments had to be done in open air,

he was able to do something significant. Later, work on a Virus Entomology was also taken up.

Q.: Why was Kayangulam selected for locating the Station?

A.: The first three foci of infection of the root (wilt) disease were Kaviyoor, Irattupetta and Kayangulam. For the set up, two gardens of 5 ha were taken on lease by the Travancore Government and 30 ha of private land acquired and handed over on lease for a period of 99 years. The scheme was approved by the Government of Travancore and Mr. Kasim, Collector, was asked by the Diwan Sir C. P. Ramaswami Aiyer to acquire the land and a notification came in gazette on the next day. No difficulty was faced in acquisition of the land. The land still belongs to Kerala Government. Dependents of those evicted were employed at the Station and the Station helped the improvement of Krishnapuram.

Q : What was the total personnel strength at the beginning and how about the living facilities?

A : The total scientific strength was 16 with four scientists in each section. There was one Farm Manager and four Fieldmen. The office staff consisted of one Superintendent, one Accountant and four Clerks. Shri Thomas Kappen was the first Superintendent. There were minimum facilities for living at Krishnapuram including school and hospital.

Q : Why is that there was still no major breakthrough in the case of root (wilt) disease?

A : The greatest difficulty is the crop itself. The material is too huge to be handled. The coconut palms live even up to a century and the gap between generations is so wide. Since it is a monocot stem there is no question of grafting or any other similar work being done.

Q : Dr. Menon, can you recollect the happiest event in your career?

A : Why not? The stone laying ceremony of Kayangulam Station was my most joyful occasion. It was done by Shri Marthanda Varma, the Elaya Raja of Travancore. It was a long cherished dream coming true. The construction was done by the PWD of Travancore. Shri K M Govinda Pillai was the Engineer. There was no interference or hitch from anyone and the building was completed in eight months. Later, Shri Dattar Singh, ICAR Vice President, came to see the building. Though he asked me why we required such a huge building, he appreciated it.

Q : Can you narrate the experiences of writing the monograph on coconut?

A.: It was an assignment thrust upon us. In a Committee meeting Dr. M. S. Randhawa asked us to write a monograph on coconut. He gave us six months' time. With the wholehearted co-operation from both the Stations we were able to prepare a draft in time. I took it to Delhi but the ICAR publication wing could not read it. Dr. Randhawa asked us to get it printed. Then, as suggested by ICAR publication wing, it was taken to the Times of India Press, Bombay. At first the Press refused to take up the printing. But I told them frankly that I would be losing my job. Then the Manager of the Press called a meeting of the workers who readily conceded to my personal request. With the personal interest and the cooperation of the workers in the press, we could complete printing within six weeks. Day and night, I was sitting in the press, correcting proofs, which you know is a tough job. For the next Committee meeting at Trivandrum I could present 15 copies of the book.

Coconut breeding: problems and prospects

CA Ninan,
Professor of Genetics and Plant Breeding
and Head, Department of Botany, Kerala
University, Trivandrum

C A Ninan took his Doctorate in Cytogenetics from the University of Travancore and was Botanist at Central Coconut Research Station, Kasaragod, from 1959 to 1963; He is now Professor of Genetics and Plant Breeding and Head, Department of Botany, University of Kerala, Kariavattom, Trivandrum.

My association with coconut started in June 1959, when I joined the Botany and Breeding Section at the Central Coconut Research Station, Kasaragod (now Central Plantation Crops Research Institute) under the erstwhile Indian Central Coconut Committee. Though I had to leave the CCRS in May 1963, to take up a teaching and research assignment in the Botany Department of the Kerala University, I have had the good fortune to sustain my interest in coconuts.

It was just at the time of my joining the CCRS, Kasaragod that the late JBS Haldane published his classical paper entitled "Suggestions for Research on Coconuts". Haldane had visited the Central Coconut Research Station at Kasaragod and gained first hand knowledge of the crop. His paper contained many valuable suggestions for research on the palm. About this time SC Harland published an interesting paper entitled "Improvement of the coconut palm by breeding and selection" in which he emphasized the need for genetic upgrading of planting material in coconuts through identification and use of prepotent palms.

During the brief period of four years of my stay at Central Coconut Research Station, Kasaragod, and after my leaving the Station, I tried to work out the suggestions contained in these two illuminating papers, besides initiating and guiding genetical and cytological aspects of work on the coconut palm. We could establish clearly that the pollen parent had a definite effect on copra content of the progeny and that when pollen of varieties like 'Kappadam' with large sized nuts was used, significant increase in copra content could be obtained. Trials were laid out to study the yield performance of the good and poor seedlings derived from individual mother palms to verify Haldane's contention that by discarding what appear to be poor seedlings, we might perhaps be losing valuable genotypes. Studies on open-pollinated and selfed progenies of a large number of foreign breeds planted earlier at the Agricultural Research Station, Pilicode and Central Coconut Research Station, Kasaragod, revealed that selfing did not reduce vigour in a few trees. It was also shown that certain high yielding trees under open-pollination with miscellaneous pollen produced superior seedlings over the years. This finding may provide indirect support to Harland's idea of prepotency in coconuts. Selection of such high yielders as seed parents, besides ensuring better yield of progenies, would also reduce the percentage of rejects in the nursery. A cytological basis for the segregation of **spicata** progenies into **spicata** and **typica** in about equal proportions was established and haploidy at the embryo stage identified cytologically. The endosperm of coconuts was shown to exhibit very high levels of polyploidy, especially those of the dwarf coconuts and the makapuno. It was also shown that many of the floral abnormalities

in coconuts were possibly related to mutational events at the genic level or cryptic structural chromosome alterations. Studies on bulbil bearing palms revealed that there was no gross cytological abnormalities in them and they were possibly mutant phenotypes. This ruled out their possible use as vegetative propagules since their reversion to the seedling habit would be difficult.

The orange dwarfs and their natural hybrids

By a consensus of opinion, the dwarfs were considered homozygous and Harland suggested their use as females for identifying prepotent talls by dwarf x tall crosses. However the chowghat orange dwarfs were not found to be homozygous to the extent conceived by earlier workers and the semi-tall progenies resembling D x T hybrids segregated even when they were deliberately self-pollinated. The semi-tall progenies of the dwarfs thus belonged to two categories namely, those segregating under natural or deliberate selfing and those resulting from natural or controlled pollination with tall pollen. Data on such progenies indicate that both are comparable in yield traits. Thus the semi-tall segregants (resulting from selfing of dwarfs) could be expected to be more uniform in yield traits as they are believed to be more homozygous as compared to D x T hybrids. Also they might be heterozygotes with certain combinations of tightly linked loci which do not segregate, The uniformity in colour traits of the off-types might be related to this. Further studies on these two categories of off-type progenies of Chowghat Dwarf Orange could yield significant results of value in the future utilisation of the dwarfs in breeding work.Basic research on dwarfs and their semi-tall progenies has to be done before they can be more effectively utilised in coconut breeding.

Use and exchange of improved material

Considerable work has been done in various countries on the improvement of the tall variety by breeding and selection and in stations like Central Plantation Crops Research Institute, Kasaragod and Agricultural Research Station, Nileshwar, a few prepotent trees have already been identified. Breeds like the Laccadive Ordinary have also been found to be of great promise for straight introduction into the mainland, India. However, the bulk of the planting material annually used by growers, even today, is derived from random-bred tall trees selected for visual superiority and until such times it would be possible to use the prepotents as seed or pollen parents of every seedling planted in future, the desired genetic improvement cannot be achieved. Pollen and seeds of known prepotents wherever available alone should be used for international exchange of germplasm.

Use of inbred talls

Results of research carried out at the Agricultural Research Station, Pilicode, have also shown that certain trees of the W.C. Tall variety do not show inbreeding depression even after two generations of self pollination. This is in conformity with Harland's idea that prepotency could perhaps be fixed by selfing. Selfed nuts of such trees could provide reasonably uniform planting material. They could also be used in tall x dwarf crosses to see whether inbred tall x dwarf cross would be better than outbred tall x dwarf cross as could be reasonably expected. At least it should be possible to produce more uniform T x D hybrids (F1) by this method of crossing inbred tall with dwarf as I had suggested earlier. Research institutes outside India which do not have selfed materials (which naturally takes several years to evolve in a perennial crop like coconut) could also take advantage of the availability of selfed seeds (up to three generations) in Agricultural Research Station, Pilicode, now under the Kerala Agricultural University. These should certainly be utilised in crosses with other geographic strains of dwarfs.

Breeding for resistance against root disease

All varieties and hybrids of coconuts so far exposed to the root (wilt) disease have been found to be susceptible in varying degrees. To locate possible sources of resistance, large scale introduction of all available breeds and multi-location varietal resistance trials would be necessary. One observation that could be taken advantage of, in this connection is the presence, even in severely

disease-affected areas of 'escapes' which do not show any disease symptoms at least externally and maintain very high yields. Maintenance of records wherever possible of future plantations in the diseased tracts would be of value to work back and see whether there is any genetic basis for this apparent resistance and if so in exploiting this. A surer but more difficult method would be to develop techniques for vegetative propagation which would enable large scale production of such genotypes. If success could be achieved in this approach, this could solve the vexing problems of coconut breeding both in health and disease. Any effort made in this direction will not, therefore, be too much. Identification of the causative agent of the root (wilt) disease is also of paramount importance in locating resistant genotypes by sophisticated *in vitro* methods in place of the time consuming and expensive field experiments.

Though coconut research in India has been in progress for the past sixty years, its golden age can be said to have started only with the take over of the research stations of the erstwhile Indian Central Coconut Committee by the Indian Council of Agricultural Research. With the consequent availability of sufficient funds and possibilities of international co-operation in coconut research that has opened up, let us hope that an early solution to the problem posed by the root (wilt) disease could be found.

Coconut development in India—in retrospect

PK Thampan
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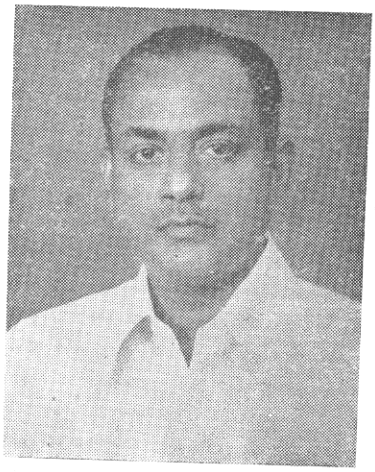

P K Thampan, Director, Directorate of Coconut Development, Cochin, held various posts in the Departments of Agriculture, Kerala Andaman & Nicobar Islands, and Govt. of India. He was also the Principal, Rural Institute, Thavanur and Deputy Director at the Directorate of coconut Development before taking over as Director. He represented India in the Asian and Pacific Coconut Community. He has written four books on coconut.

India is one of the largest coconut producing countries of the world. With an area of 1.1million hectares and an annual production of 6,000 million nuts, the country ranks third on the world map of coconut. The relative position of the country in the Asian region could be seen from Table 1.

TABLE 1
Area and production of coconut in the Asian region

Name of the country	Year	Area ('000 ha)	Production (million nuts)
The Philippines	1975	2249	8625
Indonesia	1974	1941	7512
India	1975	1116	5961
Sri Lanka	1974	466	2131
Malaysia	1974	214	870
Thailand	1975	384	514
W. Samoa	1974	32	162

India is a vast country characterised by distinct agroclimatic regions with only the coastal belts providing the optimum ecophysiological factors for the successful cultivation of coconut. Consequent on the limitations imposed by climatic factors, coconut cultivation could gain only regional importance compared to other crops grown in India. Even its regional distribution lacks uniformity with the result that as much as 70 per cent of the total coconut area is concentrated in Kerala which by itself is a small state accounting for only 1.18 per cent of the total area of the country. The differential distribution of coconut in India is shown in Table 2.

TABLE 2
The Distribution of coconut in India

Name of state	Area in '000 ha	Production in million nuts
Kerala	748.2	3718.7
Tamil Nadu	112.3	986.6
Karnataka	140.5	759.8
Andhra Pradesh	40.4	167.2
Maharashtra	8.7	50.6
Orissa	11.4	43.3
West Bengal	6.7	22.0
Assam	4.4	10.6
Goa, Daman and Diu	18.7	97.5
Andaman and Nicobar Islands	19.4	63.6
Lakshadweep	2.8	21.0
Pondicherry	1.6	19.9
Tripura	0.4	0.5
Total	**1115.5**	**5961.3**

The regional position of coconut is confined to production only because the demand for coconut and coconut products is fairly widespread in the country. The demand is for both

edible and industrial end uses and the main source of supply is the crop produced from a small ecological region. This imbalance between the demand and production has always been there in the country despite the increases in production achieved during the last decade.

Though the coconut palm has been known to exist in India since 3000 years ago, organised efforts to develop the crop have a recorded history of only less than one century. The history of its development and the commercial exploitation of the products has three distinct phases covering the latter half of the last century, the period from 1900 to 1945 and from 1945 to 1976.

The first phase

The first phase of coconut development coincided with the expansion of the European soap and edible oil industry which required large quantities of imported copra for feeding the milling sector. The increased demand for coconut products in the European markets gave a fillip to coconut cultivation and copra trade. With the introduction of wheeled traffic and increased shipping facilities, the export trade in coconut products expanded considerably which resulted in a renewed interest in coconut cultivation and focussed attention on the urgency of taking up the cultivation and development of coconut in an organised manner.

The intensive cultivation of coconut which started consequent on the above developments was also not free from problems. It was sometime during this period that the growers in the then Central Travancore area of Kerala State first noticed the incidence of an unknown disease in isolated patches which is now known as the root (wilt) disease of coconut. In 1897, the coconut growers of the area presented a memorandum to the Government describing the financial loss suffered by them due to the incidence of this disease. Roughly about the same time the coconut growers on the East Coast (Godavari District in Andhra Pradesh) were also in distress caused by the high incidence of bud rot disease. The British, as could be expected of them, would have looked the other way had not their trade interest also been involved which compelled them to appoint Dr. Butler, the Imperial Mycologist to investigate the problem. Though Dr. Butler could not identify the etiology of the root (wilt) disease or suggest measures for alleviating the sufferings of the growers, his recommendations helped to develop a modern line of approach to the problems of coconut cultivation in the country. Towards the end of the last century, agricultural departments were established in various states, thereby making coconut development recognised item of work.

The second phase

The dawn of the present century found India in a formidable position in the export trade in copra and coconut oil. During the years 1909 to 1914, India exported about 30,000 tonnes of copra annually. The increase in demand and the favourable price level maintained the tempo on the production front which, unfortunately, did not last long The prices started crashing during the first World War and the general economic crisis forced the growers to neglect the cultivation. Even after the war, the prices failed to recover and the apathy of the growers continued. During the post-war period, export of copra and coconut oil started receding while imports gained momentum. By 1924, the export had come to a standstill. Liberal imports of caustic soda into the country during the twenties had helped many soap units to come into existence. The development of soap industry, combined with increased domestic consumption of coconut and coconut oil finally caused a deficit in the commodity, a situation which continued to prevail subsequently.

Though export trade in coconut products ceased to continue, the domestic demand started to pick up which in its turn, necessitated governmental efforts for increasing the production. In 1916, with the establishment of the Coconut Research Stations at Nileshwar and Kasaragod, coconut development activities attained a purposeful momentum. At about the same time coconut farms started by the Departments of Agriculture in the then Cochin and Travancore regions of Kerala State also came into being. The Agricultural Departments disseminated among growers useful information gathered from these research stations and elsewhere. By the early

thirties Government had come to recognise the importance of the genetic improvement of the crop and envisaged schemes for the establishment of coconut nurseries. During this period, the coconut area in the country also recorded a slight increase from 0.5 million hectare in 1920–'21 to 0.57 million hectare in 1930–'31.

The world trade in copra, coconut oil and other coconut products was seriously disturbed by the outbreak of the second World War. Though not an exporting country, the war situation in general had an adverse effect on the production and marketing of coconuts in the domestic sector also. The result was a dampening of spirit on all fronts. Decline in production coupled with marketing bottlenecks finally forced the Government of India to step in, who in 1943 initiated an enquiry into the production aspects, regulation of import of copra and coconut oil, improvement of quality of copra and better utilisation of shell and fibre. The Enquiry Commission recommended the setting up of a statutory body for coconut with powers and functions similar to those of the Ceylon Coconut Board. The Government of India accepted the recommendation to set up a statutory body with somewhat narrower functions than proposed. Thus, the Indian Central Coconut Committee was formed in February 1945. The Committee continued to function till March 1966 and after that the Directorate of Coconut Development was established in its place, which took over the development and marketing of coconut in the country.

The third phase

The third phase which covers the period from 1945 to 1976 has heralded the era of coconut development in the country. It was during this period integrated efforts for modernising coconut culture and industry were promoted. Some of the major development programmes implemented during this period were the collection of reliable statistics on area and production, the establishment of Central and Regional Research Stations, the commercial production of coconut hybrids and the establishment of hybrid seed gardens, the coverage of more than 10 per cent of the total coconut area in the country under the package programme, the establishment of nurseries and parasite breeding stations, the financial assistance given to growers for expansion of area under coconut and the encouragement given to growers' cooperatives for improved marketing and processing activities. These promotional activities have led to a conspicuous increase in the area and production of coconut in the country as shown in Table 3.

TABLE 3
Changes in the area and production of coconut

Year	Area in '000 ha	Production in million nuts
1949—50	629	3251
1959—60	728	4846
1969—70	1033	5859
1974—75	1116	5961

The objectives and strategy of coconut development

The present production of coconut falls short of the domestic demand by about 25 per cent. One of the basic objectives of coconut development in the country is to wipe out this deficit within the shortest possible period. Unlike in other coconut growing countries of the world, the small coconut holders in India are essentially marginal farmers. The average size of coconut holding in the country is as small as 0.2 ha with 98 per cent of the holdings having an area of less than two ha. In Kerala State, where 70 per cent of the coconut area in the country is concentrated, there are about 2.5 million small coconut holdings. Nearly 50 per cent of the rural population of the state derives their main source of livelihood from these holdings. Though general increase in the production of coconut is essential, equally important is improvement in the productivity of small holdings which alone can augment the income of the multitudes of small and marginal growers. The strategy of coconut development has, therefore, been evolved to accomplish the two-fold objectives of increasing both the production and productivity of small holdings through scientific management of the palm

and intensive utilisation of holdings under coconut.

The current programmes of coconut development

The programmes of coconut development which are currently under implementation were framed to satisfy both the short-term and long-term requirements. To ensure sizable productivity increases within a short period, programmes on scientific management of the existing palm population covering irrigation, manuring and plant protection aspects have been formulated. For developing increased production potential under the long-term approach, programmes giving priority for the genetic improvement of the palm by the production of hybrid planting material for replanting and new planting within a reasonable short period have been adopted. A brief description of the major programmes so far formulated and implemented in the country is given below.

1. Package programmes

Package programmes are the most effective short-term approach adopted for achieving significant increases in productivity from the existing palm population. The programme aims to implement intensive production-oriented programmes encompassing the use of quality planting material, adequate fertilizer inputs, irrigation and improved plant protection techniques in potential districts in the different states for a continuous period of five years. The objective is to achieve a cent per cent increase in production within five years. The programme is implemented in units of 500 hectares each with a total coverage of 1,20,000 hectares. The growers covered under the programme will receive credit facilities for adopting improved management practices. For effective extension education, field demonstrations have also been established at the rate of 10 demonstration units of 0.25 ha each for every operational area of 500 ha. The total financial investment for the programme for five years is Rs. 772.34 million which includes a credit component of Rs. 761.56 million.

2. Hybrid seed gardens

The production of coconut hybrids (T x D and D x T) has received priority in the National Plan since 1966. The programme which started with the production of 26,000 T x D seedlings every year is now a major development activity and will be continued until the D x T hybrid seed farms established in the country start commercial production of hybrids. The present programme is to produce 5,25,000 T x D seedlings and 1,00,000 D x T seedlings every year of which 4,50,000 T x D seedlings and the entire D x T seedlings will be from Kerala. The yearly financial investment for the purpose is about Rs. 3.0 million.

For the commercial production of D x T hybrids, five hybrid seed farms have been established in the country. These gardens, one of 200 hectares in Kerala, one of 200 hectares and another of 120 hectares in Karnataka, one of 100 hectares in Tamil Nadu and one of 50 hectares in Orissa, are expected to produce about 4 million hybrid seedlings annually from 1985. The investment stipulated for a period of five years (1974–1979) is Rs. 4.0 million.

3. Elite seed farm and coconut nurseries

The production and distribution of quality planting material of the local cultivars initiated on an organised scale in 1945 continued as a popular development programme since then. In 1970, a 40–hectare elite seed farm was also established in Karnataka with the progenies obtained from controlled pollination of pre-potent palms for the production of T x T progenies. The coconut nurseries established in the different states have an annual output of about four million seedlings and the annual investment is about Rs. 10 million.

4. Expansion of area

Despite the ecological restriction for expansion of area under coconut, the estimated availability of suitable area for new plantings is about 1,30,000 ha. Area expansion programmes initiated in potential centres had achieved a coverage of about 25,000 ha. Credit facilities are extended to the growers for the purpose and the total investment is about Rs. 125 million.

5. Rejuvenation of diseased coconut gardens

In the absence of cultivars resistant to the root (wilt) disease of coconut, how best the unit productivity could be maintained at a

satisfactory level even in the presence of the disease is a matter of considerable importance to Kerala. The coconut hybrids possessing desirable economic qualities like precocity in bearing and high yield potential, are utilised for underplantings and replantings in a selected unit of 5000 hectares after removing all the disease infected palms. Even in the absence of differential response to disease incidence, if the high yield potential of hybrids manifests any improvement in the productivity per unit area, an expanded programme of replanting in all the disease affected gardens in the state could be drawn up with confidence. The present programme started during 1973–74 has already covered about 3000 hectares. The financial investment for five years (1974–1979) is Rs. 2,65,000.

6. Other programmes

Other programmes currently in operation in the country include protected belt spraying in Kerala against leaf rot, parasite breeding stations in the different states for the biological control of *Nephantis serinopa*, comprehensive coconut development programme in Tamil Nadu and the demonstration programme in Pondicherry, Goa and Maharashtra. The annual investment for these programmes is about Rs. 1.0 million.

"In a country such as India agriculture is central to the economy. Nearly half of the country's gross national product is generated in agriculture, more than half of all consumer expenditures are for food. In years of poor crops total consumer expenditures consistently decline, and there is an even greater decline in industrial investment ..... Thus agricultural policy involves much more than a race between food and population, it fundamentally determines who will and who will not participate in a country's economic growth. The choice of a policy therefore involves a host of considerations.

— **John W Mellor**

Research centres for coconut in India

KPP NAMBIAR
Associate Professor
Kerala Agricultural University

K P Padmanabhan Nambiar served the Agricultural Department of the erstwhile Madras State for 13 years from 1945. Then he worked as Research Officer at the Arecanut Research Station, Peechi, for eight years. From 1966 to '72 he was Deputy Director of Agriculture (Coconut Research) at the Central Coconut Research Station, Nileshwar. Shri Nambiar is now Associate Professor (Coconut Specialist) at the Coconut Research Station (Kerala Agricultural University), Pilicode.

KERALA

Coconut Research Stations, Pilicode, Nileshwar II and Nileshwar III

Research on coconut in India commenced with the establishment of four research stations in Kasaragod Taluk of South Kanara District of the erstwhile Madras State in 1916 as a result of the decision of the Government of Madras that a detailed study of coconut in all its aspects should be undertaken in the West Coast, where the crop was extensively cultivated. To obtain representative soils on which coconut was generally grown four research stations were established at Pilicode, (Nileshwar I) 58 km north of Cannanore town, representing lateritic gravelly soil, Nileshwar II, 10 km north of Pilicode, representing red sandy loam, Nileshwar III, 2 km north of Nileshwar II, representing the barren coarse sand and Kasaragod, 120 km north of Cannanore representing red loamy soil. With the setting up of the Indian Central Coconut Committee, the Kasaragod Station was handed over to the Committee by the Madras Government in the year 1947. The erstwhile Indian Central Coconut Committee established a Research Station at Kayangulam 110 km north of Trivandrum in the year 1948 to carry out research on pest and disease problems of coconut in general and root (wilt) disease in particular. On abolition of Indian Central Coconut Committee, the ICAR took over the administrative control of the Kasaragod and Kayangulam Research Stations in the year 1966. In 1970, the Central Coconut Research Stations at Kasaragod and Kayangulam and the Arecanut Research Station, Vittal were amalgamated to form the Central Plantation Crops Research Institute, with Kasaragod as the headquarters.

In addition to the Coconut Research Stations I, II and III at Pilicode and Nileshwar, another two substations were started at Kumarakom on the eastern bank of the Vembanad lake in Kottayam district, and Pachallur, 8 km away from Trivandrum, by the State Department of Agriculture, Travancore in 1947 and 1948. In 1972, when the Kerala Agricultural University was formed, Nileshwar I and II were handed over to the University and Nileshwar III continued to be under the Department of Agriculture, Kerala.

Highlights of research

With a view to spotting out coconut varieties with desirable economic characters several exotic and indigenous varieties were introduced at Pilicode from 1925 onwards for trials. Detailed studies on the performance of the earlier introductions showed that Laccadive Ordinary, Philippines, Java, Cochin China, New Guinea and Laccadive Micro were cultivars suitable for the West Coast and superior to the ordinary West Coast Tall. Among the recent introductions, the Philippines variety 'San Ramon' was

found to produce large sized nuts yielding 380 g copra per nut (as against 150 g for West Coast Tall.

As early as in 1936, Tall x Dwarf hybrids were produced at Nileshwar. The early bearing nature of the dwarf was dominant in the hybrids which attained steady bearing age earlier than the tall types. The total annual yield of copra was more in T x D than its parental types. Later studies revealed that the dwarf orange was preferable to dwarf green for use as male parent. Studies conducted on the performance of hybrid progenies obtained by crossing promising exotic varieties and West Coast Tall with semitall type 'Gangabondam' as male parent have yielded useful results. Laccadive Ordinary x Gangabondam producing 20.2 kg of copra per year proved to be superior to all other hybrids. D X T hybrids raised from dwarf orange palms were high yielders. Yield studies revealed that progenies of seedlings obtained by controlled cross pollination of higher yield groups recorded higher yields than selfed and natural progenies of lower yield groups. Superiority of Laccadive Dwarf to Chowghat Dwarf Green, Andaman Dwarf and Gangabondam was established. Open pollinated progenies of T x D were in no way inferior to the parent T x Ds when rigorous selection was made in the nursery.

Future line of work

In order to evolve inbred lines in coconut and to determine whether hybrid vigour is met with in the crosses between the first generation selfs, progenies of six family groups which did not show any inbreeding depression on selfing were selfed and planted for study of performance. Sibmated progenies of S_1 progenies were also planted along with this.

New introductions are being studied to test their regional adaptability reaction to diseases and to exploit the genetic diversity found in them. Regular yield trials with promising exotic and indigenous varieties and hybrids are being continued. Field trials to study the manurial requirements of coconut are in progress. Studies on the performance of nutmeg, cinnamon and banana under the shade of coconut are in progress. Five of the most promising introduced types are being arranged to be planted in two-hectare blocks for large scale multiplication for distribution of seedlings.

It is proposed to develop third generation selfs (S_3) which do not show any inbreeding depression and also those which exhibit maximum depression from the second generation selfs. These are proposed to be planted and studied. It is programmed to conduct detailed studies on the performance of different dwarfs and occurrence of natural D x T in the different dwarfs.

Coconut Research Sub-stations at Balaramapuram and Kumarakom

These stations were started by the Indian Central Coconut Committee and are run by the State Department of Agriculture. The Balaramapuram Station was first started in 1948 at Pachalloor, 8 km from Trivandrum, in an area of 17 ha. The present area of 14 ha at Kattachalkuzhi, 3 km south of Balaramapuram representing typical red loam soil was acquired in 1963.

The Kumarakom Station on the eastern bank of Vembanad lake in Kottayam district was started in 1947 in a private plantation of 23 ha. The land was acquired by the Government in 1958. The palms are grown in single and double rows on bunds alternated by channels. Agronomic and manurial trials are in progress at these stations.

TAMIL NADU

Regional Coconut Research Station, Veppankulam

The Regional Coconut Research Station, Veppankulam in Tamil Nadu established in 1958, was originally sponsored jointly by the Government of Tamil Nadu and the erstwhile Indian Central Coconut Committee. At present this forms a sub-centre under the All India Co-ordinated Coconut and Arecanut Improvement Project and is functioning under the control of the Tamil Nadu Agricultural University. Genetic and agronomic trials are in progress at this Centre.

Tamil Nadu Agricultural University, Coimbatore

Research work in coconut has also been initiated at the Tamil Nadu Agricultural University from 1973.

Scheme for the investigation of coconut wilt disease, Muthupet

Originally sanctioned by the erstwhile Indian Central Coconut Committee and State Government, the scheme at Muthupet in the Thanjavur district is now a part of the All India Co-ordinated Coconut and Arecanut Improvement Project run by the Tamil Nadu Agricultural University. Investigations on Thanjavur wilt are in progress at this Centre.

KARNATAKA

Regional Coconut Research Station, Arsikere

The Research Station at Arsikere started in 1958 by the State Department of Agriculture was handed over to the Horticulture Department in 1963 and to the University of Agricultural Sciences, Bangalore, in 1965. The Station started with a germplasm collection mostly from Kasaragod. Thirty five types have so far been collected. T x D, Laccadive Ordinary, Laccadive Dwarf, Gangabondam, Andaman Dwarf, Dwarf Green and Andaman Ordinary are promising types raised for multiplication at this Centre.

ANDRA PRADESH

Regional Coconut Research Station, Ambajipeta

This station at Ambajipeta in the East Godavari district established in 1955 by the State Government, was taken over by the Andhra Pradesh Agricultural University in 1966. Varietal, agrononmic and manurial trials are being conducted at the Station.

Pathology Laboratory, Razole

This centre was started in 1959 for investigations on the diseases of coconut with particular reference to Thatipaka disease.

MAHARASHTRA

Regional Coconut Research Station, Ratnagiri

The Regional Coconut Research Station at Ratnagiri established in 1955 by the Indian Central Coconut Committee is now functioning under the control of Konkan Krishi Vidyapeeth, Dapoli. It is financed by the Indian Council of Agricultural Research under the All India Co-ordinated Coconut and Arecanut Improvement Project.

Among the varieties and hybrids introduced and tried in the Station, Tall x Dwarf Green, Gangabondam, FMS, Philippines and Fiji were superior to West Coast Tall in performance.

An industrialist's view

Shri P T John who represented the industry in the erstwhile Indian Central Coconut Committee and several others has an unstinted interest in plants, both agricultural and ornamental. Even at the present age of 76 he is an active farmer, and it is a really worthwhile experience to go round his farm at Kalamasseri at Cochin where he has one of the finest collections of orchids, spices, mango trees and of course heavily bearing coconut trees.

(Interviewer: K Kunhikrishnan)

Question: What is your impression about the research work done so far on coconut?

Answer: Exceedingly good work has been done at Kasaragod with limited facilities. Eliminating the chances for natural cross pollination, they have been able to produce the hybrids. At Kayangulam very good work has been done on the pest and disease aspects, although even with the best of our efforts the root (wilt) disease continues to be a major problem.

Q: Is there any other reason than the root (wilt) disease for the low yield of coconut palms in Kerala?

A: Our average yields for the whole country are not very impressive. A palm like coconut has to be grown on a large scale, when management becomes easier. Under our conditions we do not have the resources, traditions or facilities for adoption of proper management practices. In Kerala we do not have a plantation of coconut worth the name. In an area where the number should be 100 palms we have a minimum of 150 palms actually. This results in competition among the palms and low yields.

Q: Can you suggest better methods for obtaining higher yields, then?

A: Chances of coconut in Kerala, the land of coconuts, are not bright. Coconut plantations as big as 2–4 hectares will be the ideal solution. This would mean that it essentially is not a small holder's crop. As we have done in the case of rubber, coconut also should be exempted from the purview of land ceiling laws.

Q: How about the prospects of coconut oil?

A: Extraction *cum* expulsion method would be ideal. World situation of edible oils is such that there is always a shortage. We had a bumper crop of groundnut last year, but not enough oil. There should be some methods like an electronic selector for selecting nuts with better oils. The kernel milk on centrifugation gives beautiful oil in a direct process. You feel like eating it. The residue could be used for oil cake.

Q: Is such a method feasible for coconut under our conditions?

A: No. Only if you have large plantations. In France portable units are carried to the plantations for extracting lemongrass oil. Something like that for coconut should be thought of so that no product is wasted. Coconut charcoal for example is better than animal char-

coal and rubberised coconut fibre is very good.

Q: What do you suggest for improving coconut in Kerala?

A: The root (wilt) disease-affected trees should be cut off. It is not late even now. Plant a quality seedling, manure it. It is in your own, your neighbour's and your country's interest.

Q: But all varieties seem to be more or less susceptible to the disease?

A: May be. But something is better than nothing. A well managed tree starts bearing from the 6th or 7th year. Sixty to 70 nuts per tree annually are really good. Otherwise one has to wait for a long time.

Shri John also narrated his efforts for cultivating oil palm in Kerala. According to him Kuttiadi area would be ideal for its cultivation.

Research on coconut soils in Kerala—a resume

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Krishnan Madhusudanan Pandalai, a Fellow of the Royal Institute of Chemists, London, worked in various capacities as Joint Director and Director, Central Coconut Research Station, Kasaragod, and Post graduate Professor and Head of Department of Chemistry, N. S. S. College, Pandalam. He has put in 40 years of research service in various branches of chemistry, was a guest worker at the Rothamasted Experimental Station, Harpenden, Herts, UK and has travelled widely in the United Kingdom, France, West Germany, the Netherlands and Rome. Along with Dr. KPV Menon he is an author of 'Coconut Palm – A monograph".

Coconut soils of Kerala can be broadly categorised into laterite, red, coastal sandy and alluvial soils. The laterite soils are red in colour and of varying depth. They are poor in all plant nutrients particularly calcium and potassium and have low base exchange capacity. The soils are well drained and possess good water holding capacity. The upland laterites are shallow, gravelly and of poor retentive capacity. The lowland laterites have heavy texture and owing to the high content of iron and aluminium the phosphate fixing power is rather high, while the fixation of ammonium ions is generally low. If well manured, this soil offers a very good medium for coconut.

Red soils are derived mainly from granites, gneisses and allied rocks of the micaceous type. The soils are of various shades of red due to the presence of iron oxide in a free state. They are of coarse to fine texture, and are rather poor in organic matter content, plant nutrients, and base exchange capacity.

The coastal sandy soils have very poor water retention capacity. Incorporation of large quantities of organic matter, clay or silt, frequent irrigation and regular fertilisation are measures which help to obtain good yields of coconut on these soils. Alluvial soils of the esturine and back water areas vary in texture from sandy to clayey. Where the clay fraction is high the soils tend to become sticky when wet and hard when dry. The soils have good water holding capacity. The heavy soils are difficult to till and require skill in handling. These soils offer a generally satisfactory medium for excellent coconut growth. By and large, coconut also thrives well on soil types other than those described above *viz.* peaty or *kari* soils, volcanic soils, and marine and coral soils.

Availability of moisture and nutrients and their release

There is ample evidence to show that the soil moisture is a real factor limiting growth and productivity of the palms and they thrive well in places of well distributed rainfall throughout the year. Excess of soil moisture leads to water logging of the soil and stagnant conditions which are detrimental to palm growth. Quite a number of diseases affecting the palms have either entirely or in part some relation to either excessive or inadequate moisture availability. Susceptibility to water logging is dependent upon the nature of the soil type. Clayey soils are prone to suffer from this defect and incorporation of sand and/or organic matter in large quantities could better the condition. Large coconut areas in the country suffer from moisture deficiency. This arises due to poor rainfall in the sense that bulk of the rain is concentrated in a few months of the year and a large portion of the rain received practically runs to waste. The water supply to palms is also conditioned by the evaporation so much so that it is dependent more upon rainfall-evaporation ratio more than the amount of rainfall received. These call for the need of moisture conservation in coconut soils

so as to keep loss due to evaporation to a minimum. Proper cultivation of the soil by operations such as ploughing or digging with spade, or piling of mounds, according to the nature of the soil and the facilities available, mulching of the soils to prevent moisture evaporation *etc.* are helpful steps in this regard. Mulches also help the soil to be more permeable to increased water intake. But when there is moisture stress, serious repercussions can occur due to competition by the cover crops for the available soil moisture. Provision of wind brakes, increasing the moisture holding capacity of loose textured soils by green manuring, addition of esturine silt or clay to loose soils, terracing and bunding in low rainfall areas, giving irrigation facilities *etc.* are employed as means of bettering moisture conservation with success in the different soil groups in the country.

One of the main conclusions arising from the well known NPK experimental trials conducted under the auspices of the Coconut Fertiliser Demonstration Scheme by Messrs Potascheme, Bangalore was that systematic manuring was helpful in inducing quicker bearing and improving the yield of adult bearing palms. There was indication to show that the extent of response varied with soil type, the red loam soils showing high response to both the aspects while sand and sandy loam soils showed only poor response. Reclaimed loams thus showed only a relatively small difference in the percentage of palms that came to bearing but the differences in yield were appreciable. The difference in the laterite soil for the percentage of palms that came into bearing was appreciable while the yield response was little.

Long term effects of soil management and manuring on coconut yield in the permanent observation plots at Kasaragod which are being continued ever since it was started fifty seven years ago in 1919 and carefully followed up every year revealed the following facts: (1) Under the climatic and soil conditions obtaining at Kasaragod regular cultivation and manuring are necessary to step up and maintain coconut yields at a high level, (2) Regular cultivation by itself is highly effective in increasing yields even in the absence of manuring.

Recent studies indicate that once a good soil build up of P has been attained following regular P application, the same may possibly be discontinued for some time, or the recommended annual dose be decreased without adverse effect to the P nutritional needs of the palms. Attempts have been made in recent years to categorise soil groups in coconut growing areas on the basis of the available nutrient status based on the 'ratings' suggested by earlier workers which had been widely adopted. The coconut soils included in this study had a 'medium' rating of available nitrogen, and low to medium rating for available potassium. This condition was characteristic of the coastal sandy and sandy loam groups. Interesting results from Kasaragod and Kayangulam tend to show that (1) different sources of organic matter on seedling growth in a littoral sandy soil, cattle manure was the most effective in increasing seedling girth and height, (2) during the early bearing stages in the talls leaf production was increased with higher nitrogen doses, and the number of functioning leaves with higher potash doses, (3) mixed cropping with cacao increased the yield of coconut markedly (with 58.5 more nuts per palm per year in the plot with a double hedge of cacao). Such a system appeared to favour a high activity of beneficial micro-organisms in the rhizosphere of both coconut and cacao. Dominant among the beneficial micro- organisms were nitrogen fixing and phosphate solubilising organisms. The same type of result was obtained when mixed cropping was done with napier grass. (4) During the dry months from December to April irrigating the palms at 6 cm depth once in 16 days was found to be beneficial in the sandy loam soils, (5) in multidisciplinary investigations on the root (wilt) disease, it was seen that application of an annual dose of 500g of magnesium oxide increased the yield from 49 to 62 nuts per palm, the practice also hastened the initiation of flowering in young palms in the disease-affected area, (6) results of comprehensive analytical assessments of soils and leaf tissues have helped to bring out the differences in nutritional status of soils and leaf in healthy and disease-affected tracts, (7) the evaluation of the foliar composition of a five-year old coconut plantation showed that leaf nitrogen and potassium contents increased significantly from 1.40 and 0.46 per cent of dry matter in the control plots to

1.55 and 0.92 per cent respectively in plots receiving the highest level of fertilisers *viz.* 1.0 kg each of nitrogen and phosphoric acid and 2.0kg of potassium per tree per year. There was no significant increase on leaf phosphorus although available phosphorus in the surface soil of the highest fertiliser treatment increased significantly over that of no fertiliser, (8) results of a three-year period observations at Kasaragod to study the influence of NPK + micronutrients on foliar yellowing revealed that molybdenum, boron, copper and manganese in the order mentioned restored to a large extent the foliar green colour, (9) there was a general increase in foliar N, P_2O_5, and K_2O with increase in yield. No such trend was seen with calcium and magnesium. (10) by careful estimates it was possible to fix fresh values for the annual removal of NPK from the soil. These are 96 kg of N, 48 kg of P_2O_5, 144 kg of K_2O, 87 kg of CaO and 36 kg of MgO per hectare of coconut garden having 173 palms, each tree yielding 40 nuts.

The coir fibre

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Janardhan Venkatesh Bhat, the first Doctorate in Bacteriology in India (1942), took his D.Sc. from Bombay University in 1953. After working as Research Fellow in University of California, he worked as Professor & Head in the Department of Microbiology in St. Xaviers College, Bombay, and as Professor, Fermentation Technology at the Indian Institute of Science, Bangalore for about 20 years. Dr. Bhat was Recipient of Rafi Ahamed Kidwai Award in 1971–72. He is currently working as Emeritus Scientist of ICAR in Kasturba Medical College, Manipal, Karnataka.

Coir fibre is a unique fibre derived from the mesocarp of the fruit of an equally unique tree, the coconut palm. India enjoys a monopoly in the world trade of coir and coir products. The Indian fibre enters the world market as a variety of products including curled coir, yarn, door mats, mattings, carpets and rugs, cordages and ropes, and rubberised coir, and earns for the country well over rupees 150 million. Among the many uses of coir may be mentioned the manufacture of fabricated cement articles, roofing boards, hard boards, and heat insulating materials.

According to the method of extraction and use, coir is categorised into three main classes.The yarn fibre which is the longest and usually obtained from retted green coconut husks is extensively used for spinning and weaving mats and matting, the bristle fibre extracted from ripe and dry husks is used for the manufacture of brushes and brooms, and the mattress fibre extracted from ripe and dry husks is used for filling mattresses and in the upholstry industry.

Production of retted coir from the fermented (retted) coconut husks is scientifically one of the most interesting microbiological processes. It is the retting in water of the husks – both exo - and meso carp - that causes separation of the leathery exocarp from the fibrous mesocarp and the subsequent separation of the individual fibres from the cork-like parenchymatous cells containing the cementing materials dispersed throughout the mass. The nonfibrous material accounts for over 50% of the husks and the remainder constitutes the fibre composed of cellulose, cellulosan, lignin and hemicellulose, polyphenols, pectic substances, and other minor constituents. The separation of the fibre from other constituents by retting is not only economically profitable but it is also the method of choice for quality fibre.

Unlike the retting of flax, jute and other plant straws, which is completed within a few days, retting of husks has to be continued for a considerable length of period varying from five to twelve months. This is because the phenolic substances in the coconut husk have to be leached away before the decomposition of the natural cementing materials, the pectins, sets in.

Microbiological examination of the ret liquor and retted husks reveals the dominant flora of coir rets to be *Escherichia*, *Pseudomonas*, *Micrococcus*, *Bacillus*, *Paracolobactum* and *Alcaligenes*. The subsidiary flora are *Achromobactor*, *Aerobactor* and *Corynebacterium*. These predominant bacteria are capable of attacking pectic substances by virtue of possessing one or the other well-defined enzymes attacking these substances. The yeasts associated are *Saccharomyces fructuum*, *Debaryomyces hansonii*, *D. klockeri*, *Cryptococcus diffluens*, *Rhodotorula glutinis* and *R. flavus*. To a lesser extent *Debaryomyces*

nicotianae, *Hansenual schneggii* and *Candida* species are also encountered.

One of the important processes in the retting of husks is the leaching of polyphenols from the husks into the surrounding steep liquors. Husks of 10–12-month-old nuts are best suited for retting. It is of interest to record that not less than four months are needed to degrade most of the polyphenols and pectins contained in the husks steeped in water, no matter whether the water is free from sodium chloride or is brackish or marine in origin.

Over 300 bacterial cultures have been isolated from the retting medium, many of which are pectinolytic. *Micrococcus varians* and *Debaryomyces hansonii* have been identified among these.

The fact that *Micrococcus* species are involved in the oxidation of phenol as well as pectin confers a uniqueness on coir fermentation in contrast to other retting processes. Added to this, the association of yeasts efficient in decomposing both phenolics and pectins bestows on coir ret a distinction not known in other rets.

Salt (sodium chloride) is not indispensable for retting though it helps in preventing early retting and in leaching phenolics. Periodic flushing of the retting liquor is conducive to the production of good quality fibre. Likewise aeration of the retting environment not only reduces the period of retting, but also helps in yielding superior quality fibre. Partial crushing of husks before steeping hastens the build up of microflora associated with retting and speeds up the process.

The results of research for well over a decade suggest that retting process can thus be controlled to yield better quality fibre. The experience gained in the laboratories leaves no doubt of the success that may be achieved in this natural fermentation for the progress of science, better production of coir and economy of the country.

Coconut with other crops —some success stories

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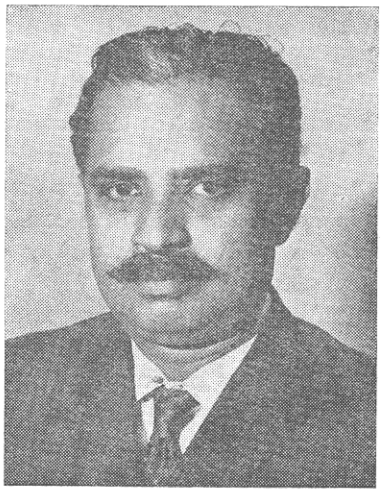


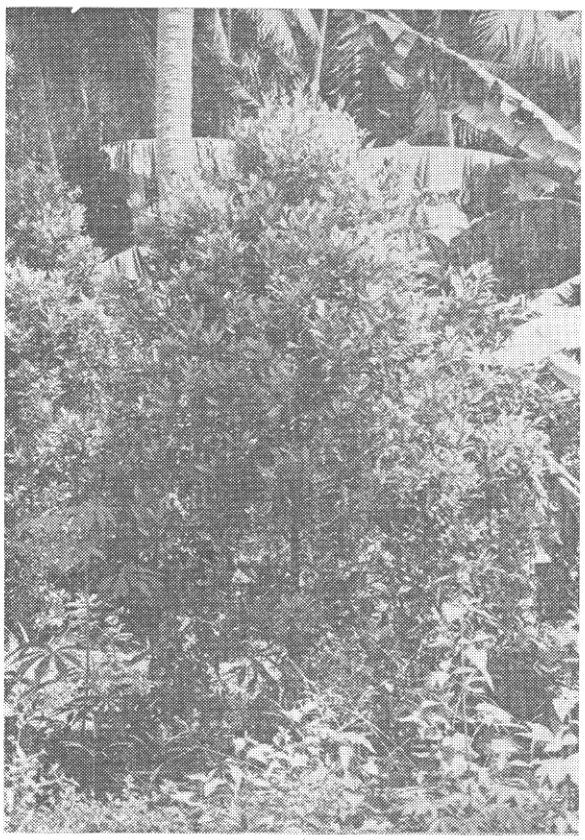
Shri R Hali after graduating from the Agricultural College, Bangalore, in 1956, joined the services of the Rubber Board as Rubber Instructor and subsequently the Department of Agriculture, Kerala. He is now the Principal Information Officer, Farm Information Bureau, Kerala State. He has published hundreds of popular articles on agriculture in leading dailies and weeklies and initiated broadcasting of Farm News in Malayalam over the All India Radio.

No member in the vast plant kingdom is so popular as coconut to the people of Kerala, as the palm has become so close to their life and even a part of it. Not only the people but its languid rivers, alluring back waters, charming blue lagoons and above all the enchanting green paddy fields require the presence of the stately palm close by, to enhance their own beauty and attraction. Homestead whether it belongs to a space scientist or a political commentator of a news paper will have at least two or three coconut palms. The reason is simple; his kitchen will not function with a minimum of one coconut a day. This may be one of the reasons for the heavy demand for coconut seedlings even in the urban areas.

The third decinial world agricultural census report (1971) on Kerala reveals that the number of farm holdings in the state is over twentyfour lakhs owned by about eleven lakhs of farmers. Since then we have given rights on land to seventeen lakhs of tenants and allotted land to over two and a half lakhs of hitherto landless people. The first choice of all these new land owners is undoubtedly a few coconut seedlings. The coconut cultivation thus scattered over the tiny holdings poses a titanic task before the agricultural extension and communication agencies, to make available the modern farming techniques and assist them to practise the results of research in their farms.

Inspiring are the success stories that come out from those farmers who practise what the extension agencies preach and their experience gives a bright hope about the future of coconut culture in this land named after 'the palm'. 'I was getting only one thousand and six hundred nuts from my 106 trees annually in 1962. But within four years I could raise it to 6,000 nuts per year and maintain the yield without any fall till now' claimed Mr. Chakrapani, a hard working farmer hailing from the sandy coastal tracts near Quilon. "Water played the magic" revealing the key that opened the path to prosperity Chakrapani continued, 'I installed a filter point well and a pumpset and gave regular watering to the palms in summer months. Availability of water, that too in plenty, brought many changes in my cropping pattern and farming techniques. I successfully intensified the manuring practices and started growing good fodder grass in the garden which helped me to modernise my cow rearing job by switching over to crossbred ones from the indigenous.' "More good cows brought me more milk. Then I found better fodder and more cows bring plenty of cow dung which enabled me to provide the palms more organic manure." This striking success emerged from the results of studies which proved summer irrigation would give enormous boost to the palm to double or even more, its production. Irrigation facilities extended to the coconut garden also open vast opportunities for multiple cropping or crop mixing in the gardens.

Clove is a money spinning cash crop in Kerala. But growing clove is a difficult job. It requires filtered sunlight, constant care and moist soil during summer. "I have planted cloves in my coconut garden that too badly infected with root (wilt).My clove plants are about four years old and many of them are in flowers" revealed Mr. Mohammed Kunju, a very enterprising farmer of Vithura in Southern Kerala. He has successfully planted more than 100 cloves in an acre of coconut garden after cutting down the badly affected palms. "Believe it or not I am getting more nuts now from these palms, may be due to the special care and management given to the cloves. I am also raising bananas in the garden. From coconuts and bananas alone I am getting over Rs. 6,000/- annually. The cloves have just started to yield and the price of dried clove is over Rs. 300/- per kg now." "Cloves need shade of coconut palm and so I must say, clove if nursed well, will also enhance the production and profit from coconut."



If clove is an aristocrat in the coconut garden, cassava is a poor man's guest there and experience reveals that coconut gardens are ideal for growing cassava too. "But both should be manured well and the tapioca (cassava) should be planted giving a distance 1.5 meters between two plants and soil bunds should be made to check erosion" says Mr. K. Madhavankutty Panicker of Pirappancode — an area famous for cassava cultivation. From an area of half an hectare coconut garden he could get five tonnes of tubers in the first year. During the second year also the yield was the same. In the third year the yield of tuber was over seven tonnes, thanks to the timely rains. Sri Madhavankutty claimed the special care given in the garden by way of digging and manuring, has resulted in the increased yield from coconut palms. The yield was only 2,700 nuts per year three years ago and now it is over 9,500. Thanks to the intercropping techniques evolved by the research for the coconut gardens.

Many crops which were grown only in the open space exposing them to direct sunlight are now finding 'comfortable' occupation under the coconut palms. One among the same is *Amorphophallus*. "The common belief is that *Amorphophallus* will come up well only in open space but I have no land to leave vacant and so growing in it the coconut garden under the shade of the palm is a must for me," says Mr. Sahadevan another small but very enterprising farmer. His claim is that planting of three hundred *Amorphophallus* in sixty cents of coconut garden is a paying proposition. He too is of opinion that the digging of the land and application of manure for raising tuber has helped him to enhance the coconut yield apart from getting a profit of Rs. 500/- yearly by selling *Amorphophallus*.

All these farmers could achieve success by emulating the innovations of research. The experience of successful farmers generates more confidence and courage not only among fellow farmers but extension and research workers too to intensify their efforts. The number of farm holdings in the state is too large that it is a massive task to make bulk of them aware of the innovations and help them copy the techniques in their own farms and gardens. The farmer being a

person with more intimate alround contact with the palm, there are several things for scholars too to learn from him. "I have a coconut palm which produces about twenty four spadices an year and all bear fruits" claimed Mr. Madhavan Nair, near Thazhava in Quilon district. "I had the fortune to plant few seedlings produced by the Department of Agriculture and distributed through the local National Extension Service Block some fifteen years ago" Mr. Nair started to unfold the fascinating story about his 'wonder palm.' 'All the seedlings were planted on the bunds made close by the paddy field. The young palms grew fast and I applied some cattle manure and 2 kg of 8 : 8 : 16 coconut fertiliser mixture every year. It was the local agricultural officer who brought to his special notice about characters of the tree. Before it I was happy about the particular palm as it was giving me more yield. But its characters were studied with interest only from 1974." On the day of our visit we could count 22 open spadices with bunches bearing big nuts to fresh unpollinated buttons. "Last week I had harvested two bunches otherwise you could have seen all of them there" was Mr. Nair's answer to our enquiry.

The nature of bearing of spadices is described by Menon and Pandalai in the 'Coconut palm-a monograph' as follows:

"In a regular bearer, therefore the number of leaves and the number of spadices are almost the same, i.e. 12 per annum for most of the palms. Jack and Sands (1929) have recorded the following intervals between the opening of the successive spadices for dwarf palms having differently coloured petioles. Annually about 17-19 spathes are produced in this type.

Colour of petiole	Interval in days
Yellow	18.5 to 21.1
Red	19.3 to 24.2
Green	18.7 to 23.1

But here is a palm which is producing a spathe every fortnight.

Mr. Nair said that the size of nuts from the palm was medium and from one bunch he gets twenty to twentyfive nuts. The kernel and quality of copra are also claimed to be quite good. A scientific explanation from an exclusive study about this palm is a must because even today unless and until one sees the palm, the story about a coconut tree that gives twentyfour bunches of coconuts an year will be considered fictitious. Sixty years of intensive research about a palm which can live more than hundred years is not a long period. More and more useful items are brought to light every day by the research men for the benefit of the growers. Then why not a study on the peculiar habits of this wonder palm? Coconut today in Kerala is a small holder's pet palm. To him the tree is really a great blessing. So a variety which can give twentyfour bunches of nuts in an year will make the palm the real "Tree of Heaven."

DOUBLE COCONUT

Coco-De-Mer a palm, **Lodoicea maldivica,** generally called Double coconut is a native of the Seychelles Islands. The flowers are borne in enormous fleshy spadices, the male and the female on distinct plants. The fruits, among the largest known, take ten years to ripen; they have a fleshy and fibrous envelope surrounding a hard, nutlike portion that is generally two-lobed, suggesting a double coconut. The nut weighs up to 27 kg and takes about 2–3 years for germination. The tree flowers at the age of thirty years. The contents of the nut are edible.

The empty fruit (after germination of the seed) is found floating in the Indian ocean, and was known long before the palm was discovered.

Maximising the utility of coconut—

INTEGRATED "SOLVOL" PROCESS

T V P Nambiar,
Chemical Construction Company (P) Ltd.,
Madras 400 001

In spite of its great economic value, processing of coconuts has remained more or less static till recent times. The usual age old method of drying coconut kernel into copra for subsequent pressing in expellers to produce coconut oil and oilcake is very wasteful, cumbersome and costly. The old copra process is liable to spoilage, rancidity and microbial infection and it is reported that about 25% of all coconuts produced in the world is wasted or rendered unsuitable for effective utilisation.

The ECAFE Conference held in Manila in 1968 for better utilisation of coconuts recommended as under:

> "The ideal method of obtaining high quality oil and proteins for human consumption from coconuts would be direct processing of the wet meat out of fresh coconuts, without producing dried copra first. In view of the fast growing population in South East Asia and the pre-eminent need for protein rich food in countries such as India, it would be most worthwhile to start such ventures on a large scale".

This is exactly what we are doing by establishing a large scale modern integrated coconut processing complex at Ponnani in Kerala and elsewhere in the coconut growing countries of the world.

By intensive research and extensive pilot plant studies and other observations we have developed and perfected over the last six years, the SOLVOL process for integrated processing of fresh coconuts for large scale production of coconut proteins, coconut flour, coconut honey and coconut oil for edible purposes and by-products like coconut shell carbon, shell chemicals and cooking gas fibre or coir from coconut husk, carbon from coir dust *etc.*

Coconut is Nature's principal storehouse of nutrition. It contains in an abundant measure excellent proteins, carbohydrates, minerals and vitamins, besides plentiful supply of excellent edible oil. In these days of universal shortage of foods, especially good proteins, fats and carbohydrates, this undertaking at Ponnani assumes added significance as it points out a way to overcome the chronic nutritional imbalance and scarcity prevailing in India and other South East Asian and African countries. Moreover, the SOLVOL process for integrated processing of coconuts shows a way for giving a better price for the coconuts to the farmer who has been mercilessly exploited by the middle men and traders from time immemorial.

Solvol Process

The integrated SOLVOL process consists of the following operations:

Soon after harvesting and bringing then to the factory, the coconuts are dehusked and deshelled to recover the inner kernel The outer brown cover on the kernel uup (testa) is carefully removed and the kerne is washed. sterilised and scrapped into a fine mest. The

meal is then carefully squeezed in special continuous presses to bring out the milk. The milk is filtered and spray dried under high vaccum and the resulting coconut oil-cum-proteins are separated from each other by filtration or centrifuging. The proteins are solvent-extracted (using an edible grade solvent) to remove and recover the oil adhering to it. The defatted "coco-proteins" are an excellent material for preparation of baby foods, weaning foods, convalescent food drinks and other preparations.

While splitting the coconuts into halves' the coconut water (endosperm water) is carefully collected. Coconut water contains appreciable quantities of glucose, fructose, levulose, minerals and growth promoting trace elements. Coconut water is filtered and evaporated under carefully controlled vacuum conditions and blended with a little golden syrup to produce "coconut honey" which is an excellent breakfast food, bread spread, soft drinks additive and sweetner.

The fluffy white mass left after squeezing out the milk is carefully dried and solvent extracted (using an edible grade solvent) to remove and recover the residual oil present therein. The extracted meal is thoroughly desolventised, dried, ground, and graded to a fine mesh and marketted for edible purposes. It is an excellent additive to wheat flour, rice flour and corn flour for making bread, biscuits, crispies, cookies and a variety of other food preparations like idli, dosa, vada, upma *etc.*

In case it is preferred to make "high protein coconut flour", the shredded kernel (without squeezing out the milk) is straightaway dried in a continuous counter current drier and the dried meal is solvent-extracted (using an edible grade solvent) to remove and recover all the oil. The extracted full meal is then powdered and graded to a fine mesh and used for, enriching wheat flour, rice flour, corn flour *etc.*, in various kinds of food preparations.

Even the testa removed from the kernel cup is dried and solvent-extracted to recover all the oil and the extracted meal is utilised in animal feed compositions.

Oil

The quality of coconut oil produced by this new SOLVOL process is excellent — very much better than the quality of oil produced by the old copra milling process. There is practically no free fatty acids in the oil. The entire oil present in the coconut kernel is recovered by this new SOLVOL process and no oil is allowed to go waste through the oilcake or residual meal or water emulsions, thus making this process more efficient and more economical than all other known dry or wet processes.

Proteins

Coconut proteins contain a high percentage of lysine, cystine, histidine, arginine, methionine and other important essential amino acids which are highly nutritious and vital for the human body. Presence of a high percentage of easily assimilable invert sugars along with the essential amino acids, makes coconut proteins extremely important and useful as a constituent of baby foods, convalescent food drinks etc. Coconut proteins have been found as good as egg proteins and meat proteins after careful nutritional evaluation.

Coconut honey

Coconut honey is easily assimilable and extremely palatable and contains many growth promoting trace elements, besides glucose, fructose and levulose. It is an excellent breakfast food and bread spread, soft drinks additive and sweetener.

High protein coconut flour

If the shredded kernel is carefully dried in a continuous counter current drier, and then solvent-extracted to remove and recover the oil, what is left over is a snow white meal containing about 25% proteins and about 65% carbohydrates, together with minerals and vitamins *etc.* This high protein coconut flour can very advantageously be used as an additive for enriching wheat flour, rice flour, corn flour *etc.* for preparation of bread, biscuits, cookies, crispies and several other kinds of food preparations. Coconut flour has been evaluated and found as good or even better than wheat flour for food preparations.

When the fresh shredded kernel is carefully pressed in the continuous press to press out the coconut milk, the operation can be so adjusted as to yield a press meal retaining about 12 to 15% proteins. This press meal or

residue can immediately be dried in a continuous counter current drier and solvent-extracted (using an edible grade solvent) to remove and recover all the oil. This solvent-extracted meal is powdered and graded to a fine mesh and can be used as an additive to wheat flour, rice flour, corn-flour *etc.*, in various kinds of food preparations.

A highly efficient sterilising system is built into the plant to ensure complete bacterial purity for all the finished products.

Coconut shell carbon

If coconut shell is subjected to a process of destructive distillation several valuable products can be obtained. Coconut shell carbon, chemicals like acetic acid, grey acetate of lime, phenols, creosote *etc.*, from the pyroligenous liquor and noncondensible gases which can conveniently be used as boiler fuel or compressed in cylinders for use as domestic cooking gas.

Similarly if the coir dust is subjected to destructive distillation, carbon and pyroligenous liquor and fuel gas can be obtained.

Coconut fibre or coir

The coconut husk can be mechanically processed to get good quality coir fibre which has several uses in industry and manufacture of house-hold articles. The SOLVOL process gathers at least 1,00,000 coconuts every day in one plant and it becomes very economical and profitable to process all the by-products under one roof as an integrated industry.

Average minimum yield of products from fresh coconuts

Our extensive investigations have shown that on an average the following minimum yields of high protein coconut flour, coconut honey, coconut oil and by-products such as carbon, fibre, chemicals and cooking gas can be obtained from an average sized Kerala coconut:

	Average yield per nut (g)
High protein coconut flour ..	50
Coconut oil	110
Coconut honey	10
Coir fibre	80
Coconut shell carbon ..	30
Coir dust carbon	30
Pyrolygenous liquor from shell and coir dust	30
Cooking gas from one coconut shell and coir dust ..	30

An average sized fully matured Kerala coconut (with husk, shell, kernel and water) weighs approximately 1.1 kg In other countries like Philippines, Indonesia, Malaysia and Sri Lanka average sized coconuts are bigger, better and heavier than those of Kerala.

Working economics & profits

A 1,00,000 nuts/day integrated SOLVOL coconut processing plant would register the following approximate working economics:..

Debit

	Rupees
Cost of 1,00,000 Coconuts @ 80 paise each	80,000
Add all inclusive processing expenditure for processing 1,00,000 nuts (details worked out below)	32,000
	1,12,000

Credit

Sale value of 5,000 kg. of high protein coconut flour @ Rs. 8/kg ..	40,000
Sale value of 1,000 kg of coconut honey @ Rs. 15.00 per kg	15,000
Sale value of 11,000 kg of excellent coconut oil @ Rs. 9.00/kg ..	99,000
Sale value of 3,000 kg of by-product coconut shell carbon Rs. 500/ton	1,500
Sale value of 3,000 kg of coir dust carbon @ Rs. 400/ton	1,200
Sale value of 3,000 kg of by-product pyrolygenous liquor and chemicals recovered by destructive distillation of coconut shell @ Rs. 1000/ton	3,000
Sale value of 8,000 kg of fibre @ Re. 1 per kg	8,000
Sale value of 3,000 kg of cooking gas @ Rs. 500/ton	1,500
Sale value of 500 kg of feed stock from testa	250
	1,69,450
Margin of profit per day	57,450

The Plant can work for at least 250 full working days in a year and earn a gross profit of over Rs. 14 million per annum, which works out at over 55% annual returns on the total investments of Rs. 25 million.

Investments

	Rupees
Land: 5 to 6 Acres	100,000
Water Supply: 25,000 glns/day	100,000
Boiler & accessories	500,000
Electric Power Supply: 500 KVA with Stand-by Generator Set. ..	600,000
Cost of Plant Machinery	15,000,000
Technical Consultation	1,500,000
Transportation, Erection & Installation	1,200,000
Civil works	3,000,000
Pre-Operational & Promotional expenses	500,000
Total —	22,500,000
Working capital	2,500,000
GRAND TOTAL	**25,000,000**

Processing cost

Approximate all inclusive processing cost for operating a 100,000 nuts/day SOLVOL coconut processing plant is as under:

Electricity	**Rs. per day**
400 units per hour @ 15 paise per unit for 24 hrs	1,440
As fuel gas is free from the coconut shell destructive distillation plant, the fuel cost is taken only @ Rs. 50 per ton for 2 Tons of steam per hr. for 24 hrs.	2,400
Coal for destructive distillation 5 tons	1,500
Water — 25,000 glns. per day (including softening)	200
Labour — 500 workmen @ Rs. 8 per day	4,000
Solvent extraction charges (all inclusive)	2,000

Staff	(Operational)	Salary per month
One	— Works Manager	3,000
One	— Chief Engineer	2,000
Three	— Shift Engineers	2,400
One	— Chief Chemist	2,000
Three	— Shift Chemists	2,400
Three	— Shift Supervisors	1,800
Six	— Operators	3,000
Three	— Store Keepers	1,500
Three	— Lab. Chemists	1,500
Three	— Peons	600
Three	— Sweepers	600
Three	— Truck Drivers	900
Twelve	— Watch & Ward	2,400
		24,100
		i.e., Rs. 964/day

STAFF	(Managerial)	
One	— General Manager	3,000
One	— Purchase Manager	1,500
One	— Sales Manager	1,500
Six	— Asst. Manager	4,800
One	— Chief Accounts Officer	1,500
Four	— Accounts Assistants	2,000
Six	— Clerks	3,000
Six	— Typists	3,000
Three	— Peons	600
		20,900
		ie., Rs. 834/day

		Rs. per day
Telephones, Telegrams, Telex, Stationery *etc.*		1,000
Canteen		500
Labour Welfare		500
Travelling & Incidentals		1,000
Transportation & Handling of coconuts		2,500
Packing & Forwarding charges for finished products		3,000
Depreciation of Machinery & Fixtures worth Rs. 225 Lakhs	10%	7,500
Interest . . 15% on Rs. 25 lakhs Working Capital		1,250
Insurance . . 1/2% on Rs. 225 lakhs		375
Miscellaneous & Sundries		1,000
All inclusive processing expenditure for 1,00,000 coconuts		31,963
		OR 32,000
or for 1,000 coconuts		320
or for one coconut		0.32

Role of India in the international trade in coir

John Chandy, Deputy Director, Coir Board, Cochin 682016

Among the industrial hard fibres 'coir' has a prominent position. It is the fibre extracted from coconut husks, the fibrous material surrounding the shell of coconuts. Coconut palm is cultivated extensively in the tropics, particularly in southern Asia, Oceania and East Africa. About 29,000 million nuts are produced throughout the world per annum. But only India and Sri Lanka are the two main countries which utilise coconut husks for production of coir on a commercial basis. The Philippines, the world's largest producer of coconuts, has only a small coir industry which caters mainly to domestic requirements. Small quantities of coir are produced in Tanzania, Bangladesh, Burma, Kenya, Malaysia, Mozambique and Seychelles. But when compared with the extent of availability of the raw material their production of coir is negligible. Total world production of coir fibre is estimated to be 2,82,000 tonnes, half of which is produced in India. Sri Lanka's production is estimated to be 1,13,000 tonnes. The break up of the world output of coir is given in Table 1.

TABLE 1
World Production of Coir

Country	Production (tonnes)
India	1,40,000
Sri Lanka	1,13,180
Tanzania	8,500
Bangladesh	5,800
Thailand	3,000
The Philippines	2,500
Burma	2,170
Kenya	2,000
Seychelles	1,900
Malaysia	1,500
Mozambique	1,000
Morocco	500
	2,82,050

Coir fibre is extracted either by retting the green husks steeped under water for long periods, and beating them to separate the fibrous material, or from dry husks by mechanical decortication. The techniques employed for extraction of fibre in India and Sir Lanka differ. While Sri Lanka's production is from dry husks, in India the bulk of the coir fibre is produced from green husks by natural retting. For spinning into yarn and for weaving into floor coverings, fibre obtained from retted husks which is known as 'white fibre, is more suitable. Brown fibre produced by mechanical decortication is mostly used for upholstry, brush making, making rubberised coir etc. While India has a virtual monopoly in the production of 'white fibre' Sri Lanka holds the unique position as the major producer of brown fibre in the world. India has started production of brown fibre only very

recently. The States of Karnataka and Tamil Nadu have made some headway in this regard.

Coir fibre is further processed into coir yarn and other finished products. In the absence of advanced technology, further processing of fibre is carried out only on a limited scale in coir producing countries, other than India. Their production is mostly intended for domestic consumption or for export as such to developed countries for further processing. But India has developed technology for spinning of coir fibre into yarn, weaving of floor coverings, such as coir mats, mattings, rugs, carpets and for rope making. India holds a virtual monopoly in the production of coir yarn. Yarn is spun either by hand or using ratts. Out of 1,40,000 tonnes of coir fibre produced in India annually, nearly 1,30,000 tonnes are converted into yarn. The production of yarn is estimated to be 1,24,500 tonnes a year. India has an established handloom industry for manufacturing coir mats, mattings, rugs and carpets. The production of these floor coverings is just over 27,000 tonnes a year. The production figures of coir and coir goods are given in Table 2.

TABLE 2

Production of coir and coir goods in India

Commodity	Quantity (Tonnes)
Coir Fibre	
Mat fibre	1,36,200
Bristle fibre	800
Mattress fibre ..	3,000
Total	1,40,000
Coir yarn	1,24,500
Coir products	27,100
Coir rope	13,000
Curled coir	2,200
Rubberised coir goods ..	800

Coir industry in India is export-oriented. Indian coir enters the world market in the form of raw coir fibre, spun coir yarn and as woven coir products, and finds markets in more than hundred countries in the world. This accounts for more than half the world trade in coir. India's exports over the last five years could be seen from Table 3.

TABLE 3

Composition of coir exports from India

Commodity	1971—1972		1972—1973		1973—1974		1974—1975		1975—1976	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Coir Fibre	392	6.25	298	4.62	276	3.77	161	3.05	266	6.94
Coir Yarn	30,642	722.42	31,924	818.58	29,373	822.01	24,401	826.71	22,970	1,002.19
Coir Mats	13,498	507.50	12,742	526.60	12,302	573.28	11,322	646.53	7,488	562.48
Coir mattings, Rugs & Carpets	7,101	240.40	3,648	132.53	3,457	140.40	5,049	263.29	5,275	337.11
Coir Rope	238	3.85	104	1.64	140	2.84	138	3.47	270	6.70
Curled Coir	441	5.52	773	9.81	1,208	15.49	762	10.40	1,014	19.52
Rubberised Coir goods	—*	—	—	0.01	3	0.39	1	0.17	1	0.26
Total:	**52,312**	**1,485.94**	**49,489**	**1,493.79**	**46,759**	**1,558.18**	**41,834**	**1,753.62**	**37,284**	**1,935.20**

Quantity in quintals Value in lakhs of rupees

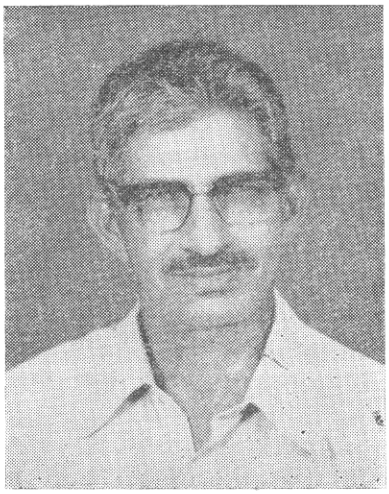
India exports only a small quantity of coir fibre; the export during 1975–76 was 266 tonnes which formed only 0.7% of her total exports of coir. But the yarn exported from India forms 98% of the yarn entering the world market. The export of this item from India during the year 1975–76 was 22,970 tonnes which accounted for 62% of her total exports of coir. Finished products of coir exported are coir mats, mattings, rugs, and carpets. Since the developed countries, particularly the West European countries, have a well developed coir floor coverings manufacturing industry, even though India is the only supplier of these products among the coir fibre producing countries, her share in the world trade has been dwindling in recent years. On an average 16,000 tonnes of these items are exported every year. The export during 1975–76 stood at 12,764 tonnes which accounted for 34% of her total coir exports. Another item of coir exported from India is coir rope. The export of this item was 270 tonnes during 1975–76. India has started production of brown fibre only in recent years, as stated elsewhere and she has started to export small quantities of curled coir and rubberised coir products in the recent past. Her export of curled coir was 1,014 tonnes in '75–76.

India's exports of coir are directed to almost all regions, but the major consumer of this item is West Europe whose share is more than 60%. The American countries come next in order and then the East European countries.

Export of coir from India has been steadily declining since 1960. Coir yarns exported from here to developed countries are mostly used for manufacturing floor coverings, and the products made by them compete with our products made on traditional handlooms. The West Europe had developed a well organised coir industry producing a wide variety of superior quality coir products. In recent years they are switching over to the manufacture of floor coverings of other materials. This is an opportunity for stepping up our export of coir products. In Europe there is good prospects for rubber or PVC backed floor coverings. We have to develop advanced techniques for production of such products. Indigenous skill and imported technology should be used advantageously to exploit the present situation. Technical collaboration between the European and Indian manufactures is the only answer to maintain our traditional market for coir and to improve the exports. In view of the high labour cost in West Europe there is a tendency to close coir factories. The manufacturers of coir products in those countries are now favourably inclined to transfer the advantage of the opportunity to modernise the Indian coir industry and we can hope for a bright future for the coir industry.

CPCRI and the small farmers of Kudlu

CH Abdulla
President, Kudlu Service Co-operative Sociey, Kasaragod



In the early days when the Madras Government established a Coconut Farm of about 30 acres at Kasaragod the coconut cultivators were not even aware of the importance of ploughing and manuring their coconut gardens. Many farmers did not care to grow coconut because they did not find it more remunerative than short term crops.

The scientists of the Coconut Farm started out by demonstrating the importance of ploughing and proper manuring. They even lent bullocks on hire for ploughing the neighbouring farms. They kept a portion of the farm for demonstration, dividing it into three blocks: one was properly cultivated and manured, the second was ploughed but not manured, and the third was neither ploughed nor manured. The plots are still maintained at the Institute and any old timer who sees these plots is reminded of the efforts of the early scientists to convince local farmers of the benefits of proper manuring and ploughing of coconut gardens. The differences in the yields of the coconut trees in the three blocks were remarkable. The ordinary farmers paid no heed in the beginning but in the long run they were convinced of the results of proper care and management of coconut palms.

The introduction of high yielding varieties of coconut from various parts of the world attracted the attention of coconut farmers at Kasaragod and many of them were anxious to grow these new varieties in their gardens. The most attractive among them was the spikeless variety which was not common anywhere outside the Farm.

Times have changed and the farmers are no longer disinterested observers. Now requests from villagers come in thousands for coconut seedlings raised at the Central Plantation Crops Research Institute. The early bearing and high yielding hybrids like T x D and T x G are very popular.

Irrigation and intercropping introduced in the recent past at the Institute are being gradually adopted in the neighbourhood and the results are encouraging. Removal of nonbearing trees was a practice opposed by the farmers in olden days, but the CPCRI showed them how the new plantation can thrive well after the removal of nonbearing old trees.

During the days of the old State Farm, many of the villagers in the adjacent area had to abandon their homes and land – my family was one among them – when the area of the farm was to be extended, but many considered it a blessing in disguise when they got employment at the Institute.

There is an old saying, the banana fibre is sold by the fragrance of the flowers it ties together; the village of Kudlu will continue to prosper day by day as the Institute grows.

ACHARYA PK
5 June 1940
.....
Horticulture
Junior Agronomist
Coconut Research Station
[All India Co-ordinated Coconut & Arecanut Improvement Project]-
Konark 752 111, Orissa

Currently associated with coconut manurial trials under the co-ordinated project.

AHAMED BAVAPPA KV
12 January 1930
Ph. D.
Genetics & Plant Breeding
Director
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Reorganised the research programmes on coconut with thrust on germplasm collection, hybrid vigour exploitation and intensive cropping programmes for higher productivity from plantations. Intensified research on root (wilt) disease; established a hybrid seed garden; studied the F_1 hybrids of Tall and Dwarf and its bearing on the genetics of dwarfness. Author/co-author of 16 publications on coconut.

AIYADURAI SG

ANANDAN AP
24 February 1905
B. A.
Coconut Breeding
Retired Scientist
Sachidanandam
Nileshwar 670 314, Kerala

Associated with coconut research for a period of over 25 years. Major contributions include fixing criteria for selection of ideal parent trees for hybridisation, with special reference to $T \times D$ hybrid production and raising second generation of selfed progenies and their evaluation. Author of four publications.

ANTONY DAVIS T
9 February 1923
Ph. D.
Biology
Professor and Head
Crop Science Department
Indian Statistical Institute
203 Barrackpore Trunk Road
Calcutta 700 035, West Bengal

Associated with coconut research for a period of over 28 years. Contributions in the fields of physiology, biometrics and population genetics of coconut. Published over 150 scientific papers.

ANTONY J
27 July 1921
M. Sc.
Entomology
Junior Parasitologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Responsible for setting up the entomology laboratory at Central Plantation Crops Research Institute, Regional Station, Kayangulam. Contributions include the study of pests of coconut and their control. Published 30 scientific papers.

ANTONY KJ
30 August 1937
M. Sc. (Botany)
Plant Pathology
Junior Plant Protection Officer
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Setting up of demonstration plots; raising coconut nursery; training of extension and research workers; fertiliser trials, operational research project *etc.*

ARAVIND S SUMMANWAR
10 January 1937
Ph. D. (U.S.A.)
Fungal Pathology/Virology
Virus Pathologist
Division of Mycology & Plant Pathology
Indian Agricultural Research Institute
New Delhi 110 012

Established the association of the virus in the etiology of coconut root (wilt) disease; through serological reactions identified the virus as a strain of Tobacco Mosaic Virus. Author of seven scientific papers on coconut root (wilt) disease.

BALAKRISHNAN TK
30 July 1926
B. Sc. (Botany)
Meteorology
Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Collection and compilation of meteorological data at CPCRI. Author of one publication.

BANERJEE SIBSANKAR
1 February 1929
Assoc. IARI
Agronomy
Dy. Director of Agriculture
Directorate of Agriculture
Writer's Building
Calcutta 700 001, West Bengal

Recommendations on plant protection measures, use of balanced fertilisers and adoption of other improved cultural practices. Published several popular articles on coconut.

BHASKARAN UP
1 June 1934
Ph. D.
Agronomy
Irrigation Agronomist
Agronomic Research Station
Kerala Agricultural University
Chalakudy 680 307, Kerala

Conducted research on coconut in the fields of crop nutrition, fertiliser management, irrigation, intercropping and crop improvement through hybridisation. Published 10 scientific and popular articles.

BHAT JV
2 March 1913
Ph. D., D. Sc.
Microbiology
Emeritus Scientist
Kasturba Medical College, Manipal 576 119
Karnataka State

For over a decade worked on all aspects of coir retting with special reference to micro-organisms involved and the biochemistry of the process. Contributed valuable information on the factors influencing the retting process including degradation of pectic substances and polyphenols. Published over a dozen scientific articles.

CHACKO MATHEW
13 April 1934
M. Sc. (Botany)
Plant Physiology
Assistant Plant Physiologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with research on the physiology of coconut palm for the past 18 years. Worked on production physiology especially on the photosynthetic efficiency in relation to yield and chlorophyll content. Author/co-author of 13 scientific publications.

CHANDY KURIAN
24 February 1925
Ph. D.
Entomology
Entomologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Developed through laboratory and field experiments, mechanical, chemical and biological methods of control for combating pests of coconut. Piloted a PL 480 project on "Methods of control of coconut rhinoceros beetle". Identified two new pests of coconut in India. Author/co-author of 80 scientific publications and 60 popular articles.

CHATTERJEE SIBDAS
16 June 1934
B. Sc. (Ag.)
Soil Conservation/Seed Testing
Coconut Development Officer
Government Coconut Nursery
Chandernagore P. O., West Bengal

Associated with coconut developmental schemes and hybrid seednut production in West Bengal.

DAS CC
5 July 1925
B. Sc. (Ag.)
.....
Deputy Director of Agriculture (Millet)
Department of Agriculture
Bhubaneswar 751 003, Orissa

Organised coconut nurseries in various parts of Orissa.

DAS RC
8 October 1925
Ph. D. (U. S. A.)
Horticulture
Professor and Head
Department of Horticulture
Orissa University of Agriculture & Technology
Bhubaneswar 751 003, Orissa

Associated with teaching post-graduate course on plantation crops including coconut and research on nutritional aspects of coconut.

DEBABRATA PAUL
2 November 1947
B.E., A.M.I.E.
Mechanical Engineering
Junior Scientist (Engg.)
Jute Technological Research Laboratories
12 Regent Park, Calcutta 700 040, West Bengal

Utilisation of coconut products.

DHARMARAJU EDWIN
2 May 1925
Ph. D.
Entomology/Biological control
Crop Protection Expert
South Pacific Regional College of
Tropical Agriculture
Apia, Western Samoa, *via* Australia

Started the first Biological Control Stations in Andhra Pradesh and Sri Lanka; perfected the techniques for the mass multiplication of parasites of the coconut caterpillar *Nephantis serinopa* under laboratory conditions. Author of one book, 12 scientific and six popular articles.

DWIVEDI RS
15 July 1944
Ph. D.
Plant Physiology
Plant Physiologist (Radiotracer)
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Devising a portable coconut tree climbing instrument. Developed a rapid tissue test for identification of root (wilt) disease.

EASWARIAMMA CS (Female)
19 March 1944
M. Sc. (Ag.)
Cytogenetics and Plant Breeding/Plant Pathology
Research Assistant
Central Tuber Crops Research Institute
Trivandrum 695 017, Kerala

Associated with studies on the diagnosis of root (wilt) disease of coconut, isolation, identification and pathogenicity trials on fungi causing leaf rot and stem bleeding diseases.

ELIZABETH GEORGE (Female)

GEORGE MV
30 November 1937
M. Sc.
Agricultural Statistics
Junior Statistician
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Conducted comprehensive survey of coconut root (wilt) disease by adopting a multistage cluster sampling; estimated the intensity of disease and loss in yield and evolved a method of indexing the intensity of disease. Developed a technique for estimation of field population of lacebug. Author/co-author of six publications.

GEORGE TG
24 July 1942
M. Sc. (Ag.)
Agricultural Extension
Assistant Agronomist (Production)
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted field trials on the control of rhinoceros beetle in different climatic zones. Associated with the Operational Research Project in root (wilt) affected area.

GOVINDANKUTTY MP
27 December 1945
Ph. D.
Histopathology/Tissue culture
Assistant Anatomist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Comparative anatomy of healthy and root (wilt) disease affected coconut palms; histological and histochemical alterations in the palm due to micro-organisms *etc.*

GOWDA P MUDDAPPA
13 August 1929
Ph. D. (U.S.A.)
Agronomy/Physiology
Horticulturist (Olericulture)
University of Agricultural Sciences
Bangalore 560024, Karnataka

Associated with research and extension work pertaining to coconut.

HARIDASAN M
18 September 1945
Ph. D.
Soil Physics
Junior Scientist (Soils)
Central Plantation Crops Research Institute
Kasaragod 670 124 Kerala

Mineral nutrition of coconut; soil testing and plant analysis of coconut.

INDIRA P (Female)
10 April 1939
M. Sc. (Botany)
Physiology
Scientist - S
Central Tuber Crops Research Institute
Trivandrum 695 017, Kerala

Pollen germination, physiological causes of root (wilt) disease and nutritional exhaust studies in coconut. Author of two scientific publications.

JACOB MATHEW
7 June 1941
M. Sc.
Agricultural Statistics
Junior Statistician
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Worked out heritability, general and specific combining abilities for yield and yield components with special reference to mother palm selection; genotypic and phenotypic correlations to work out selection standards. Seasonal abundance and pattern of distribution of *S. typicus* in coconut gardens have been worked out. Author/co-author of 15 scientific papers, 2 survey reports and one popular article.

JAYASANKAR NP
8 April 1937
Ph. D.
Microbiology
Plant Pathologist (Microbiology)
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Major contributions include systematic investigations on the microflora associated with retting of coconut husk and microbiological changes in the constituents of husk. Studied the association of bacteria in relation to coconut root (wilt) disease and alteration in the phenolic metabolism subsequent to pathogenesis; coconut root surface microflora and their activity in relation to inter and mixed cropping. Author/co-author of 27 scientific publications.

JOHN CM
8 June 1896
B. A. (Biology)
Agronomy/Plant Breeding and Genetics
Retired Scientist/Director (Honorary)
Central Agricultural Training & Service Institute
Vidyanagar, Kottayam 686 018, Kerala.

As the first Director of Central Coconut Research Stations, was responsible for planning and organising coconut research in India and was associated with coconut research for a period of 29 years. Contributions include coconut breeding programmes, building up of germplam collection, long range agronomic experiments and mixed cropping trials *etc.* Published over 21 original scientific publications.

JOSEPH K V
20 October 1938
M. Sc.
Biochemistry
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Established that the incidence of root (wilt) disease was associated with a fall in concentration of total phenol and increase in levels of polyphenol oxidase and peroxidase. Published four scientific papers.

JOSEPH PM
3 March 1925
B. Sc. (Ag.)
Extension
Joint Director of Agriculture
Department of Agriculture
Alleppey 685 001, Kerala

JOSY JOSEPH
14 November 1931
Ph. D.
Genetics & Plant Breeding
Junior Breeder
Central Plantation Crops Research Institute
Research Centre, Palode,
Pacha 695 562, Kerala

Cytogenetic studies; F_1 and F_2 seedling evaluation of T x D hybrids.

KAMALA DEVI CB (Female)
1 January 1938
M. Sc. (Ag.)
Soil Science/Agricultural Chemistry
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research work for the past 13 years. Contributed in the fields of micronutrient status of coconut palm with special reference to root (wilt) disease, incidence of rubbery kernel and NPK fertiliser experiments. Author/co-author of 9 scientific publications.

KAMALAKSHYAMMA P G (Female)
2 June 1944
M. Sc.
Chemistry
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Nutritional requirements of Dx Tcoconut palms through fertiliser trials; effect of mixed farming in coconut gardens on the nutritional status of soil and yield of palms *etc.* and published one scientific paper.

KAMBLE L MAHADU
2 March 1952
M. Sc. (Ag.)
Genetics & Plant Breeding
Senior Research Assistant
Central Plantation Crops Research Institute
Research Centre
Port Blair 744 303, Andaman

Coconut breeding. Study of nut characters of palms in the Andaman and Nicobar islands.

KANNAN K
3 June 1929
M. Sc. (Horticulture)
Horticulture/Agronomy
Horticulturist
Banana and Pineapple Research Station
Kannara 680 652, Kerala.

Evaluation of varieties and hybrids for large scale planting. Intercropping trials with annual and perennial crops in coconut gardens. Published six papers.

KASTURI BAI KV (Female)
30 March 1948
M. Sc.
Plant Physiology
Scientist S
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Production physiology in coconut.

KIKANI KP
9 February 1942
B. Sc. (Ag.)
Coconut Agronomy
Junior Agronomist
I/c. Research Officer,
Plantation Crops Research Station,
Mahuva 364 290, Gujarat

NPK fertiliser trials; evaluation of different cultivars and hybrids, response to cultural practices etc., published two scientific papers.

KOSHY PK
1 March 1942
Ph. D.
Plant Pathology/Nematology
Nematologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Established a Nematology Laboratory at Central Plantation Crops Research Institute, Regional Station, Kayangulam. Identified 23 genera of plant parasitic nematodes associated with coconut. Proved the pathogenicity of *Radopholus similis* on coconut. Author of four scientific papers.

KOYAMU K
15 July 1924
M.Sc.
Agronomy/Soil Science
Joint Director
Department of Agriculture
Calicut, 673 004, Kerala

Reported the possibility of retovering vigorous natural hybrid seedlings in the dwarf orange selfed progenies for the first time. Other contributions include study on dwarf coconuts, agronomic approach for increasing coconut yield *etc.* Author co-author of three publications.

KRISHNAKUMARI N (Female)

KRISHNAMURTHY C
18th May 1913
M. Sc. (Ag.)
Biological control of crop pests
Retired Scientist
Retired Principal, S. V. Agricultural College
K.T. Road, Tirupathi 517 501, Andhra Pradesh

Was in charge of production and distribution of all the parasites of *Nephantis* sp. from Biological Control Stations at Razole and Ambajipeta. Six research papers and two papers in extension.

KUNHIRAMAN CA
9 December 1919
S. S. L. C.
Farm Management
Farm Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for a period of over 30 years. Was mainly responsible for selecting quality seednuts and supplying to various coconut growing states in India. Actively associated with farm management and published four scientific papers.

KURIAN N JOHN
23 November 1937
M. Sc. (Ag.)
Mycology & Plant Pathology
Senior Technical Assistant
Directorate of Coconut Development
Government of India
Cochin 682 011, Kerala

Studies on coconut diseases with special reference to leaf rot and root (wilt). Associated with the publication of Coconut Bulletin as a member of its Editorial Board. Published number of popular articles on coconut cultivation.

LAKSHMANACHAR MS
10 January 1933
M. Sc.
Statistics
Assistant Director
(Marketing, Economics, Research & Statistics)
Directorate of Arecanut & Spices Development
Government of India
Calicut 673 005 Kerala

Contributed in the field of planning statistical design for field experiments and analysis of data. Author/co-author of over 19 scientific publications.

LAL SB

LAXMINARAYAN C
24 December 1924
Associate IARI
Plant Pathology
Plant Pathologist
Maize Research Station
Amberpet 500 013, Hyderabad

Established the pathology laboratory for the study of Thatipaka disease in Razole, Andhra Pradesh. Co-author of two scientific publications.

LEELA C (Female)
16 May 1938
M. Sc. (Ag.)
Soil Science & Agricultural Chemistry
Assistant Professor
College of Horticulture
Kerala Agricultural University
Mannuthy 680 651, Kerala

Crop nutrition, fertiliser management, production of hybrids and their evaluation *etc.* Published four scientific papers.

LILY VG (Female)
2 April 1929
M. Sc.
Mycology/Plant Pathology
Assistant Plant Pathologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted studies on fungi parasitic on coconut palm; role of fungi in transmission of root (wilt) disease, detection of vesicular arbuscular mycorrhiza *etc.* Reported for the first time incidence of fungus *Gongronella butleri* in coconut. Published 10 scientific and three popular articles.

MANORAYAN GHOSE
14 July 1947
M. Sc. (Ag.)
Anatomy
Senior Technical Assistant
Crop Science Department,
Indian Statistical Institute,
203 Barrackpore Trunk Road,
Calcutta 700 035.

Contributed in the field of anatomy of palms including coconut. Author/co-author of two scientific publications.

MARIAMMA DANIEL (Female)
4 April 1947
M. Sc.
Entomology
Research Assistant
Central Plantation Crops Research Institute
Regional Station,
Vittal 574 243, Karnataka

Field introduction and colonisation of *Platymeris laevicollis* Dist. a predatory bug on the rhinoceros beetle, *Oryctes rhinoceros.*

MARKOSE VT
23 May 1941
M. Sc. (Ag.)
Agronomy
Deputy Director
Directorate of coconut Development
Government of India Cochin 682011, Kerala

Associated with the planning and conducting experiments on coconut nutrition, spacing and intercropping. Currently engaged in formulating the coconut development schemes in the country. Published five scientific and three popular articles.

MATHEN K
29 March 1930
M. Sc. (Zoology)
Entomology
Junior Virus Entomologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

WHO IS WHO IN COCONUT RESEARCH EXTENSION

1. *Name*
2. *Date of Birth*
3. *Academic qualification*
4. *Field of specialization*
5. *Present employment*
6. *Present address*
7. *Contribution to field of specialization*

This 'Who is Who' is a compilation of biodata of Research/ Extension Workers of coconut in India. The proforma we formulated was widely circulated among the present and retired coconut workers and the information gathered presented in the above format. In spite of our best of efforts we could not furnish the details for a few scientists and any such omission may please be considered unintentional. We take this opportunity to thank all those institutes, universities, departments, *etc.*, who whole-heartedly co-operated with us by widely circulating the proforma and for getting biodata of various persons. Thanks are also due to all our friends and colleagues who co-operated with us in bringing this out.

MK Muliyar
EVV Bhaskara Rao
PM Zubaida

Abdulla Koya KM
1 July 1944
M. Sc. (Ag.)
Agricultural Entomology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted laboratory and field trials on the control of red palm weevil and rhinoceros beetle. Published three scientific and two popular articles.

Abdul Wahid P
10 June 1946
M. Sc. (Ag.)
Agricultural Chemistry
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Research Scholar
Central Rice Research Institute
Cuttack 753 006, Orissa

Proposed a concept of 'satisfactory level' for monitoring the deficiency of *Ca*, *Mg* and *Na* through leaf analysis. Suggested the possibility of skipping *P* application without affecting the nutrition; established that root *CEC* is implicated in the cation nutrition of coconut. Author of 8 scientific publications.

Abraham VA
29 May 1940
M. Sc. (Ag.)
Agricultural Entomology/Zoology
Assistant Toxicologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Evolved methods to prevent red palm weevil entry into coconut palm through wounds and cut ends of leaf petioles. Studied the biology of *Suastus gremius*, *Gangara thyrsis* and *Paradasynus* sp. Recorded new pests like *Paradasynus* and *Myllocerus* on coconut. Author/co-author of 22 articles.

Associated with coconut research for the past 18 years. Major fields of contribution are on pests of coconut, and their control,nematode association, mechanism of transmission of root (wilt) disease *etc.* Author of over 30 scientific papers and 20 popular articles.

MATHEW AS
26 May 1934
M. Sc.
Soil Chemistry
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted surveys in healthy and root (wilt)-affected areas in Kerala and stem bleeding-affected tracts in various parts of India for collection of soil and tissue samples for determination of their macro and micro nutrient status. Author of four publications.

MATHEW GEORGE
31 January 1949
M. Sc.
Microbiology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Studied the association of *Enterobacter cloacae* with the root (wilt) disease of coconut. Author/co-author of two scientific publications.

MENON KPV
20 March 1904
Ph. D.
Plant Pathology
Retired Scientist
38/376 Edakkad P. O.
Calicut, Kerala

Senior author of the 'Coconut Palm — A Monograph'. Responsible for establishing Philippines Coconut Research Institute (Philcorin). As Joint Director and later as Director of Central Coconut Research Station, Kayangulam, led a team of scientists working on various diseases of coconut. Published over 60 articles.

MENON K SETHUMADHAVA
8 November 1928
M. Sc. (Ag.)
Agronomy/Extension
Extension Agronomist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with coconut development activities for 15 years in Lakshadweep conducted trials on intercropping with annuals and perennials in coconut gardens. Invented a simple process for deodorising and preserving coconut toddy. Published seven scientific articles and 14 popular articles.

MENON SREECANDATH RAMAN KUTTY
4 May 1911
M. A.
Chemistry/Coconut Technology
Retired Scientist
"Neelakanta Bhavan"
Peruvaram Road
N. Parur 683 513, Kerala

Production of pulp and paper board from dry coconut husk; industrial utilization of fallen immature nuts; chemistry of coconut fibre. Author/co-author of six publications.

MICHAEL KJ
15 January 1933
M. Sc.
Plant Physiology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Investigations on the root system of coconut palm affected by root (wilt) disease. Physiological derangement of respiratory metabolism. Author/co-author of five publications.

MODI BIPINCHANDRA V
10 October 1931
B. Sc. (Ag.)
Extension
Coconut Development Officer
Office of Coconut Development Officer
Mahuva 364 290, Gujarat

Associated with development and extension of coconut in Gujarat State.

MOHAMED ALI AB
8 June 1952
B. Sc. (Ag.)
Agricultural Farm Management
Junior Agricultural Officer
Coconut Farm, Vytilla
Cochin 682 019, Kerala

MOHAMMAD ISSACK A
1 December 1927
M. Sc. (Ag.)
Agricultural Botany
District Agricultural Officer
Department of Agriculture
Alleppey 688 001, Kerala

Associated with the implementation of schemes on coconut (package units and plant protection). Extension work in the field of coconut cultivation.

MOHAMMAD VARISAI

MOHANDAS C
3 October 1949
M. Sc. (Zoology)
Nematology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

MOHANTY PS
20 February 1940
M. Sc. (Ag.)
Entomology
Senior Research Assistant
Regional Coconut Research Station
Sakhigopal 752 014, Orissa

MOHAPATRA KC
26 October 1922
B. Sc. (Ag.), Assoc. IARI
Agronomy
Dy. Director of Agriculture
(Fruit Preservation)
Department of Agriculture
Bhubaneswar 751 006, Orissa

Reoriented coconut research and extension schemes in Orissa and organised embankment plantations and demonstration plots.

MULIYAR MOHAMED KUNHI
1 July 1933
M. Sc. (Ag.)
Agronomy/Extension
Extension Agronomist (Trng.)
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with the coconut research for a period of over 19 years in the fields of nutrition, irrigation, intercropping, varietal response to manuring and cultivation operations. Responsible for formulating the current recommended dose of NPK fertilisers. Currently associated with coconut extension/development, and published 10 scientific papers.

NAGARAJ AN

NAGARAJA SHARMA K
1 June 1942
M. Sc. (Ag.)
Horticulture
Research Assistant
All India Co-ordinated Coconut & Arecanut Improvement Project
Coconut Research Station
Ambajipet 533 214, Andhra Pradesh

Hybridisation and evaluation; plantation efficiency analysis; studies on barren nuts; transplanting age of seedlings and their field performance.

NAIR R BALAKRISHNAN
27 August 1928
M. Sc. (Botany)
Cytogenetics and Plant Breeding
Junior Breeder
Central Plantation Crops Research Institute
Research Centre, Port Blair 744 101, Andamans

Evaluation of new cross combinations in coconut breeding programmes. Floral initiation studies; co-author of two scientific papers.

NAIR MRGK
21 February 1922
Ph. D.
Agricultural Entomology
Professor and Head
Department of Entomology
College of Agriculture, Vellayani 695 522
Trivandrum, Kerala

Worked out the biology of *Callispa* sp., a minor pest of coconut. Guided research on toxicity of insecticides to parasites of coconut caterpillar. Author of 4 scientific publications on coconut.

NAIR P GOPALAKRISHNAN
27 April 1933
M. Sc. (Ag.)
Agricultural Chemistry
Junior Agricultural Chemist
Central Tuber Crops Research Institute,
Trivandrum 695 017, Kerala

Worked on the correlation between leaf composition and yield in coconut. Author of one publication.

NAIR R GOPINATHAN
13 November 1926
M. Sc.
Botany
Junior Scientific Officer
Central Tuber Crops Research Institute
Trivandrum 695 017, Kerala

Studies on anatomy of coconut fibre; evaluation of indigenous and exotic cultivars with special reference to fibre and kernel; Effect of growth regulators in preventing occurrence of barren nuts and control of weeds through hormonal weedicides. Published four scientific and seven popular articles.

NAIR P GOPINATHAN
6 April 1932
M. Sc. (Ag.)
Cytogenetics & Plant Breeding
Lecturer
Department of Botany
University of Kerala, Kariavattom,
Trivandrum 695 581, Kerala

Contributed in the field of cytology and breeding of coconut with special reference to inbred lines, three way hybrids; embryo culture *etc.* Published 6 scientific articles.

NAIR CP RADHAKRISHNAN
15 May 1947
M.Sc. (Ag.)
Agricultural Entomology & Plant Nematology
Junior Entomologist
Central Plantation Crops Research Institute
Regional Station
Vittal 574 243, Karnataka

Associated with preliminary investigations on the role of *R. similis* in the incidence and its control. Co-author of two scientific publications. Also associated in the coconut extension work.

NAIR PKR
12 March 1942
Ph. D.
Agronomy
Agronomist (Soils)
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with studies on production potential, compatibility, economic feasibility, input requirements and soil fertility aspects of various inter, mixed and multistoreyed crop combinations in coconut gardens. Published 17 articles.

NAIR R VIKRAMAN
19 April 1944
Ph. D.
Agronomy
Associate Professor
College of Horticulture
Mannuthy 680 651, Kerala

Associated with the research projects on nutritional requirements of coconut and mixed farming.

NAMBIAR CK BALAKRISHNAN
8 July 1930
Dip. Licentiate Food Technology
Soil Science
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Evaluation of organic manures with reference to various soil types. Preservation of poonac (coconut oil cake). Survey and classification of coconut growing soils in Cannanore district. Published nine scientific papers.

NAMBIAR MC
10 April 1925
B. Sc. (Ag.)
Cytogenetics and Plant Breeding
Project Co-ordinator (Spices & Cashew)
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for over 25 years. Contribution in the fields of seasonal variation in nut production and sex expression, pattern of genetic variation, inheritance pattern of reproduction, genetical analysis of yield attributes, cytological investigations, origin of dwarf coconut palm and culture of pollen tubes of coconuts. Published 21 scientific articles.

NAMBIAR PK NARAYANAN
25 January 1931
Ph. D.
Agricultural Chemistry & Soil Science
Associate Professor
Kerala Agricultural University
Coconut Research Station
Pilicode 670 314, Kerala

Nutritional studies in laterite soils. Nursery techniques and evaluation of various Tall x Gangabondam hybrids.

NAMBIAR KP PADMANABHAN
15 July 1923
B. Sc. (Ag.) D.I.H.
Horticulture
Coconut Specialist
Coconut Research Station
Kerala Agricultural University
Pilicode 670 314, Kerala

Associated with coconut research for the past one decade. Contributed in the fields of production and evaluation of performance of T x D hybrids. Identification of prepotent palms. Author of five scientific and nine popular articles.

NAMPOOTHIRI KUK
7 December 1940
Ph. D.
Cytogenetics & Plant Breeding
Geneticist
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala
Principal Scientific Officer
Nigerian Institute for Oil Palm Research
P. M. B. 1030, Benin City, Nigeria

Associated with coconut research for the past 12 years. Contributions include a tentative classification of *Cocos nucifera* L.; electrophoresis in identifying varieties and hybrids; karyotypic studies; identification of prepotents, phenotypic and genotypic correlations and other coconut breeding programmes. Author/co-author of six scientific and five popular articles.

NATARAJAN P
24 June 1948
M. Sc. (Ag.)
Rodentology/Insect Pathology
Assistant Entomologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Studied the magnitude of rat damage in coconut garden and possible control measures; control of rhinoceros beetle and leaf eating caterpillar. Published one article on coconut.

NAYAR TV RAMAKRISHNAN
23 November 1944
M. Sc. (Ag.)
Agronomy
Assistant Agronomist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Mixed farming in coconut gardens and crop-weather studies.

NELLIAT EV
27 January 1925
M. Sc. (Ag.)
Soil and Water Management
Head of the Division of Agronomy
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for the past 29 years. Formulated efficient fertiliser management practices based on rooting pattern, soil and tissue status, crop response and water requirement, and effect of sea water irrigation on coconut production. Multistoreyed cropping was conceived and tested for achieving higher efficiency in utilisation of sunlight, soil, water and other inputs. Publications include 3 reports, 16 scientific papers and 5 popular articles.

NINAN CA
7 April 1929
Ph. D.
Cytology, Genetics & Plant Breeding
Professor of Genetics & Plant Breeding & Head
Department of Botany
Kerala University Kariavattom,
Trivandrum 695 581, Kerala

Contribution in the field of cytology of endosperm, problems in production of D x T hybrids, effect of pollen on nut characters *etc.* Author/co-author of over 30 scientific publications.

NIRULA KK
5 May 1917
Ph. D., Dip. Plant Nematology
Entomology, Nematology, Plant Protection.
Plant Protection & Quarantine Officer
International Crops Research Institute for the Semi Arid Tropics (ICRISAT), 1-11-256,
Begumpet,
Hyderabad 500 016, Andhra Pradesh.

Recorded *Leucopholis coneophora* causing damage to coconut root, isolated a new virulent race of "Green muscardine" fungus against *Oryctes* grubs, recommended integrated pest control against *Nephantis serinopa.* Published 40 scientific papers on coconut pests.

PANDA KC
5 February 1942
Ph. D.
Plant Physiology
Agriculture Supervisor
Regional Coconut Research Station
Sakhigopal 752 014, Orissa.

PANDALAI KM
22 March 1908
Ph. D., F.R.I.C. (Lond.)
Agricultural Chemistry/Microbiology
Retired Scientist
'Vilayil Matom'
Mavelikara 690 101, Kerala

Associated with coconut research for over a period of seventeen years. Major contributions are: a systematic investigation on the soil physical conditions and soil fertility factors with special reference to root (wilt) disease; coconut nutrition studies; experiments with growth promoting substances and correction of certain abnormalities and observations on permanent expt. plot etc. Co-author of "Coconut Palm – A Monograph". Published over 125 original scientific papers.

PANDIT SV
12 June 1923
B. Sc. (Ag.)
Plant Pathology
Plant Pathologist
College of Agriculture, Rajendranagar,
Hyderabad 500 030, Andhra Pradesh

Associated with studies on symptomatology of stem bleeding disease, spread of *Thatipaka* disease, coconut leaf blight and *Ganoderma* wilt diseases. Author/co-author of 5 scientific publications.

PANKAJAKSHAN AS
28 May 1933
M. Sc., M. Stat., Dip. Mkg.
Statistics/Marketing
Statistical Officer
Directorate of Coconut Development
Govt. of India, Cochin 682 011, Kerala

Designing field experiments for coconut, economic studies of price trends of coconut products; economic evaluation of agronomic trials in evolving fertiliser recommendations for coconut *etc.* Author of 16 publications.

PAPA RAO A
5 August 1934
M. Sc.
Plant Pathology
Ph. D. Scholar
Department of Plant Pathology
College of Agriculture, Rajendranager
Hyderabad 500 030, Andhra Pradesh

Worked on coconut pathology for 13 years. Studied symptomatology, nature and spread of *Thatipaka* disease. Also associated with the study on other diseases of coconut such as *Ganoderma* wilt, stem bleeding, bacterial leaf blight *etc.* Author of ten scientific publications.

PATEL JS
11 December 1905
Ph. D. (Edn.)
Plant Breeding & Agronomy
Retired Scientist
Gadapura Gotri Road
Baroda 390 007, Gujarat

Author of 'The Coconut- A Monograph' Serving as Consultant Oil Seeds Specialist and Director of Agriculture, Bihar, Agricultural Commissioner, of India. He was associated with coconut research/development in various States.

PATIL VEDPRAKASH K
2 January 1942
Ph. D.
Horticulture (Pomology)
Associate Dean & Principal
College of Agriculture
Marathwada Agricultural University
Parbhani, 431 401 Maharashtra

Associated with research activities pertaining to cultural, manurial and other aspects of coconut cultivation. Author of one publication on coconut.

PERRAJU A
18 June 1918
M. Sc. (Ag.)
Professor and Head, Entomology
Agricultural Entomology and Zoology
Agricultural College, Bapatla 522 101
Andhra Pradesh

Organised work on biological control of *Nephantis serinopa* at Razole. Published two articles on biological control of coconut caterpillar.

PILLA PN CHANDRASEKHARA
6 September 1925
Ph. D.
Genetics & Plant Breeding
Joint Director of Agriculture
(Plant Protection)
Directorate of Agriculture
Trivandrum 695 522, Kerala

Conducted manurial and cultural experiments on coconut to find out optimal doses of fertilisers for coconut gardens in black and laterite soils of Kerala.

PILLAI G BHASKARAN
3 December 1931
M. Sc. (Zoology)
Entomology
Entomologist
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for a period of 14 years; evolved a sampling technique for estimation of field population of *Nephantis serinopa* and its parasite complex. Other contributions include, laboratory evaluation of and field trials with insecticides for control of rhinoceros beetle, their effect on natural predators and integrated control of this pest. Published 22 articles on coconut.

PILLAI N GOPALAKRISHNA
3 September 1927
M. Sc.
Soil Science/Plant Nutrition
Soil Chemist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with coconut research for the past 25 years. Carried out a comprehensive nutritional survey of the coconut soils of Kerala and macro and micronutrient requirements of the coconut palm with special reference to root (wilt) disease. Author of one book, 35 scientific publications and seven popular articles.

PILLAI N GOPINATHAN
27 November 1934
M. Sc.
Mycology/Plant Pathology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted a survey and mapped the distribution, spread and intensity of coconut root (wilt) disease in Kerala. Other contributions include the study of etiology, mechanism of transmission and control of root (wilt) disease. Author of seven scientific and two popular articles.

PILLAI K SADASIVAN
1 September 1936
Ph. D.
Agricultural Entomology/Soil Zoology
Scientist S-1
Central Tuber Crops Research Institute
Trivandrum 695 017, Kerala

Associated with the work on biological control of *Nephantis serinopa* and also control of Rhinoceros beetle. Author of four publications.

PILLAI K SIVASANKARA
17 July 1930
M. Sc. (Ag.)
Agronomy
Associate Professor
Kerala Agricultural University
Coconut Research Sub-Station
Kumarakom 686 563, Kerala

Manurial experiments; evaluation of cultivars and hybrids.

PILLAI PK THANKAMMA (Female)
2 June 1939
M. Sc. (Ag.)
Cytogenetics & Plant Breeding
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for a period of seven years. Karyomorphological studies on Tall and Dwarf coconuts, studies on inbreeding depression, pollen sterility, pachytene analysis breeding programmes. *etc.* Co-author of two scientific publications.

PILLAI R VASUDEVAN
14 March 1932
M. Sc. (Ag.)
Plant breeding and Genetics
Breeder
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Conducted extensive survey of coconut growing states and responsible for large collection of indigenous and exotic coconut cultivars at Central Plantation Crops Research Institute, Kasaragod. Reported for the first time the flowering initiation in the tenth leaf axil in coconut. Reported the tolerance of D x T to root (wilt) disease. Published 16 papers.

PONNAMMA KN (Female)
23 February 1947
M. Sc.
Entomology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Investigations on the exotic parasite (*Spoggosia bezziana*) and an exotic predator (*Platymeris laevicollis*). Biological control of *Oryctes*; maintained mass culture of indigenous parasites of *Nephantis serinopa*, for supply to the different parasite breeding stations.

POTTY V PADMANABHAN
2 May 1945
M. Sc. (Ag.)
Microbiology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with investigations on the rhizosphere microflora with special reference to root (wilt) disease and biochemical changes in disease affected palms. Published five scientific papers.

PRASANNA KUMARI TO

PUSHPADAS MV

RADHA K (Female)
6 March 1926
Ph. D.
Plant Pathology/Mycology
Plant Pathologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam,
Krishnapuram 690 533, Kerala

Studies on the fungi associated with root (wilt) disease; incidence of leaf rot in root (wilt)-affected tract; response of progenies from healthy and diseased palms. Published 33 scientific papers and eight popular articles.

RAJASEKHARAN N

RAMACHANDRAN CP
9 July 1934
B. Sc.
Entomology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Assessment of damage and field control of *Oryctes;* bioassay of insecticides against *Oryctes* and *Nephantis;* chemical and biological control of pests. Author of five publications.

RAMACHANDRAN M
30 September 1927
B. Sc. (Ag.)
Agronomy
Assistant Agronomist
Oilseeds Experiment Station
Tindivanam 634 001, Tamil Nadu

Setting up of coconut pilot demonstration plots; evaluation of T x D hybrids. Published two articles on coconut.

RAMADASAN ACHAT
28 April 1934
Ph. D.
Physiology/Pathology
Plant Physiologist
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with the investigations on physiology of root (wilt) disease and adduced evidence for possible association of pathological toxemia in the disease complex. Responsible for establishment of physiology lab. at Central Plantation Crops Research Institute, Kasaragod. Author of 16 publications.

RAMANANDAN PL
30 May 1928
M. Sc.
Soil Science
Scientist S-1
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for the past 25 years. Contributions include correction to foliar yellowing through manurial applications, soil testing and soil survey. Author of 13 publications.

RAMASUBBAIAH K
14 March 1926
Ph. D.
Insect Toxicology
Associate Professor of Entomology
College of Agriculture, Rajendranagar
Hyderabad 500 030

Explorative investigations to extend the programme for breeding of parasite of *Nephantis serinopa* were made and rearing techniques were improved.

RAO C KAMALAKARA
27 September 1918
B. Sc.
Entomology/Parasitology
Entomologist
C/o. M.S.V.V.S. Sugars, Chagallu 534 342
West Godavary Dist., Andhra Pradesh

Evolved techniques for mass multiplication of parasites and predators of coconut caterpillar. Author of four publications including a booklet on coconut cultivation in Telugu.

RAO C SESHAGIRI
15 February 1935
B. Sc. (Ag.)
Entomology
Assistant Entomologist
Biological Control Laboratory
Nidadavole, Andhra Pradesh

Techniques for breeding different parasites of coconut caterpillar were standardised. Established a parasite breeding station at Somapeta in Srikakulam district. Author of four publications on pests of coconut and biological control of *Nephantis*.

RAO N RAGHAVA
28 December 1914
M. Sc. (Ag.)
Agricultural Entomology – Pest Control
Retired Deputy Director of Agriculture (Research)
45-37-34 A, Jagannadhapuram,
Vishakapatnam 530 004, Andhra Pradesh

Evolved schedules for release of parasites to control *Nephantis serinopa* Mayr and devised cheap containers of despatch of parasites. Published one scientific paper.

RAO N SRINIVASA
15 July 1945
M. Sc. (Ag.)
Entomology
Senior Research Assistant
Horticultural Experimental Station (ICAR)
Chethalli 571 248, Karnataka

Studied the biology of *Brachymeria nephantidis* Gahan, a pupal parasite of *Nephantis serinopa* and published one scientific paper.

RAO SSSV
27 October 1922
B. Sc. (Ag.), Assoc. IARI
Botany
Retired Scientist
Chhatrapur 781 150, Orissa

Founder-organiser of the coconut research and extension scheme in Orissa. Developed the Regional Coconut Research Station, Sakhigopal, Orissa, and organised the A.R.C. plantation scheme. Author of one publication.

RATH KC
8 January 1925
B. Sc. (Ag.)
Extension
Deputy Director of Agriculture, (Coconut)
Regional Coconut Research Station
Sakhigopal 752 014, Orissa

Planned hybrid seed garden in Konark (Orissa State); Farmers training and setting up of demonstration plots.

RATH DIGAMBAR
November 1942
M. Sc. (Ag.)
Agronomy
Agriculture Supervisor (Coconut)
Regional Coconut Research Station
Sakhigopal 752 014, Orissa

RATNAM TC (Female)

RAVINDRAN PS
28 September 1940
M. Sc. (Ag.)
Cytogenetics and Plant Breeding
Senior Research Assistant
Central Tuber Crops Research Institute
Trivandrum 695 017, Kerala

Cytogenetical problems; induced mutations, shedding of female flowers — causes and remedies, developmental morphology of the nuts, barren nut production and control measures. Author of one publication.

RAWTHER TSS
28 June 1931
M. Sc. (Botany)
Plant Pathology
Junior Plant Pathologist
Central Plantation Crops Research Institute
Research Centre, Palode
Pacha 695 562, Kerala

Associated with coconut research for the last 18 years. Contributions include the study of etiology and control of root (wilt) disease, assessment of hybrid's reaction to disease; contributed eight scientific articles.

RAY PK
13 February 1944
Ph. D.
Soil Physics, Soil Chemistry,
X-ray Crystallography and use of radioisotopes
Radiological Safety Officer
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Evaluation of efficiency of different sources of phosphatic fertilizers in coconut using radioisotopes; rapid tissue test for diagnosis of root (wilt) disease.

ROBERT CECIL S
18 November 1935
M. Sc.
Soil Chemistry/Plant Nutrition
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Conducted nutritional surveys and fertiliser trials to study the role of soil and nutritional factors on the incidence of root (wilt) disease of coconut. Author/co-author of five scientific and four popular articles.

SAHASRANAMAN KN
22 September 1925
B. Sc. (Ag.)
Farm Management/Agronomy
Assistant Farm Superintendent
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with coconut research for a period of 23 years. Chief contributions include farm management, evaluation of green manures and cover crops, inter cropping and mixed cropping trials and entomological aspects of coconut. Published 29 articles.

SAMRAJ J

SANKARASUBRAMONEY H
30 April 1924
M. Sc.
Soil Science
Manager (Market Development)
163, Kalakshetra Colony
Madras 600 041, Tamil Nadu

Studied soil properties in relation to the diseases of coconut in South India. Author/co-author of 20 scientific articles.

SANKARANARAYANAN MP
10 March 1922
B. Sc. (Chemistry)
Soil Survey and land utilisation
Junior Chemist
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Conducted a reconnaisance survey of the coconut areas of Cannanore and Kozhikode districts, and classified and characterised the soil. Studied the nutritional aspects of the coconut palm with special reference to root (wilt) disease. Published 25 papers.

SASAMAL S
12 April 1943
M. Sc. (Ag.)
Chemistry
Senior Research Assistant
Regional Coconut Research Station
Sakhigopal 752 014, Orissa

SHANKAR N

SASIKALA M (Female)
14 April 1947
M. Sc. (Ag.)
Plant Pathology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Studies on etiology and mechanism of transmission of coconut root (wilt) disease.

SATHIAMMA B (Female)
22 March 1939
M. Sc. (Zoology)
Agricultural Entomology and Acarology
Assistant Entomologist
Central Plantation Crops Research Institute
Regional Station, Vittal 574 243, Karnataka

Control of major and minor pests; biology and bionomics and population studies of major and minor pests; taxonomy and host-parasite relationship of mites; Published 14 scientific papers.

SATYABALAN K
11 April 1921
M. Sc. (Ag.)
Cytogenetics and Plant Breeding
Breeder (Oil Palm)
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Associated with coconut research for over 24 years. Contributions include the study of performance of exotic and indigenous cultivars and hybrids; evolved the criteria for identification of prepotent palm. Rendered technical advice in programming the research and developmental activities in Fiji for two years. Published 40 papers.

SATYANARAYANA RAO V
5 February 1934
M. Sc.
Organic Chemistry
Junior Chemist
All India Co-ordinated Coconut and Arecanut Improvement Project
Coconut Research Station
Ambajipeta 533 214, Andhra Pradesh

SAYEED PM
1 July 1911
B. Sc. (Ag.)
Horticulture/Extension
Retired Scientist
Janata House, Cannanore 670 112, Kerala

Associated with coconut research for a period of 30 years. Contributions include establishment of criteria for the selection of high yielding varieties of coconut, extending area under coconut with high yielding varieties and studies on button shedding.

SESHA REDDY P
1 July 1950
M. Sc. (Ag.)
Horticulture
Research Assistant
All India Coordinated Coconut and Arecanut Improvement Project
Coconut Research Station
Ambajipeta 533 214, Andhra Pradesh

SHAH SS
1 January 1930
M. Sc. (Ag.)
Marketing
Deputy Director
Directorate of Coconut Development
Government of India
Cochin 682 011, Kerala

SHAMSUDDIN VM
8 June 1939
M. Sc. (Ag.)
Cytogenetics & Plant Breeding
Agricultural Officer
Department of Agriculture
Union Territory of Lakshadweep
Kavaratti 673 555, *Via* HPO Calicut

Manurial studies, pollen and pollination studies with selected parents; intercropping trials in coconut gardens.

SHANTA P (Female)
5 July 1931
Ph. D.
Plant Pathology
Virologist
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Studies on transmission of root (wilt) disease of coconut: identified the involvement of pathogenic agent resembling a virus which is both soil and insect transmitted. Published 37 scientific and 3 popular articles.

SHANTAPPA PB
12 June 1932
B. Sc. (Ag.)
Agronomy
Farm Superintendent
Regional Coconut Research Station
Arsikere 573 013, Karnataka

Coconut nutritional studies and evaluation of cultivars and hybrids. Author of five publications.

SHEKHAWAT GS
9 July 1941
Ph. D.
Phytobacteriology
Bacteriologist
Central Potato Research Institute
Simla 171 002

In collaboration with two other bacteriologists worked on the incidence of coconut root (wilt) disease in Kerala and concluded that viral etiology of the disease was doubtful as *Pseudomonas* sp. was found in association with the diseased coconut roots. Author of one scientific article on coconut.

SINGH KAPIL DEO
10 October 1943
Ph. D.
Soil Science
Scientist S-1 (Soils)
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

SOSAMMA VARGHESE K (Female)
6 September 1947
M. Sc. (Botany)
Nematology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Associated with isolation and identification of plant parasitic nematodes associated with coconut and study of their host range and pathogenicity.

SRIDHARAN CS
12 December 1940
M. Sc. (Ag.)
Breeding
Deputy Horticultural Officer
Oil Seeds Experiment Station
Tindivanam 634 001, Tamil Nadu

Evaluation of T x D hybrid coconut; coconut development and extension work. Author of one publication.

SRI RAMA RAO TOLETY
2 August 1929
M. Sc. (Ag.)
Horticulture
Assistant Horticulturist
All India Co-ordinated Spices and Cashewnut Improvement Project
Lam, ARS (PO)
Guntur 522 002, Andhra Pradesh

Streamlined technique for production of pedigree coconut seedlings and Tall x Gangabondam hybrids. Introduced inter and mixed cropping patterns in Godavari Delta. Published three scientific articles.

SUBBA REDDY KV
15 June 1931
M. Sc. (Ag.)
Horticulture
Assistant Horticulturist
Coconut Research Station
Ambajipeta 533 204, Andhra Pradesh

Hybridisation and evaluation; plantation efficiency analysis; studies on barren nuts occurrence in different seasons; transplanting age of seedlings and their field performance.

SUBBAYYA J
1 July 1927
Ph. D.
Plant Pathology/Virology
Professor & Head of the Department
Department of Plant Pathology
S. V. Agricultural College
Tirupati 517 502, Andhra Pradesh.

Associated with investigations on "*Thatipaka*" disease of coconut in Andhra Pradesh. Conducted intensive surveys for estimating its intensity and extent of damage, symptomatology, nature and spread of the disease were also worked out. Published two scientific papers.

SUBRAMANYAN V
16 September 1902
D. Sc. (London), F.N.A.
Agricultural Biochemistry
Food Technology and Nutrition
Head, Paddy Processing Research Centre
Tiruvarur, 610 108, Tamil Nadu

Integrated processing for production of oil, protein and other fractions from coconut. Application of chemical treatment for the control of infection during the production of copra. Developed the "Subramanyam process" for the production and increase in yield of copra in the Philippines. Published a large number of scientific papers.

SUKHENDU SEKHAR GHOSE
23 November 1940
B. Sc.
Botany
Senior Technical Assistant
Crop Science Department
Indian Statistical Institute
203 B. T. Road, Calcutta 700 035

Floral morphology, external morphology of leaves, fruits, roots *etc.* and other morphological characters of young and adult palms including their mode of germination process. Published four articles on coconut.

SUKUMARAN AS
23 January 1943
M. Sc. (Zoology)
Entomology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Estimation of crop losses due to pests and diseases. Varietal trials in root (wilt)-affected area to test their reaction to disease.

SUKUMARAN CK
23 October 1926
M. Sc. (Ag.)
Agricultural Botany
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Genetical investigations, exploitation of hybrid vigour, biometric and prepotency studies; establishing homozygous lines *etc.* Published four scientific papers and three popular articles.

SUMATHY KUTTY AMMA (Female)
8 October 1937
M. Sc. (Botany)
Plant Physiology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Physiology of resistance/susceptibility of coconut leaves against leaf rot, biochemical factors in relation to coconut root (wilt) disease; embryo culture and the effect of micronutrients on the germination of coconut seed nuts *etc.* Published three papers.

SUNDARA RAJU P
20 April 1951
M. Sc. (Zoology)
Nematology
Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

SUNNY NINAN
2 September 1950
M. Sc.
Organic Chemistry
Research Fellow
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

SWAMINATHAN MONCOMBU SAMBASIVA
7th August 1925
Ph. D.
Cytogenetics/Mutation Breeding
Director General, ICAR,
& Secretary to Govt. of India
Indian Council of Agricultural Research
Krishi Bhavan
Dr. Rajendra Prasad Road
New Delhi 110 001

Gave the cytological basis for the origin of dwarf coconuts the latter being the products of inbreeding among different tall varieties. An initial mutation responsible for origin of dwarf coconut might have led to overlapping of male and female phases of inflorescence rendering self-pollination both possible and predominant. Also provided the chemotaxonomic classification of different coconut varieties and their hybrids.

THAMPAN PK
10 April 1933
M. Sc. (Ag.)
Agronomy
Director
Directorate of Coconut Development
Government of India
Cochin 682 011, Kerala

Responsible for the planning and co-ordination of coconut development and marketing activities in the country. Author and co-author of 4 books, 3 scientific papers and a number of popular articles.

THIPPESWAMY M
6 April 1939
M. Sc. (Ag.)
Entomology
Subject Matter Specialist
(Plant Protection)
Farm Advisory Unit
Sri Venkateswara Agricultural College
Tirupati 517 502, Andhra Pradesh

Survey and estimation of damage due to red palm weevil in Chittoor District. Chemical control trials of red palm weevil *etc.*

THOMAS CA
9 January 1930
M. Sc.
Forage production
Junior Scientific Officer
Central Rice Research Institute
Cuttack 763 006, Orissa

Investigations on abnormalities in coconut, vegetative propagation by inducing suckers, application of hormones to induce parthenocarpy and nutrient curative studies with special reference to leaf rot and root (wilt) diseases. Author/co-author of seven scientific and four popular articles.

THOMAS JOSEPH
22 July 1933
M. Sc. (Ag.)
Plant Pathology/Mycology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Investigations on the anatomical changes in root (wilt) affected palm, transmissibility of disease, role of *Phytophthora palmivora* in causing bud rot of coconut and pathogenic aspects of stem bleeding *etc.* Author and co-author of nine papers.

THOMAS KM
14 October 1933
M. Sc. (Ag.)
Agronomy
Assistant Director (Coconut)
Department of Agriculture
Trichur 680 001, Kerala.

Determined the NPK requirements of back water regions of Kerala. Identified the nursery and establishment techniques suitable for East African conditions. Headed the breeding project in Trichur district. Author of eight scientific and seven popular articles.

THOMAS PK
8 October 1926
Assoc. IARI
Soil Conservation and Water Management
Project Co-ordinator (WM)
Central Soil and Water Conservation Research and Training Institute
218, Kaulagarh Road
Dehra Dun 248 001

Planned soil survey of coconut growing areas of west coast and genetically classified the laterite and associated soils of Malabar. Studied nutritional aspects of coconut palm in healthy and diseased areas and published five scientific papers.

THOMAS VARGHESE P
11 July 1951
M. Sc. (Ag.)
Agronomy
Scientist S-1
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Crop diversification in coconut gardens and NPK nutritional studies. Published one paper on coconut.

THOMAS VARKEY
25 January 1930
M. Sc. (Botany)
Plant Physiology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Studied the major nutrients exhausted by the coconut palm through different morphological plant parts. Published three scientific papers.

THOMAS VAIDYAN KL
17 April 1949
B. Sc.
Statistics
Computor
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

THOMMAN KJ
23 March 1922
B. Sc.
Plant Pathology
Senior Research Assistant
Central Plantation Crops Research Institute
Regional Station, Kayangulam
Krishnapuram 690 533, Kerala

Anatomical changes in root (wilt) affected coconut leaves. Biological control of *Oryctes* using pathogens, study on etiology of stem bleeding *etc.* Published four articles.

VERGHESE EJ

VIJAYAKUMAR G
2 December 1944
M. Sc. (Botany)
Cytogenetics
Senior Research Assistant
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala

Quantified overlapping of floral phases, identified insect visitors and estimated their role in pollination, inbreeding depression, pollen sterility and hybrid vigour exploitation programmes. Co-author of two scientific publications.

VIJAYALAKSHMI K (Female)
23 December 1935
Ph. D.
Soil Physics
Soil Physicist
Dryland Agricultural Project
Hyderabad 500 013

Studied some of the effects of cultural practices on soil physical characters, development of coconuts during different months, nutrient enrichment of soils *etc.* Author/co-author of eight scientific publications.

VISWANATHAN AR
17 May 1928
B. Sc. (Ag.), D.I.H.
Extension
Crop Specialist
Oilseeds Experiment Station
Tindivanam 634 001, Tamil Nadu

Implemented coconut development scheme in coastal area of Ramanathapuram. Rendered technical assistance for development of coconut gardens in patta lands. Established large scale coconut nurseries.