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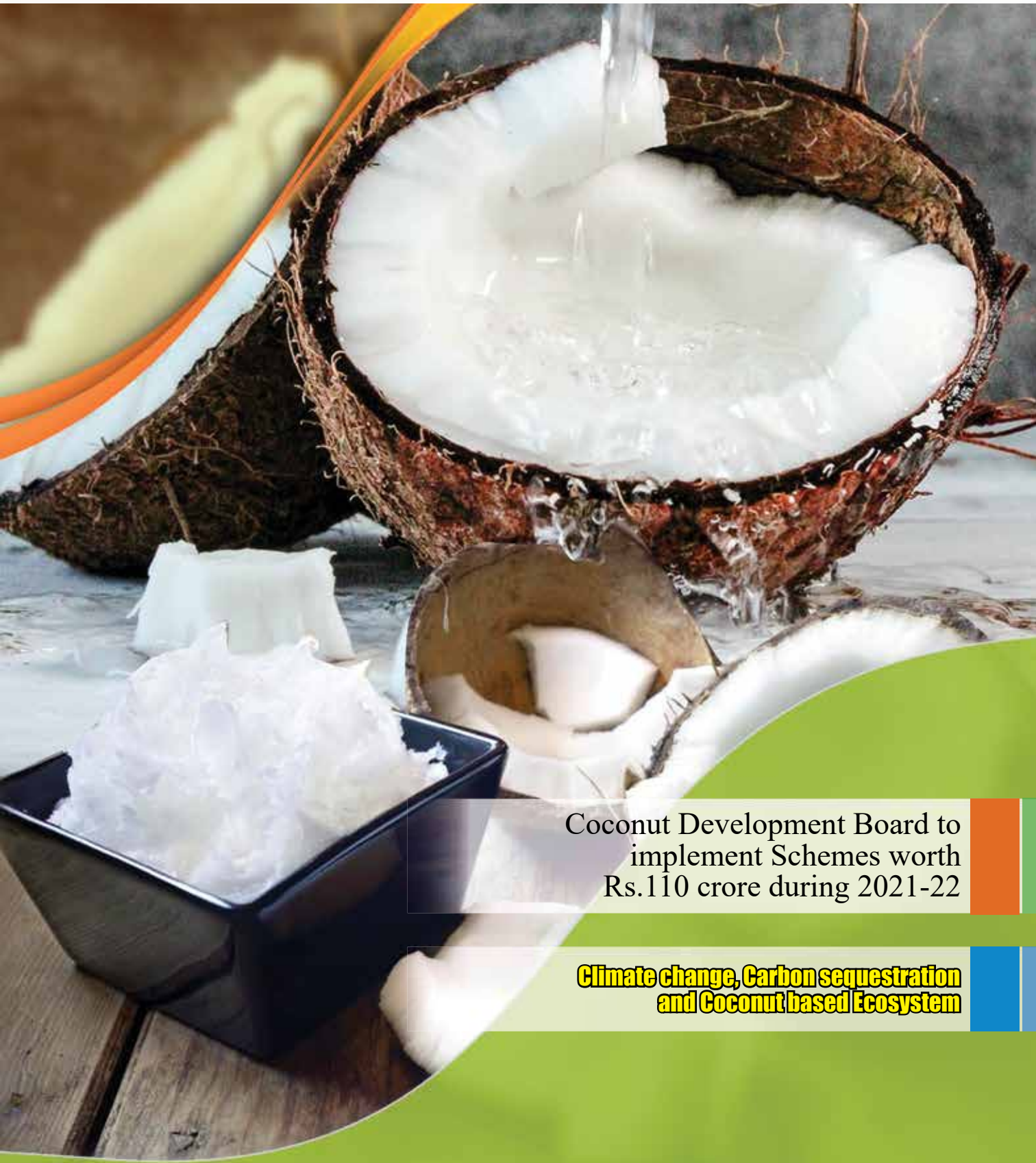

Coconut Development Board to implement Schemes worth Rs.110 crore during 2021-22

Climate change, Carbon sequestration and Coconut based Ecosystem

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Articles, research papers and letters on different aspects of coconut cultivation and industry are invited for publication in this Journal. All accepted material will be paid for. The Board does not accept responsibility for views expressed by contributors in this Journal. All remittances and correspondence should be addressed to the Chairman, Coconut Development Board, Kochi - 682 011.

Coconut Development Board

The Coconut Development Board is a statutory body established by the Government of India for the integrated development of coconut cultivation and industry in the country. The Board which came into existence on 12th January, 1981, functions under the administrative control of the Ministry of Agriculture and Farmers Welfare, Government of India, with its headquarters at Kochi in Kerala State and Regional Offices at Bangalore, Chennai, Guwahati and Patna. There are five State Centres situated in the states of Orissa, West Bengal, Maharashtra and Andhra Pradesh and in the Union Territory of Andaman & Nicobar Islands. DSP Farms are located at Neriyamangalam (Kerala), Vegiwada (Andhra Pradesh), Kondagaon (Chhattisgarh), Madehpura (Bihar), Abhayapuri (Assam), Pitapalli (Orissa), Mandya (Karnataka), Palghar (Maharashtra), Dhali (Tamil Nadu), South Hichachara (Tripura) and Fulia (West Bengal) besides a Market Development cum Information Centre at Delhi. The Board has set up a Technology Development Centre at Vazhakulam near Aluva in Kerala.

Functions

❒ Adopting measures for the development of coconut industry. ❒ Recommending measures for improving marketing of coconut and its products. ❒ Imparting technical advice to those engaged in coconut cultivation and industry. ❒ Providing financial and other assistance for expansion of area under coconut. ❒ Encouraging adoption of modern technologies for processing of coconut and its products. ❒ Adopting measures to get incentive prices for coconut and its products. ❒ Recommending measures for regulating imports and exports of coconut and its products. ❒ Fixing grades, specifications and standards for coconut and its products. ❒ Financing suitable schemes to increase the production of coconut and to improve the quality and yield of coconut.

❒ Assisting, encouraging, promoting and financing agricultural, technological, industrial or economic research on coconut and its products. ❒ Financing suitable schemes where coconut is grown on large scale so as to increase the production of coconut and to improve its quality and yield and for this purpose evolving schemes for award of prizes or grant of incentives to growers of coconut and the manufacturers of its products and for providing marketing facilities for coconut and its products. ❒ Collecting statistics on production, processing and marketing of coconut and its products and publishing them. ❒ Undertaking publicity activities and publishing books and periodicals on coconut and its products.

The development programmes implemented by the Board under the project Integrated Development of Coconut Industry in India are- production and distribution of planting material, expansion of area under coconut, integrated farming for productivity improvement, technology demonstration, market promotion and Information and Information Technology. Under the Technology Mission on Coconut, the programmes implemented by the Board are development, demonstration and adoption of technologies for management of insect pest and disease affected coconut gardens, development and adoption of technologies for processing and product diversification and market research and promotion.

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Message from the Chairman's desk

Dear Readers,

Quality of products is gaining significance with each passing day and becomes truer in case of food products. Quality of a food product was earlier defined in relation to parameters like chemical constitution, microbiological factors etc. But as the world progressed, many parameters got added in defining the quality of a food product which included quality of the process, equipment, worker safety, environmental impact, ensuring fair price to the farmer etc. And with the emergence of these parameters, various certification systems were introduced in order to ensure compliance of these parameters. Today at a time when the whole world is one global market, our industry has to move in line with the requirements of the global consumers to gain a foot hold in the market.

Coconut Development Board has been promoting the value addition of coconut products in a concerted manner since 2001-02 under the scheme Technology Mission on Coconut. The efforts have been fruitful leading to the establishment of around 530 coconut processing units thereby equipping the sector with an additional capacity to process around 3600 million nuts per year. In order to elevate the standards of our industry and to take it on par with international specifications, the Board is also extending support for quality certification on par with the schemes extended by the Quality Council of India. The entrepreneurs in the coconut sector may make use of this opportunity to upgrade their units in accordance with the quality standards in demand in the highly competitive global market, thereby ensuring quality production and also equipping themselves for a fair price for their products.

The global market for coconut products has been showing an increasing trend with increasing health consciousness among the consumers. The global pandemic has shifted the preference to products which are protective foods, increase immunity and possess nutritional attributes. Coconut holds a premium position since it has medium chain fatty acids in plenty with lauric acid being the major component. Coconut water and Virgin Coconut Oil have become greatly desired coconut products owing to its health attributes. The increasing vegan population across the globe is creating niche markets for coconut milk, flavoured coconut milk beverages, coconut yoghurt, coconut ice cream, frozen desserts etc and this trend has made its way to India too. With the opening up of the economy, products from Thailand, Sri Lanka, Indonesia, Malaysia etc have been introduced in the domestic market. The beauty care segment is brimming with new innovative products from coconut, beyond the wildest imagination of mankind, the coconut tooth paste being a recent addition which capitalizes on the application of coconut oil in dental care. Hence it has become very important for our industry to innovate, process, produce and pack quality certified products. History has shown that no recession or pandemic is going to decrease the relevance of food. Let us strive to make our coconut industry globally competitive with innovative, healthy, quality products from coconut to the benefit of the millions of coconut farmers in our country.

Rajbir Singh IFS
Chairman

Coconut Development Board to implement Schemes worth Rs. 110 crore during 2021-22

Pramod P Kurian, Assistant Director and **Kumaravel S**, Development Officer,
Coconut Development Board, Kochi -11

Coconut Development Board (CDB) implements various schemes like extending technical and financial assistance for expansion of area under coconut supplemented by planting material production programmes and productivity improvement programmes through its Regional Offices, state Centres and DSP Farms located in various states of the country in association with the state Agriculture/ Horticulture Departments, Agriculture/ Horticulture Universities, other related departments and agencies. CDB also encourages processing for value addition in coconut with supporting programmes of marketing and exports.

CDB schemes are implemented as subscheme with 100 % central assistance under the Mission for Integrated Development of Horticulture (MIDH) which is a Centrally Sponsored Scheme under the Ministry of Agriculture and Farmers Welfare, Govt. of India for the holistic growth of the horticulture sector covering fruits, vegetables, root & tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa and bamboo.

For the year 2021-22, a total amount of Rs. 110 crore has been allocated by the Ministry for implementation of various CDB schemes under the MIDH. The schemwise physical and financial allocations under different schemes for the year 2021—22 are shown in Table 1.

S. No.	Scheme	Physical	Financial (Rs. in lakh)
1	Production and distribution of quality planting materials		
a	Demonstration cum Seed Production (DSP) Farms	1 new farm & Maintenance of 11 existing farms	322.00
b	Establishment of Regional Coconut Nurseries	25 lakh seedlings	400.00
c	Establishment of Nucleus Coconut Seed Gardens	3 new units & maintenance installments for 3 units	13.50
d	Establishment of Small Coconut Nurseries	41 new units & maintenance installment for 22 units	46.50
		Sub Total	**782.00**
2	Expansion of Area under Coconut	4510 ha new & maintenance installment for 5956.59 ha	330.00
3	Integrated Farming for productivity improvement		
a	Laying out of Demonstration Plots	545.60 ha new & maintenance installment for 1830.48 ha	410.00
b	Organic Manure Units	75 no.	30.00
		Sub total	**440.00**
4	Technology Demonstration/ Quality Testing Laboratory	Need basis	50.00
5	Marketing, Market Intelligence Services, Statistics & Strengthening of Export Promotion Council (EPC)	Need basis	120.00
6	Information & Information Technology	Need basis	250.00
7	Technical Service & Project Management including Infrastructure & Administration	-	4278.00
8	Technology Mission on Coconut	Project basis	1000.00
9	Replanting and Rejuvenation of old coconut garden	6180.55 ha new & maintenance installment for 10676.59 ha	3700.00
10	Coconut Palm Insurance Scheme	2.86 lakh palms	20.00
11	Kera Suraksha Insurance Scheme	9797 climbers	30.00
	Total		**11000.00**

Table 1

1. Production and Distribution of Quality Planting Materials

The objective of the programme is to enhance the production and supply of good quality planting materials through following component programmes.

▶ *i.* Demonstration cum Seed Production (DSP) Farms:

Demonstration cum Seed Production (DSP) Farms in different parts of the country are established for creating infrastructure facilities for production of quality planting materials besides demonstrating the scientific coconut cultivation to various stake holders in respective regions. The Board has so far established 11 DSP Farms in the States of Andhra Pradesh, Assam, Bihar, Chhattisgarh, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu, Tripura and West Bengal in a total area of 362 ha. Budget support of Rs. 27 lakh for maintenance of these farms and Rs. 25 lakh in the first year of a new farm

are extended annually for meeting farm operational expenses.

▶ *ii. Establishment of Regional Coconut Nursery:*

This scheme is implemented with the objective of supplementing the coconut nursery programmes of the State Governments. Various State Governments will procure quality seednuts and raise Nursery with the existing infrastructure facilities available with the Department. The staff component and infrastructure facility for establishing the nursery are entirely to be borne by the State Government.

50% of the operational expenditure will be extended by the Board as Board's share @ Rs.16/- per seedling.

▶ *iii. Establishment of Nucleus Coconut Seed Gardens:*

The scheme is implemented to establish nucleus seed garden of selected cultivars in the Govt./ Quasi Govt. and private sector to meet the future demand of quality coconut seedlings. Individual farmers, Cooperative Societies, NGOs, KVKs and other Government/ Quasi Government organizations having suitable land to establish seed garden are eligible for availing financial assistance under this programme.

Financial assistance @ 25% of the total expenditure incurred limited to a maximum of Rs. six lakh will be extended by the Board for a maximum of 4 ha. over a period of three years. A detailed project showing the item of expenditure proposed for various fixed maintenance cost of the unit also need to be furnished along with the application for availing assistance under this scheme.

▶ *iv. Establishment of Small Coconut Nursery:*

The scheme is implemented to encourage private sector and other agencies in seedlings production by providing financial assistance for establishing coconut nurseries.

Financial assistance is limited to 25 % of the project cost or Rs. Two lakh, whichever is less, per unit of 0.4 ha (100% of the cost of seed nut and transport, maintenance of the nursery and other infrastructure facilities, etc.) with a production capacity of 25,000 certified seedlings per annum.

Minimum subsidy of Rs. 50,000/- for unit of 0.10 ha with production capacity of 6,250 seedlings per year is also being considered. The area requirements and production capacity in respect of North and Northeastern region is 12.5 cents for production of 3125 seedlings with an eligible financial assistance of Rs. 25000/-. The eligible subsidy is released in two installments.

2. Expansion of area under coconut:

Under the Scheme 'Expansion of area under coconut', the financial assistance to a tune of Rs. 6,500/- to 15,000/- per ha. is extended depending on variety / location, for planting coconut seedlings in new area, with a view to increase the area under coconut and production. The subsidy is extended for a maximum of four ha per beneficiary, in two equal annual installments, as detailed below.

	Item	Cost norms	Pattern of assistance
a) Normal area			
i)	Tall varieties	Rs. 26,000/ha	25% of cost for a maximum of four ha. per beneficiary, in two equal installments.
ii).	Hybrid varieties	Rs. 27,000/ha	
iii)	Dwarf varieties	Rs. 30,000/ha	
b) Hilly & Scheduled areas			
i)	Tall varieties	Rs. 55,000 / ha	25% of cost for a maximum of 4 ha. per beneficiary, in two equal installments.
ii).	Hybrid varieties	Rs. 55,000 / ha	
iii)	Dwarf varieties	Rs. 60,000 / ha	

As per the operational guidelines of Mission for Integrated Development of Horticulture (MIDH), Govt. of India, Hilly Areas include those areas covered under Hill Area Development Programme and

Table 2: Training Programmes Condcted at CIT						
S No	Name of training programme	Duration	Fees	Topics/ Products covered	Targeted participants	Minimum participants needed for a batch
1	Coconut Convenience Foods-1 day-Demonstration only	1 Day	Rs.500/- per head	Coconut chips, Chocolate, Cookies, Lemonade (squash), Pickle- 5 products, Theory sessions on value addition, packaging & Hygiene.	Kudmbasree units, other Self Help Groups, FPOs(CPS, CPF,CPC), Individuals	5
2	Coconut Convenience Foods-4 Days	4 Days	Rs.2000/- per head	Coconut chips, Chocolate, Cookies, Lemonade, Pickle, Chutney Powder, Coconut ladoo, Tender Coconut Spread, Coconut candy, Coconut Jelly, Virgin Coconut Oil(hot process)-Theory sessions on value addition, packaging& Hygiene.	Kudmbasree units, Individuals, Other Self Help Groups, FPOs	5
3	Coconut Vinegar from coconut water by slow process/ Nata de coco.	1 Day	Rs.1000/- per person	Coconut Vinegar	Basic science knowledge Kudmbasree units, Individuals, other groups, FPOs	5
4	Training on Chemical analysis.	1 week	Rs.2500/- per person	Chemical analysis of coconut products	Minimum qualification- Graduation in Chemistry/ Biochemistry/ Food chemistry/ Food Technology	1
5	Training on Microbiological analysis	2 weeks	Rs.5000/- per person	Microbiological analysis	Minimum Qualification – Graduation in Microbiology/other life sciences with microbiology as one of the subjects	1
6	Entrepreneurship Development Programme	5 days	Nil	Sessions on Entrepreneurship, value additon, Food safety, Quality aspects, Marketing strategies, Schemes of CDB etc.	Farmer groups/Self Help Groups etc.	20

Western Ghat Development Programme. Scheduled Areas include those areas notified by Govt. of India and State Governments.

3. Integrated farming in coconut holdings for productivity improvement:

The objective of the programme is to improve production and productivity of the coconut holdings through an integrated approach and thereby increasing the net income from unit holdings with the following component programmes.

The scheme components 'Laying out of Demonstration Plots' and 'Establishment of Organic manure Units' under 'Integrated Farming' are being implemented in Public Sector Farms.

▶ *i) Laying out of Demonstration Plots:*

Under this, financial assistance is limited to Rs.35,000/- per ha. in two annual installments depending on the activities undertaken in the coconut gardens with a view to demonstrate the possibility of improving the productivity and income through Integrated farming, with all possible convergence with other suitable schemes, which in turn may create visible impact in the farming community.

▶ *ii) Establishment of Organic Manure Unit:*

Under this scheme, financial assistance is extended to popularize the use of organic manure in coconut holdings.

Maximum assistance is Rs.60,000/- towards 100% of the cost for unit of size 1200 cubic ft (dimension 60ft x 8ft x 2.5 ft or two units of 30 ft x 8ft x 2.5ft) with production capacity of 80 tons per year in four cycles and of permanent structure and to be administered on pro-rata basis. Smaller units are also promoted and the minimum volume shall be 150 cubic feet (dimension 15ft x 5ft x 2 ft) with production capacity of 10 tons/ year in four cycles and financial assistance may be reduced accordingly.

Coir pith compost units with concrete floor of size 5m x 3m (40 units) with a capacity to produce 80 tons/ year are also eligible for subsidy under this scheme. Financial assistance is also extended to smaller units with minimum size of 5m x 3m (5 units) with a capacity of 10 tons/ year. Roof of convenient sizes also required for organic manure units.

4. Technology Demonstration/ Quality Testing Laboratory

The scheme is implemented by two establishments of the Board viz., CIT, Aluva, Kerala and Regional Office, Guhwahati, Assam.

The CDB Institute of Technology (CIT) at Aluva, Ernakulam District in Kerala is continuously engaged in the development and standardization of new value added coconut products and for demonstrating the same to entrepreneurs. It also houses the Quality Testing Laboratory (QTL) and Pilot Testing Plant integrating technology, entrepreneurship and quality management. CIT offers various services and training programmes to Individuals, Farmers' Collectives / SHGs/Women groups, private entrepreneurs and Vocational Higher Secondary, UG & PG students (Food Science/ Food Technology/ Food Engineering/ Agriculture). Details of the training programmes are given in Table 2:

A fullfledged NABL accredited Quality Testing Laboratory (QTL) is operating at the Institute in accordance with ISO/IEC 17025:2017 in the disciplines of chemical and biological analysis. The laboratory is equipped with advanced analytical instruments and modern facilities as per NABL requirements to carry out chemical/ microbiological tests of coconut based products, other food products and fertilizers. The Chemical and Microbiological Parameters that are being analysed in the CIT and the charges are available in Board's website. Four days training programmes on 'Preparation of coconut based convenient foods' is also being organized by Board's Regional Office located at Guwahati, Assam.

5. Marketing, Market Intelligent Services, Statistics and Strengthening of Export Promotion Council

The Board undertakes market promotion activities for the development of the coconut sector in the country. The major activities are Market Promotion, Market Intelligence, Market Research, Market Development, facilitating Farmers' Collectives and performing the responsibilities of Export Promotion Council.

The Department of Commerce, Ministry of Commerce and Industry, Government of India has notified Coconut Development Board as an Export Promotion Council (EPC) for all coconut products other than those made from coconut husk and fiber, on 1st April 2009 vide Public Notice No.169 (RE-2008)/2004-2009.

CDB issues Registration cum Membership Certificate (RCMC) at the capacity of Export Promotion Council (which is mandatory for exporters) to enable

exporters to avail various benefits under the Foreign Trade Policy and duty neutralization schemes of the Ministry of Commerce, Govt. of India. CDB as EPC provides services such as securing benefits under different incentive schemes for products from the coconut sector, facilitating participation of exports from coconut sector in International Trade Fairs, disseminating important trade information, providing commercially useful information and assistance to exporters in developing and increasing their exports, organizing seminar, conference and buyer seller meet, Exporter Excellence Award etc.

Financial assistance for establishment of Procurement Centres by Farmer Collectives in coconut sector, scheme for Skilled Manpower Development for Processing, Assistance to entrepreneurs/ Coconut Producer Companies to participate in domestic trade fairs/ exhibitions, Assistance for Quality Certification, etc. are also extended under the scheme. Support for setting up of Sales Outlets for coconut products and 'Brand Building for coconut products' are also extended under the scheme 'Technology Mission on Coconut (TMoC)'.

The details of the component programmes are provided in Board's website.

Collection, classification, compilation, analysis and interpretation of primary as well as secondary data pertaining to area and production of coconut, market price, weather, import and export of coconut products, etc. and dissemination of information to farmer community in Board's website as well as through print media, etc. are also being undertaken regularly as part of Statistics related to coconut, apart from other statistical studies.

6. Information and Information Technology

The Board organizes training & awareness programmes at Panchayat, block, district and national levels for farmers and other stakeholders on various topics related to coconut for enhancing awareness about the programmes of the Board. The Board is undertaking several programmes under Information & Information Technology with a view to disseminate information on various aspects of coconut cultivation and industry through publication in Board's in-house periodical magazines in various languages viz, monthly (English & Malayalam), quarterly (Tamil, Kannada & Hindi) and biannual (Marathi & Telugu), various print, electronic & social media, organizing/ participation in exhibitions & fairs at national & international levels, production &

screening of promotional video films, documentation of success stories, etc.

CDB has instituted the biennial scheme of National Awards in coconut cultivation, product development, product improvement, quality up gradation, product diversification, craftsmanship, extension activities, Farmer Collectives etc. The Board implements skill development programmes on 'plant protection aspects on coconut including harvesting using palm climbing device', 'coconut based handicraft making' and 'neera technician' for the benefit of the coconut community as a whole. The expenses including accommodation for these programmes are fully borne by the Board. The 'Neera Master Technician' training programme is imparted under Technology

Demonstration scheme. The Board also maintains a well equipped Library and MIS in the organization, with IT support.

The details of the component programmes/ activities and other details under this scheme are provided in Board's website.

7. Technical Service, Project Management including Infrastructure and Administration

The expenses towards the technical services, major infrastructure developments and establishment are met from this scheme.

8. Technology Mission on Coconut

The Scheme Technology Mission on Coconut (TMOC) was sanctioned during the financial year 2001-02 with the objectives of (a) the development of new value added coconut products and by-products by research, bring these value added product to commercial production by assistance to promising entrepreneurs adopting these technologies, (b) providing assistance for the controlling of specific disease/pest in any specific area including development of technology for controlling of such diseases/pests to ensure undisrupted supply of raw materials to the coconut industry for the production of value added products and by-products (c) develop and promote market for such newly developed values added products and by-products including traditional products (ball copra, copra and oil) by research, surveys and brand promotion. The implementation of this scheme is on time bound project basis.

• TMoC scheme provides financial assistance to entrepreneurs/farmers for setting up of coconut based industries (other than coir based industries).

• TMoC scheme mainly focuses on Research and Development, Post-harvest Processing, Product diversification, Value addition and management of pest and diseases.

• Through this scheme, CDB provides assistance to Research institutes in the field of processing and product diversification & management of pest and diseases.

• Pest outbreak is one of the major problems in the field level. CDB provides assistance to Research institutes for the management of pest by developing/ demonstrating technological & non technological methods.

• For Processing, Product diversification & Value addition, CDB in collaboration with many research

institutes, have developed different technologies for the production of value added products from coconut. These products have been promoted through national and global level. Research and Development has been directed to explore new technologies for the development of coconut industries.

Details of Technology Mission covering four major components are given below:-

(1) Development and Adoption of technologies for management of insect pests and disease affected gardens:		
Scheme	Scale of assistance	Remarks
a) Development of technologies	100 % (Max. Rs. 50 lakh/ project)	for ICAR (CPCRI)/ SAU/ State Deptt. and co-op. sector
	50 % (Max. Rs.25 lakh/ project)	for NGO's and other organizations
b) Demonstration of technologies	100 % (Max. Rs. 25 lakh/ project)	for ICAR (CPCRI)/ SAU/ State Dept. / Other PSU/ Regd. Co-op. societies
	50 % (Max. Rs.10 lakh/ project)	for individuals / group of farmers/ NGO's, private companies

c) Adoption of technologies	25% of cost of technology adoption	for group of farmers/ NGO's /other organisations

(2) Development and Adoption of technologies for processing and product diversification:		
Scheme	Scale of assistance	Remarks
a) Development of technologies	100 % (Max. Rs.75 lakh/ project)	For Govt. institutions/ PSUs and co-op. societies
	75 % (Max. Rs.35 lakh/ project)	For NGOs, Individual entrepreneurs & other research organizations
b) Acquisition, training,		
Demonstration of technologies	100 % (Max. Rs.25 lakh/ project	For ICAR (CPCRI)/ SAU/ State Dept. / other related PSUs/ registered co-op. societies
	50 % (Max. Rs.10 lakh/ project)	For Individual entrepreneurs, NGO's and other organizations
c) Adoption of technologies	25% (Max. Rs. 50 lakh per project)	for group of farmers/ NGOs/ individual entrepreneurs/ other organisations
	33.3% (Max. Rs. 50 lakh per project)	for SC/ST women farmers
	50% (Max. Rs. 50 lakh per project)	in case of high value agriculture in UTs of Andaman & Nicobar Islands and Lakshadweep

(3) Market research and Promotion:		
Scheme	**Scale of assistance**	**Remarks**
(a) Market research	100 % (Max. Rs.25 lakh/ project)	For Govt. agencies & Co-op. Societies
	50 % (Max. Rs.12.50 lakh/ project)	For individuals, NGOs &other organizations
(b) Market Promotion - Brand building	100 % (Max. Rs.25 lakh/ project)	For Govt. agencies & Co-op. Societies
	50 % (Max. Rs.6 lakh/project)	For Federation of CPSs (FPOs)
	50 % (Max. Rs.15 lakh/ project)	for NGO's and private institutes

(4) Technical Support, External Evaluation and Emergent Requirement:- Support is extended on need basis as decided by the Project Approval Committee of TMOC.

The detailed information of the Mission, projects sanctioned, application forms, etc. is uploaded in Board's website.

9. Replanting and Rejuvenation of old Coconut Garden

The main objective of the scheme is to enhance the productivity and production of coconut by removal of disease advanced, unproductive, old and senile palms, replanting with quality seedlings and rejuvenating the remaining palms through integrated package of practices.

Financial assistance is extended under three components as below:

(i) **Cutting and removal of all old, senile, unproductive and disease advanced palms** Subsidy @ Rs.1000 per palm, subject to a maximum of Rs.32000/ha extended during the first year

(ii) **Replanting** Subsidy of Rs.40/- per seedling subject to a maximum of Rs 4,000/ ha extended during the first year

(iii) **Rejuvenation of the existing coconut palms by integrated management** Subsidy of Rs.17,500/- ha extended in two annual installments of Rs.8,750/- each.

The scheme is implemented on project basis based on State specific problems through State Agri./ Hort. Department. The project shall clearly indicate the action plan and calendar of operation along with location, no. of palms to be removed, area to

be rejuvenated and no. of seedlings to be replanted, etc. based on the baseline survey. The project is considered after issue of State Level Administrative Approval by State Governments.

For the detailed guidelines of the programme, please log on to https://coconutboard.gov.in/docs/r-n-r.pdf

10. Coconut Palm Insurance Scheme

Implementation of Coconut Palm Insurance Scheme (CPIS) is continued during the year 2021-22 with the objective of insuring coconut palms against natural calamities, climatic risks, pests, diseases and other perils. Under this scheme, all healthy nut bearing coconut palms in the age group from 4 years to 60 years in a contiguous area (Mono / mixed) can be insured against natural perils leading to death/ loss of palm /becoming unproductive. 50% of the annual premium is borne by the Board and balance is shared between the State Govt. and Farmer @ 25% each, as below.

Age group of Palms	Premium (Rs.)	Board's share (Rs.) (50%)	State Govt. Share (Rs.) (25%)	Farmer's share (Rs.) (25%)	Sum Assured (Rs.)
4-15 years	9.00	4.50	2.25	2.25	900/-
16-60 years	14.00	7.00	3.50	3.50	1,750/-

Insurance is for individual palms and not area based. Partial insurance of plantation is not allowed. Minimum 5 healthy nut bearing palms is the criterion to come under the insurance scheme. The scheme is being implemented in all coconut growing States through Agriculture Insurance Company and in association with State Governments.

The scheme guidelines are detailed in https://coconutboard.gov.in/docs/cpis-guidelines.pdf

11. Kera Suraksha Insurance Scheme

The Kera Suraksha Insurance scheme for Coconut Tree Climbers(CTC)/Neera Technicians/Coconut Harvesters is continued during the year 2021-22. The insurance scheme is implemented in association with M/s Oriental Insurance Company Ltd. The scheme is implemented in all coconut growing States.

The provisions under the scheme have been modified from 1st November 2020 with increased benefits under all the components of the policy. The sum assured revised under the policy is Rs. Five lakhs against 24 hours accident related risk including death.

Annual premium under the policy is Rs. 398.65/-, out of which Board's share of premium is Rs 299.65 and balance Rs. 99/- is the beneficiary's share. Beneficiary has the option of paying his/her share of premium of Rs. 99/- through DD or online mode.

The component provisions under the scheme, present compensation, responsibilities of the Board, Insurance Agency and the beneficiary, application form, etc. are available in Board's website.

(For availing the benefits under these schemes or for further information public can contact the offices of the Board located in various parts of the country.)

The geographical jurisdictions of operation of Board's offices located in various parts of the country are given below.

CDB celebrating 23rd World Coconut Day

To commemorate the foundation day of the International Coconut Community (ICC), CDB is celebrating 23rd World Coconut Day on 2nd September2021. The theme announced by ICC, for its 23rd edition of celebrations, is **"Building a Safe, Inclusive, Resilient and Sustainable Coconut Community Amid Covid 19 Pandemic and Beyond".** Shri.Narendra Singh Tomar, Hon'ble Minister for Agriculture & Farmers Welfare, Government of India, Ms. Shobha Karandlaje and Shri. Kailash Choudhary, Hon'ble Ministers of State for Agriculture &Farmers Welfare, Government of India are expected to attend the programme as Guests of Honour. Shri Sanjay Agarwal IAS, Secretary, Department of Agriculture & Farmers Welfare, Shri. Rajbir Singh IFS, Joint Secretary, (MIDH) and Chairman, Coconut Development Board, senior officers from the Ministry of Agriculture & Farmer's Welfare, Government of India, 400 prospective farmers from across the country and officials of Coconut Development Board are expected to attend the programme. The programme will be followed by a technical session for farmers on Coconut Cultivation and Value addition.

Coconut Development Board Establishments

(Address, phone no. & email details may be seen in https://coconutboard.gov.in/CDBOffices.aspx)

S. No.	Region	Unit Office(s) of the Board situated	State(s)/ UT(s) covered for implementation of schemes
1.	Kochi, Kerala	Head Office, Kochi, Kerala	Kerala & Lakshadweep Islands
		DSP Farm, Neriamangalam, Kerala	
		Technology Dev. Centre, Aluva, Kerala	
		Field Office, Trivandrum, Kerala	
2.	Bengaluru, Karnataka	Regional Office, Bengaluru, Karnataka	Karnataka & Goa
		DSP Farm, Mandya, Karnataka	
		State Centre, Thane, Maharashtra	Maharashtra
		DSP Farm, Palghar, Maharashtra	
3.	Chennai, Tamil Nadu	Regional Office, Chennai, Tamil Nadu	Tamil Nadu, Puducherry
		DSP Farm, Dhali, Tamil Nadu	
		State Centre, Vijayawada, Andhra Pradesh	Andhra Pradesh, Telangana
		DSP Farm, Vegiwada, Andhra Pradesh	
		State Centre, Port Blair, Andaman & Nicobar Islands	Andaman & Nicobar Islands
4.	Patna, Bihar	Regional Office, Patna, Bihar	Bihar, Jharkhand
		DSP Farm, Madhepura, Bihar	
		State Centre, Kolkata, West Bengal	West Bengal
		DSP Farm, Fulia, West Bengal	
		State Centre, Pitapalli, Odisha	Odisha
		DSP Farm, Pitapalli, Odisha	
		MDIC, Delhi	Gujarat, Delhi, Uttar Pradesh, Rajasthan, Haryana, Uttarakhand, Himachal Pradesh, Punjab, Jammu & Kashmir
		DSP Farm, Kondagaon, Chhattisgarh	Chhattisgarh
5.	Guwahati, Assam	Regional Office, Guwahati, Assam	All North Eastern States
		DSP Farm, Abhayapuri, Assam	
		DSP Farm, Hichachara, Tripura	

Further, as the Board's programmes are implemented in close coordination with the State Departments, the nearest offices of the Agriculture/ Horticulture Department of the State/ UT may also be contacted. ■

Current status, constraints and prospects of coconut cultivation in Assam

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The state of Assam is blessed with six agro-ecological zone viz., North Bank Plain, Upper Brahmaputra Valley, Central Brahmaputra Valley, Lower Brahmaputra Valley, Barak Valley and Hill zone which favours the growth of wide range of plantation crops. Among the various plantation crops grown in Assam, coconut is the one mostly grown by small and marginal farmers. Area under coconut in Assam is estimated to be 19,920 hectare with a production of 168.21 million nuts and the productivity is 8,444 nuts/ha. Nagoan district has the maximum area under coconut (2,941 ha) followed by Barpeta (1,622 ha) and Nalbari (1,390). Coconut is grown in most of the districts of Assam covering the Upper (Charaideo, Dhemaji, Dibrugarh, Golaghat, Jorhat, Lakhimpur, Majuli, Sivasagar and Tinsukia), Central (Dima Hasao, Hojai, East Karbi Anglong, West Karbi Anglong, Morigaon and Nagaon), Lower (Baksa, Barpeta, Bongaigaon, Chirang, Dhubri, Goalpara, Nalbari, Kamrup (M), Kamrup (R), Kokrajhar and South Salmara-Mankachar), Hills and Barak Valley (Cachar, Hailakandi and Karimganj) and North Assam (Biswanath, Darrang, Sonitpur and Udalguri). The soil and climatic condition of these regions provide congenial atmosphere for growth and development of coconut. The three distinct types of soil found in these zones are red sandy loam, alluvial red loam and lateritic soils. The climate of Assam is sub-tropical in nature receiving an annual rainfall of 1,840 mm to 3,528 mm. Though this region is non traditional area for coconut cultivation, there is potential scope for increasing the production and productivity through adoption of improved scientific cultivation practices. This article highlights the present scenario, prospects, in constraints and strategies for improving coconut cultivation in Assam.

Coconut Scenario in Assam

Coconut is an important cash crop in Assam and is having an important place in ritual and other social and cultural programmes. It is mainly grown as a homestead crop mostly by small and marginal farmers. The state occupies a major share, contributing 55% of the total area and 76% of the total production among the North Eastern regions of India. Though coconut is grown in most of the districts of Assam, its cultivation is mainly confined to Central and Lower Brahmaputra Valley Zone of Assam. Nagaon, Barpeta, Kamrup, Sonitpur, Nalbari, Golaghat, Cachar, Karimganj, Morigaon, Udalguri, Darang, Bongaigaon, Baksa and Shivsagar are the leading coconut growing and producing districts in

Assam. The crop has gain substantial importance among the farming community since they can sell the nuts at weekly/monthly interval whenever they face financial problem. Considering the area, production and productivity (Table 1) for the last eight years (2009-10 to 2017-18), area under coconut has increased from 18,800 hectare (2009-10) to 19,920 hectare (2017-18), while the production figure indicates uneven trend in productivity of about 1000 to 2000 nuts per hectare.

Table 1. Trends in area, production and productivity of coconut in Assam (2009-10 to 2017-18)

Year	Area	Production (Million nuts)	Productivity (Nuts/ ha)
2009-10	18800	157.90	8399
2011-12	20800	304.47	14638
2012-13	22150	160.21	7233
2013-14	20230	136.61	6753
2014-15	21140	237.49	11234
2015-16	19730	132.59	6720
2016-17	20600	153.27	7440
2017-18	19920	168.21	8444

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India

Suitability of new coconut varieties/ hybrids under Assam condition

Coconut though grown in all the 33 districts, covering the upper, middle and lower parts of Assam, most of the coconut grown is of the local type and there is scope for increasing the production and productivity in the state by going in for planting of more productive varieties. Assam Tall is the most common cultivar of coconut grown in this region. A higher average yield of about 80 nuts per palm per year has been reported in a selection of Assam Green Tall, at the Horticultural Research Station, Kahikuchi, Guwahati, Assam. This indicates the potential for improving coconut productivity in the state and also the need for identification of more improved varieties for cultivation in Assam. For the development of improved varieties for specific agro-climatic zones, it is necessary to characterize and evaluate the coconut genetic resources to identify their yield potential as well as adaptive features for utilization in the coconut improvement programme. Trial conducted at ICAR-Central Plantation Crops Research Institute, Research Centre, Kahikuchi, Guwahati

Kera Sankara

Chandra Sankara

Assam with fifteen coconut varieties viz., West Coast Tall, Assam Tall, Ganga Bondam, Chowghat Orange Dwarf, Malayan Yellow Dwarf, Malayan Green Dwarf, Malayan Orange Dwarf, Lakshadweep Ordinary, Fiji Tall, Chandra Sankara, Kera Sankara, Laksha Ganga, Chandra Laksha, Kera Ganga and Kerasree for growth, nut yield and nut characters resulted that among the coconut varieties/hybrids tested, Kera Sankara and Chandra Sankara hybrids were found to be suitable for the region with a potential nut yield of 96.25 and 78.0 nuts/palm/year respectively.

Constraints in coconut production in Assam

The crop needs utmost care to improve the production and productivity in Assam. The following are the main factors affecting coconut production in Assam.

▶ *Emergence of new pest*

A new pest of coconut rugose spiraling whitefly (RSW) (*Aleurodicus rugioperculatus Martin)* was reported in Kamrup and Nalbari districts of Assam hindering coconut production in Assam. The pest damage symptoms include deposition of sooty mould on the upper surface of palm leaflets. Awareness

Training on rugose spiraling whitefly

Release of *Leiochrinus Nilgirianus* in farmers field

programme on management of the pest has been done in Kamrup (Damdama, Hajo, Kalitakuchi) and Nalbari (Bijulighat, Barkuriha, Madhapur, Katpua, Tilana) district of Assam. To combat the pest incidence, augmentative biological control by releasing palm leaflets (10 cm) containing the E. guadeloupae and sooty mould feeding Leiochrinid beetle, Leiochrinus nilgirianus was undertaken in most of the pest affected hamlets by ICAR-CPCRI.

▶ *Adoption of improved varieties*

Coconut varieties like Kamrupa, Kalpa Samrudhi, Chowghat Orange Dwarf, Chowghat Green Dwarf and West Coast Tall have been recommended by ICAR-Central Plantation Crops Research Institute for Assam condition. However, farmers are still planting the local varieties and procurement of planting material is done mainly from local market of unknown sources.

▶ *Quality planting material*

Lack of quality planting material is one of the major constraints faced in the State. Though Assam is suitable for coconut cultivation, the productivity is low as non descriptive local varieties are mostly grown due to non availability of good quality planting material within easy reach of farmers. As per rough estimate by the Coconut Development Board, the annual requirement of coconut seedlings in Assam is around two lakhs but the production of quality seedlings is much below the above figure. The main problem associated with the supply of quality planting material is the lack of systematic survey for identification of quality mother plants of genuine varieties, lack of sufficient government certified nurseries for supply of coconut seedling to growers and lack of proper knowledge for selection of nuts for seed purpose from the mother plants. The seednuts collected for seedling purpose are not selected properly from genuine mother plants and scientific method of raising coconut nursery is not being followed by the nursery owners.

▶ *Poor management practices*

Coconut is mainly grown as a rainfed crop with poor management practices in Assam. Buttons and immature nut shedding is a common problem in coconut. Immature nut fall in coconut has been attributed to various factors like nutritional deficiencies, pathological conditions, insect pests and unfavourable condition like moisture stress, water logging and lack of aeration. Among the diseases, stem bleeding caused by the fungus *Theilaviopsis paradoxa* and among pest rhinoceros beetle, red palm weevil and eriophyd mite are the significant ones.

▶ *Transfer of technology*

Farmers are not aware of the improved production technology. Technology needs to be transfered at regular interval to create awareness among the farming community. Technique of seednut selection for nursery, fertilizer application, management of diseases and pests, production of quality planting material, cropping system and farm mechanization need to be disseminated. Through various researches, improved technologies have been developed, but the penetration at the farmers level is very poor particularly in non traditional coconut growing areas which need to be strengthened. Technologies like High Density Multispecies Cropping System suitable for a particular region need to be developed to enhance income from their small holding and technique of farm mechanization to enhance the productivity need to be introduced.

▶ *Marketing*

There is no proper market for coconut in Assam.

Demonstration of tender coconut punching and cutting machine

Training in coconut climbing

The farmers usually sell their produce in local market and the price of coconut is quite low ranging from Rs.30 to 40 per nut. The price of coconut is quite remunerative only during 'Bihu' festival and other religious ceremonies with the price rising to two to three fold of the normal price. Since, the coconut farmers are also not getting attractive prices due to non existence of coconut based industries and proper market tie ups, farmers harvest tender nut and sell to middlemen at lower price. The middlemen sell it in the local market and roadside of highways. Rate of tender coconut in market varies from Rs. 40 to 50 per nut depending on the size and season.

Prospects of coconut cultivation in Assam

Coconut serves as an additional livelihood enhancement crop in Assam. The importance of coconut is increasing day by day due to its various unique features. Sustainable system of production can be achieved through cropping system. In coconut garden spaced at 7.5m x 7.5m, inter space provide immense opportunity for growing shade loving annual and perennial crops for generating additional income to the growers. The availability of biomass from a well managed coconut garden is estimated to be 14 tonnes per hectare per year. Studies conducted at ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala has revealed that coconut biomass could be effectively converted into rich vermicompost using earthworm, Eudrilus sp. Low cost vermicomposting technology enables production of organic manure within a period of 60-75 days. On an average, 70% biomass recovery of vermicompost is obtained. Most of the coconut grown in Assam is by default organic and there is immense scope for producing organic coconut in this region. Farmers of Assam are not much aware about chemical fertilizers and plant protection chemicals. Thus, there is potential scope for converting this small holding into organic holdings. A holistic approach integrating IPM, IDM and INM practices is necessary to achieve higher production and productivity. Research finding yielded fruitful results in terms of increasing production and productivity through adoption of high yielding varieties and cropping system suitable for particular regions. In Assam, ICAR-Central Plantation Crops Research Institute, Coconut Development Board, Ministry of Agriculture, Govt. of India and Assam Agriculture University are working for improving the coconut scenario.

Strategies for increasing production and productivity

- Production of quality planting materials and distribution of best planting materials to the farmers.
- Identification of potential coconut pockets for higher productivity and establishment of coconut based industries like tender coconut water, coir etc.
- Establishment of coconut garden for attractive benefit to the farmers.
- Management of diseased/ unproductive / old coconut garden and need based replacement with new seedling and establishment of network for market tie-up and promotional activities.

Conclusion

Assam with its various unique features among the North Eastern regions of India plays an important role for various plantation crops. Study conducted at ICAR-Central Plantation Crops Research Institute, Research Centre, Kahikuchi among the coconut varieties evaluated under Assam condition, hybrids Kera Sankara and Chandra Sankara were found to perform better than other varieties. These hybrids can be recommended to farmers for commercial cultivation and can be included under the demonstration cum seed production programme also for enhancement of seedling production and distribution of planting material in the region. ■

Climate change, Carbon sequestration and Coconut based Ecosystem

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Climate change is a key issue of the present day. It refers to gradual increase in temperature and the consequent effect on the atmosphere. Today what we are experiencing is believed to be caused by the increase in atmospheric concentration of carbon dioxide and other green house gases. Several global initiatives have been launched to address this issue. Coconut based cropping system provides good opportunities for enhancing carbon sequestration through different perennial and annual crop combinations such as spice crops, tree crops, tuber crops and food crops. A study was initiated in 30 year old D x T coconut plantation at Regional Coconut Research Station, Bhatye, Ratnagiri (MS) under All India co-ordinated research Project on palms during 2013-14 and 2017-18. The component crops were nutmeg, cinnamon, banana and pineapple. The main focus of the study was yield maximization, carbon sequestration and employment generation potentiality generated through coconut based cropping system. Generating and establishing more sustainable cropping system is one of the needs of the hour. Multispecies and multi-storeyed cropping system ensures maximum utilization of resources for higher yield per unit area. There are many coconut based cropping systems in various countries and in India. Effective and efficient utilization of available resources for higher yield is the modern concept of cropping system. Improvement in the soil properties and biological activities in the rhizosphere due to intercropping results in the modification of soil environment for the benefit of the plant growth. Studies revealed that natural resources i.e. soil, water; air space and solar reclamation are not fully utilized under the spacing schedule 7.5 m x 7.5 m. It is reported that a well designed high density multispecies crop model suited to a given agro-climatic situation generates biomass output, yields more economic and higher total income, additional employment opportunities for family labours and meets the diversified needs of the coconut farmers, such as food, fruit, vegetables, fuel etc. The coconut based cropping systems are gaining importance as there are serious market fluctuations for coconuts and coconut products. Systematic mixed cropping of compatible crops under coconut to compensate the economic losses of sole cropping by increasing income per unit of cultivable land has become a necessity.

Economic and Social Importance

Coconut is an important crop of economic importance to many of the Asian and Pacific countries in the world. The crop provides livelihood security and employment opportunities to a major segment of the rural mass of these countries. India being the largest coconut producing country in the world occupies 31% of the global production. Widely acclaimed as Kalpavriksha or Tree of life, the coconut palm provides food security and livelihood

opportunities to more than 10 million people in India. It is an important food crop for the major chunk of Indian population. Similarly it is an important cash crop for more than 10 million farm families and a fiber-yielding crop for more than 15,000 coir based industries which provides employment to nearly six lakhs workers of which 80 per cent are women folk. Coconut and coconut products are gaining global importance as a contributing factor to the health, nutrition and wellbeing of human being. This is due to its multiple medicinal and nutraceutical properties being revealed day by day. This new development in health sector brought in an unprecedented increase in the demand for coconut products in the domestic and international markets. It is estimated that there are 5 million coconut holdings and 12 million farmers in the country.

Coconut based cropping system demonstrating carbon sequestration

Agriculture can be a primary solution to the problem of greenhouse gas emissions and climate change. As a result, farmers are now familiar with terms like carbon credit, carbon financing and carbon payments.

The issue of climate change revolves primarily around the main atmospheric form of carbon, CO2. In fact, CO2 is the metric, or currency in which changes in atmospheric radioactive forcing (i.e., global warming) are measured. The most effective way to reduce atmospheric CO2 levels is through Mother Nature's own process of photosynthesis. A few simple, back of the envelope calculations demonstrate agriculture's ability to assimilate CO2, which can potentially lead to carbon capture and storage. Let's use coconut, the nation's plantation crop, as an example. In this experiment we have compared the coconut based cropping system with monocrop coconut.

Table: Details of the component crops in coconut cropping system/ha.

Sr. No.	Name of the crop	Varieties /hybrids	Number of plants/ block	Number of plants/ ha
1.	Coconut	D x T (COD x WCT)	20	175
2.	Nutmeg	KonkanSwad	12	135
3.	Cinnamon	KonkanTej	62	615
4.	Banana	KonkanSafedVelchi	62	615
5.	Pineapple	Kew	960	10800

Above ground carbon sequestration of crops

It was observed that, among the different integrated nutrient management systems, the above ground standing biomass (SDW) and above ground carbon stock (353.25 kg/plant and 31.06 t/ha, respectively) was significantly the highest in coconut based cropping system. The lowest above ground biomass and carbon stock were observed in coconut monocrop (288.8 kg/plant and 25.6 t/ha, respectively). This is because the intercrops in coconut based cropping system have added additional biomass production than monocrop. Hence the carbon stock was the highest in the cropping system plots compared to monocrop of coconut. Furthermore, the CO2 sequestered also followed the same trend and accordingly, the highest CO2 sequestration was recorded in coconut based cropping system, whereas the lowest CO2 sequestration was noticed in coconut monocrop (93.8 t/ha). Trees are carbon reservoir on earth and in nature, forest ecosystem act as a reservoir of carbon and store huge quantity of carbon and regulate the carbon cycle by exchange of CO2 from the atmosphere. Thus, forest ecosystem plays a significant role in the global carbon cycle by sequestering a substantial amount of carbon dioxide from the atmosphere by storing it in the biosphere.

Soil bulk density and organic carbon

The bulk density of soil (g/cm3), soil organic carbon (%) and soil carbon stock (t/ha) is at 0-30 and 31-60 cm depth in the rhizosphere of different crops in the system. With respect to bulk density, no significant difference was found among the different cropping system and INM practices at both the depths during the course of study. The organic carbon (OC) content differed significantly among the cropping systems at both the depths. Among the different crops, significantly the highest soil organic carbon (0.86% and 0.81%) was documented in coconut basin at 0-30 and 31-60 cm depth in fully organic managed garden. The coconut basin in the monocropping system recorded significantly the lowest organic carbon at both the depths (0.60 and 0.51 %). The rhizosphere of intercrops like nutmeg, cinnamon, pineapple and banana also recorded higher organic carbon content, whereas in the interspace of monocropping, it was found significantly lower (0.46 and 0.44 %). Growing intercrops in the coconut garden has lead to addition of recyclable biomass from the intercrops which has resulted in improvement in the organic carbon content.

Soil carbon stock

The soil carbon stock was significantly influenced by coconut based cropping system. Among the different crops under investigation, the coconut rhizosphere had significantly higher soil carbon stock (42.31 t/ha and 39.85 t/ha) in the depths of 0-30 and 31-60 cm. The lowest soil carbon stock of 28.44 t/ha and 24.17 t/ha at 0-30 and 30-60 cm depth was noticed in the coconut rhizosphere in the monocropping system. Significantly the highest soil carbon stock was observed in coconut based cropping system at 0-30 and 31-60 cm depth in the rhizosphere of different crops. The lowest soil carbon stock observed in the coconut monocrop might be due to the absence of intercrops in the interspace which might not have contributed to soil carbon pool. Furthermore, the coconut basin rhizosphere has recorded higher carbon stock at both depths (0-30 and 31-60 cm), which might be due to increase in organic carbon in the soil owing to decomposition of root system over a period of time as compared to other crops and organic manure incorporation to the coconut crop and interaction effect of organic manure and green manure incorporation.

Economics and employment generation under coconut based cropping system

▶ *a) Economics*

The total cost involved in maintaining the coconut based cropping system was Rs. 123769.60 and the net return was Rs. 1,31,605.8 with the highest cost benefit ratio of 1:2.69. Merely monocrop of coconut recorded Rs 38,735 as net return with 1:1.60 cost benefit ratio.

▶ *b) Employment generation*

The employment potential of coconut based cropping system is observed to be very high. The labour input utilization of irrigated monocrop of coconut (at its stabilized yield stage) is 157 man days/ha/year. The labour utilization in the coconut cropping system with banana, pineapple, cinnamon and nutmeg was 297 days/ha/year. In percentage term, the increase was about 189 per cent over the sole crop system. Since it is expected that the bulk of the labour force is available from the family source of the farmer, family labour income could therefore be considerably raised when coconut based cropping system was adopted. ■

Independence Day observed in CDB

Shri. R.Madhu, Secretary, CDB hoisitng the National Flag at CDB Head Quarter premises on 15th August 2021.

Physicochemical and Pharmacological Prospective of Homemade Virgin Coconut Oil

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Abstract

Coconut is one of the most important types of plant under the palm family Arecaceae. Coconut is called "Kalpaviriksha" and it is a valuable gift to human being. A study was undertaken to estimate the nutritional value, phytochemical and physicochemical properties and microbial counts of Virgin Coconut Oil (VCO). The result showed that the oil obtained by boiling method was more than which obtained through fermentation method. The physicochemical parameters showed that the oil obtained by boiling method was best for consumption. In fatty acid composition, not much difference was noted between the virgin coconut oils. The chemical constituents present in the methanol and aqueous extracts of virgin coconut oil (Sample –A & B) were phytosterols and polyphenols and the constituents absent were steroids and flavonoids. The nutrient analysis in virgin coconut oil showed that there was not much difference between the oils. The total microbial count of virgin coconut oil obtained through boiling method was found to be safe than the oil obtained through the fermentation method.

1. Introduction

Cocos nucifera is called as "Tree of life" and it is commonly known as coconut, coco, coco – da – bahia (coconut – of – the – beach). It is produced in large amounts and exported to other countries by India, Indonesia, Sri Lanka and Malaysia.

Virgin coconut oil is considered to be a unique and high value product derived from fresh coconut and this is the only oil found with multi – functional uses. VCO can be used as a food supplement or as functional food or neutraceutical.

An attempt was made to study the physico chemical, functional properties, fatty acid composition and nutrient content for homemade Virgin Coconut Oil (VCO).

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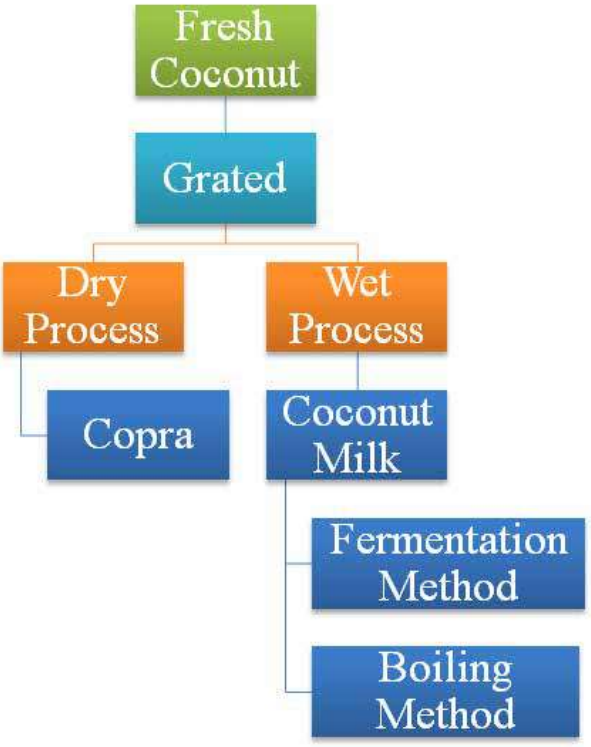

Figure 1: Processing of Virgin Coconut Oil

2. Materials and Methods

The Cocos nucifera is a drupe and it grows around 30 m in tropical and subtropical regions. It yields around 75 fruits in a year under proper growing conditions.The plant consists of exocarp and endocarp which covers the hardened endocarp containing a kernel inside. Mesocarp and endocarp are brown in colour, fibrous in nature and found to be thick of about 3 – 5 mm and the kernel is separated from the shell by the thin brown layer called testa. For the present study, healthy fresh brown coloured coconuts were collected, dehusked and analyzed. Ten to eleven month matured fresh brown coconuts were collected from the farmers, and they were selected carefully without any damage.

▶ *2.1 ANALYSIS OF PHYSICOCHEMICAL PARAMETERS*

The quantitative analysis of the physicochemical parameters such as melting point, solidification point,iodine value, saponification value, acid value, viscosity, peroxide value,moisture content,refractive index, relative density and specific gravity were determined in the VCO samples using standard procedures.

VCO by Boiling method VCO by Fermentation method

Figure 2: Virgin Coconut Oil

▶ *2.2 Analysis of Phytochemicals*

The qualtitative analysis of the phytochemicals such as flavonoids, saponins, alkaloids, steroids, terpenoids, glycosides, phytosterols, tannins, and polyphenols were determined in the Virgin Coconut Oil obtained by both boiling and fermentation methods.

▶ *2.3 Analysis of Nutrient Contents*

The nutrient content such as calories (energy), carbohydrates, proteins, fat and fibre of the virgin coconut oil produced by two different methods were analysed quantitatively.

▶ *2.4 Analysis of Fatty Acid Composition*

The fatty acid composition of the derived virgin coconut oil were analysed using standard procedures qualitatively which includes saturated fats such as caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid and stearic acid and unsaturated fats such as oleic acid and linoleic acid.

▶ *2.5 Assessment of Storage Stability*

The total microbial counts in the virgin coconut oil obtained by boiling and fermentation methods stored in the glass containers were evaluated initially on the 15th and 30th days of storage.

3. Results and Discussion

▶ *3.1 Physicochemical Analysis of Virgin Coconut Oil*

The physicochemical characteristics of the product help to identify the changes that occur during the storage period. The physico chemical parameters of Virgin Coconut Oil is presented in table I

Table I: Physicochemical Parameters of Virgin Coconut Oil				
S.no.	Parameters	Values		APCC * Standard
		Sample A	Sample B	
1	Specific gravity (g/cc)	1.017	0.916	0.915 – 0.920
2	Relative density	0.924	0.919	0.915 – 0.920
3	Viscosity	0.04	0.03	NA
4	Refractive index	1.449	1.448	1.4480 – 1.4492
5	Moisture content (%)	0.52	0.13	0.1 – 0.5
6	Solidification point (0C)	262	258	248 – 265
7	Melting point (0C)	40	38	NA
8	Iodine value	7.5	8.6	4.1 – 11.0
9	Saponification value	252	258	250 – 260 minimum
10	Acid value	1.59	1.96	< 6.0
11	Peroxide value 1st Day	1.2	1.8	≤ 3
	30th Day	2.0	2.6	
12	Free radical scavenging activity (DPPH)	34.41 ± 0.23	39.84 ± 0.37	BHT 40.39 ±0.34
13	Ferrous ion chelating activity	36.71 ±0.48	38.43 ±0.33	EDTA 42.28 ± 0.16
Sample A = Fermentation method, Sample B = Boiling method				
*APCC - Asian and Pacific Coconut Community (2007)				

Table II: - Qualitative Analysis of Phytochemical in VCO					
S.no.	Phytochemicals	Methanol Extract		Aqueous Extract	
		Sample A	Sample B	Sample A	Sample B
1	Alkaloids	-	-	+	+
2	Glycosides	-	-	+	+
3	Phytosterols	+	+	-	-
4	Steroids	-	-	-	-
5	Flavonoids	-	-	-	-
6	Saponins	-	-	+	+
7	Polyphenols	+	+	-	-
8	Tannins	-	-	+	+
9	Terpenoids	+	+	+	+
Sample A = Fermentation method, Sample B = Boiling method					

All the physicochemical parameters, peroxide value and also the potential antioxidant activity were observed to be high in virgin coconut oil obtained by the boiling method than the oil obtained by the fermentation method. Hence, it is proved that oil obtained by boiling method was best for consumption than oil obtained by fermentation method.

▶ 3.2 Phytochemicals in Virgin Coconut Oil

Chemical tests were carried out to analyse the presence or absence of the phytochemicals in the methanolic extract and also aqueous extract of the samples using standard methods. The results of the quantitative analysis of Phytochemicals in Virgin Coconut Oil is given in table II.

The methanol extract of virgin coconut oil (sample A and B) contained varied type of phytochemical compounds which include, phytosterols, polyphenols, and terpenoids. The aqueous extract of virgin coconut oil contains phytochemical compounds such as alkaloids, glycosides, saponins, tannins and terpenoids. Terpenoids were present in both the methanol and aqueous extract of virgin coconut oil (sample A and B). Steroids and flavonoids were absent in both the methanol and aqueous extracts.

▶ 3.3 Nutrient Contents in Virgin Coconut Oil

The nutrient contents are observed quantitatively in the produced Virgin Coconut Oil and it is given in table III.

Table III - Nutrient Content of Virgin Coconut Oil (100 gm)			
S.no.	Nutrients	Virgin Coconut Oil	
		Sample A	Sample B
1	Energy (K.Cal)	849.64	848.93
2	Carbohydrates (gm)	0.03	0
4	Fat (gm)	99.88	98.47
Sample A = Fermentation method, Sample B = Boiling method			

The nutrient content of both the samples (VCO – A and B) were found to be more or less similar and

Table IV - Fatty Acid Composition of VCO					
S.No.	Fatty Acids	CARBON NUMBER	Sample A (%)	Sample B (%)	APCC* STANDARDS (%)
1	Caproic acid	C6 : 0	0.09	0.41	0.40 – 0.60
2	Caprylic acid	C8 : 0	7.27	7.46	5.00 – 10.00
3	Capric acid	C10 : 0	5.95	7.25	4.50 – 8.00
4	Lauric acid	C12 : 0	53.08	49.72	43.00 – 56.00
5	Myristic acid	C14 : 0	18.35	19.43	16..00 – 21.00
6	Palmitic acid	C16 : 0	8.47	8.59	7.50 – 10.00
7	Stearic acid	C18 : 0	3.36	2.91	2.00 – 4.00
8	Oleic acid	C18 : 1	8.79	7.84	5.00 – 10.00
9	Linoleic acid	C18 : 2	1.74	1.36	1.00 – 2.50
Sample A = Fermentation method, Sample B = Boiling method					
*APCC - Asian and Pacific Coconut Community (2007)					

not much differences were observed.based on the nutritive value especially energy and fat contents. VCO – B was found to be more useful and better for the health because of its lower fat and calorie contents.

▶ *3.4. Fatty Acid Composition in Virgin Coconut Oil*

The fatty acid composition of VCO developed by both boiling and fermentation methods were analyzed and the values were compared with the APCC Standards. There was difference in the values between the samples and there was not much deviations in the fatty acid compositions.

▶ *3.5. Storage Satbility of VCO and Coconut Flour/Meal*

The storage stability of the virgin coconut oils subjected to storage in the glass container and the coconut flour / meal was stored in the glass container and ziplock polypack and it was analysed during the initial day, 15th day and 30th day and it is represented in table V.

There was slight increase in the bacterial count in sample A which may be due to the increased moisture content in virgin coconut oil obtained by fermentation method than the oil obtained by the boiling method because it was separated from the water and creamy layers. Though the values increased, it is safe and consumable.

4. CONCLUSION

It can be concluded that Virgin Coconut Oil was rich in phytochemicals and it can be used to treat various disease conditions. The vigin coconut oil obtained by boiling method was found to be rich in all the nutritional parameters than the fermentation

Table V- Total Microbial Count of Virgin Coconut Oil				
S.no.	Virgin Coconut Oil	Total Microbial Count (Cfu / Gm)		
		1st DAY	15th DAY	30th DAY
1	Sample A	1.3×103	2.9×103	3.8×103
2	Sample B	0.9×103	2.1×103	3.2×103
Sample A = Fermentation method, Sample B = Boiling method				

method. Virgin Coconut oil obtained through boiling method. was much more beneficial in both in maintaining good health and also economically low in budget. The virgin coconut oil obtained by the fermentation method and boiling method were microbiologically safe.

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Nutrient deficiency symptoms and its Management in Coconut

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Coconut (Cocos nucifera) is known as Kalpa Vriksha as each and every part of it finds its application in our daily life. Owing to its perennial nature, a major quantum of nutrients is being removed from the system through biomass accumulation. Moreover, as each part of the plant is being removed from the system for human use, the nutrients present in the different palm parts are also being removed from the production system. Hence owing to the exhaustive removal of nutrients from the soil, occurrence of nutrient deficiency symptoms is very rampant in coconut. If the deficiency symptoms are not addressed by the adoption of timely management practices, yield deterioration will occur and also the palm health will be adversely affected.

As per the criteria of essentiality proposed by Arnon and Stout (1939), seventeen essential elements are required universally for all the plants in the planet earth. Apart from the structural nutrients Carbon, Hydrogen and Oxygen, the major nutrients for plant nutrition are Nitrogen(N),Phosphorus(P) and Potassium(K) and the secondary nutrients include Calcium(Ca), Magnesium(Mg) and Sulphur (S). The micronutrients for crop production include Iron(Fe), Manganese(Mn), Copper(Cu), Zinc(Zn), Boron(B), Molybdenum(Mo) and Chlorine(Cl).

Nitrogen is a constituent of amino acids, proteins and nucleic acids. As the major source of nitrogen in the soil is organic matter, the deficiency symptoms are commonly seen in light sandy soils which are poor in organic matter and also in areas where water-logged condition is prevalent. Under water logged conditions, there will be loss of nitrogen as ammonia through volatilisation. Nitrogen is considered deficient when the quantity is below280Kg/ha in soils.

When the available phosphorus content in the soil is between 15-25 kg/ha, the soil is considered as sufficient with regard to its availability. In Kerala, the deficiency of phosphorus is not commonly encountered and the content is usually greater than 25 kg/ha. The deficiency symptoms are usually seen in palms grown in extremely acidic as well as in calcareous soils.

Potassium is the nutrient which is removed in highest proportion from coconut and hence is the key nutrient in coconut production. It is important in formation of palm trunk, imparts resistance to pest and disease attack along with regulating water balance of the plant. It enables the plant to withstand drought. It also has a role in the production of female flowers and nut setting. Seventy eight per cent of potassium is removed from the palm, when the nuts are harvested. Potassium is considered deficient when the quantity is below 110Kg/Ha in soils

Being the central ion in chlorophyll, magnesium, the secondary nutrient in plant nutrition, has a definite role in the pigment system and influences the photo synthetic capacity of the plant. It also enhances the production of female flowers and activates several enzyme systems in the plant system.

Calcium is associated with the membrane transport and hence it is very essential for the cellular function of the plant.

Sulphur is required for the formation of oil and improves the quality of oil and copra. It also improves the nut characters such as its texture and oil content.

Boron is an essential micronutrient for coconut, which helps in the multiplication of meristematic tissues. It helps the metabolism of protein, synthesis of pectin, maintenance of water relation, translocation of sugars, tissue respiration, fruiting process, growth of pollen tube and in the development of flowers and fruits. Wide spread deficiency of boron is noticed in the coconut growing areas which may be attributed to the continuous removal through cropping, and due to the non-replenishment of the same along with regular fertilizer application.

Iron is a micronutrient acting as a catalyst in chlorophyll formation. It is also involved in electron transport and respiration. The deficiency of iron is usually seen in calcareous soils. Excess liming will induce chlorosis resulting from iron deficiency.

Not only major nutrients, secondary nutrients and micronutrients are also important for the sustained coconut production. Hence it is imperative understand the importance of each and every nutrient for coconut production and the symptoms associated with the deficiency of individual nutrients.

The nutrient requirement for coconut is 500g N, 320g P and 1200g K per palm per year (Package of Practice Recommendations, CPCRI, 2016). The proper balance of NPK in the soil is essential for the use efficiency of these nutrients. Hence the availability of the one may affect the availability and utilization of the others. The symptoms of deficiency and its management with regard to the nutrients important for coconut productivity are outlined below.

Nutrient Symptoms Management

Nitrogen

The general symptom of nitrogen deficiency is the reduction in chlorophyll content with golden yellow coloration of older leaves near the petioles and light brown colour near the end, which later dries out. Yellowing starts from the tip of the leaf and leaflets and progresses along the midrib. The peculiarity of nitrogen deficiency is that mid rib also turns yellow at times of deficiency. The deficiency can be managed through the application of nitrogenous fertilizers depending on the soil test data. Apart from the addition of nitrogenous fertilisers, the soil should be enriched with organic matter by the addition of organic manure, green manure and green leaf manuring. Incorporation of organic matter will improve the physio chemical properties of the soil and improve the nutrient and water holding capacity.

Phosphorus

The deficiency symptoms are manifested as purple discoloration, due to the accumulation of anthocyanin pigments and the leaves stay upright. In addition, there will be restricted root growth. Soil test-based application of phosphatic fertilisers

to provide the requisite amounts of available phosphorous

Potassium

The deficiency is common in light sandy soils as well as in laterite soils. High levels of calcium and magnesium in soil results in depletion of this nutrient from the root zone. Excessive liming is another reason for the occurrence of potassium deficiency. Also intercropping with potassium exhaustive crops such as tapioca, fodder grass and pineapple without proper addition of fertilisers can result in the exhaustive depletion of potassium. Orangish yellow discoloration starts from the tip of the leaflets, progressing along the, margin towards the base. The mid rib remains green. Leaf tip becomes withered and became necrotic, necrotic spots also appear on the discoloured part of the leaflet. Later the necrotic spots coalesce together giving a scorched appearance. The appearance of a green triangle with the base in the lowest leaflets and apex towards the tip is a characteristic feature of potassium deficiency in coconut. The symptoms can be managed by the addition of soil test-based potash fertilizer application.

In order to avoid the possibility of the removal of potassium ions through leaching, it is essential to increase the exchange capacity of the soil. Hence proper addition of organic manures should be ensured to increase the exchange capacity of the soil.

Magnesium

Yellowing is the predominant symptom of magnesium deficiency. In the older leaves starting from the tip and extends towards the base and later the younger leaves also turn yellow. Magnesium deficient leaves have distinctly green leaf centres and bright lemon yellow to orange margins. Yellowing occurs principally in those parts of the leaf which are exposed to sunlight, the shaded part remains green. Application of dolomite @ 1 kg per palm 2 weeks prior to fertilizer application and applying magnesium sulphate @ 500 gram per palm during the second dose of fertilizer application can manage its deficiency.

Calcium

Calcium is an immobile element in plant and the deficiency symptoms first appear on the youngest leaves. Young leaves exhibit narrow white bands at their margins. Later there will be rusty appearance in leaf margin. Along with this there will be rolling up of leaves. Sometimes there will be death of buds. Application of lime or dolomite @ 1 kg per palm depending on the lime requirement of the soil two week prior to fertiliser application can supply calcium apart from correcting soil reaction.

Boron

Symptoms appear on the leaves, roots inflorescence and nuts. There will be root thickening, darkening and short ramifications, later the root tips die off, causing overall growth reduction. Since boron is an immobile element in plant, the first symptoms appear on the youngest leaf. Meristematic tissues are seriously affected by boron deficiency. Leaf symptoms appear as fasciation, failure of the leaves to split, 'crown choke disorder'. There will be crinkling and reduction in elongation of young leaves.

Pollen production, pollen grain germination and

Table 1. Fertiliser application schedule for coconut palms

Stage of palm	1/3rd dose (May-June) (gram palm-1)			2/3rd dose (September-October)(gram palm-1)		
	Urea	Mussoriephos	Muriate of potash	Urea	Mussoriephos	Muriate of potash
First year	-	-	-	110	150	170
One year after planting	120	170	190	240	340	375
Two year after planting	240	340	380	480	680	750
Third year onwards	365	500	565	730	1000	1125

Table2. Rating of primary nutrients in soil			
Nutrient(kg/ha)	Low	Medium	High
Nitrogen	<280	280-560	>560
Phosphorus	<10	10-25	>25
Potassium	<110	110-280	>280

Table 3. Rating of secondary and micronutrients		
Nutrient	Deficiency	Sufficiency
Calcium	<300 ppm	>300 ppm
Magnesium	<120 ppm	>120 ppm
Sulphur	<5 ppm	5-10 ppm
Zn (0.1 N HCl for acid soils)	<1ppm	>1ppm
DTPA Zn (soils with pH>7	<0.6ppm	>0.6 ppm
Cu (0.1 N HCl for acid soils	<1ppm	>1 ppm
Cu-DTPA(soils with pH>7	<0.12ppm	.>0.12 ppm
Hot water-soluble Boron	<0.5ppm	0.5-2.0 ppm
Iron	<5ppm	>5ppm
Manganese	<1ppm	>1ppm

pollen tube development will be affected. There will be poor nut setting and button shedding will be rampant. In certain conditions, occurrence of 'Hen and chicken disorder, in a particular bunch is also noticed, ie., there will be occurrence of big and small nuts together in a bunch. Soil pH has to be corrected before the application of borax.

Dolomite can be added @ 1 kg per palm two weeks prior to fertilizer application. Apply borax@ 160 gram in 4 split doses along with organic manure @ 25 kg per palm. Ensuring soil moisture will improve the faster recovery of symptoms through improved boron use efficiency. Soil compaction has to be managed by providing better aeration.

Iron

Yellowing starts from the younger leaves and gradually uniform chlorosis will be observed in the entire crown of the palm. There will not be any necrosis. The deficiency can be managed by the application of ferrous sulphate @ 0.2% depending on the intensity of the symptom and the soil test data.

Manganese

Being an immobile element in plant, the deficiency symptoms are usually initiated at the youngest leaves of the palms grown in calcareous

soil. There will be narrow longitudinal brown necrosis parallel to veins and margins gradually leading to curling of younger leaves. New leaves emerge chlorotic with longitudinal necrotic streaking, towards the tip of the leaf. The base of the leaf shows the curling or frizzling which is characteristic of severe manganese deficiency. Foliar spraying of 0.5% manganese sulphate can also be done.

Copper

The deficiency of copper is usually encountered in soil rich in organic matter. The symptoms include severe bending of the rachis of the youngest leaves, accompanied by yellowing and desiccation of the leaf tip. Graduated colouring from green through yellow to brown is characteristic to the deficiency of copper. The deficiency can be managed by the application of copper sulphate@ 25g per palm per year.

Zinc

Zinc deficiency is characterized by formation of small leaves. Leaflets become chlorotic, narrow and reduced in length. In acute deficiency, flowering is delayed. Zinc deficiency will also lead to button shedding. The deficiency can be managed by the application of zinc sulphate@ 100g per palm per year.

Sulphur

Yellowing initiates on the youngest leaves with older leaves remaining green. Leaves droop as the stem becomes weak. In older palms, the number

of leaf and size are reduced. Apron of dead fronds develops around the stem due to weakness of the rachis. Nuts may fall prematurely. Copra becomes rubbery and will be of poor market quality.
Magnesium sulphate application (20%S) can supply the sulphur requirement, under conditions of deficiency in soil.

Nutrient management strategies for combating deficiency symptoms and maintaining palm health

Adoption of systematic nutrient management strategies from the time of planting onwards can ensure better palm health and productivity. In this regard, the strategies emphasising integrated nutrient management will be more appropriate. Integrated Nutrient Management (INM) refers to maintenance of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimisation of the benefits from all possible sources of plant nutrients including chemical fertilisers, organic manures and biofertilizers in an integrated manner. Each of the components have a complementary effect on the other there by enhancing the overall efficiency of the system. Being a perennial plantation crop with a productive period spanning 6 to 7 decades, for the optimum growth and productivity of coconut, adoption of systematic nutrient management strategies are required. The nutrient requirement of coconut is 500g nitrogen, 320g Phosphorus and 1200g potassium per palm annually. The schedule of application of nutrients is as follows (Table 1).

The first split dose of 1/3 quantity in rainfed production system may be applied in May –June with the onset of monsoon, two weeks after correcting soil pH through liming.The second split dose of 2/3 fertilisers is applied during September-October or depending upon the availability of rainfall and adequate soil moisture. Sowing cowpea seeds @ 100g in one basin during June and incorporation of the biomass, just at the commencement of flowering by one or two plants can supply 25 kg biomass and 120-150g nitrogen. Organic manure application @ 25kg per palm can be applied at the time of covering the basin. In order to meet the requirement of magnesium, magnesium sulphate@500g per palm per year can be applied at the time of second dose fertiliser application. In Irrigated gardens the total quantity of fertilizers can be given in four equal splits at three month intervals.

Retirement

Shri K M Vijayan, Senior Field Officer, retired from the services of Coconut Development Board on 4th January 2021. He served the Board for 30 years.

Shri K K Subhash, Assistant Library & Information Officer, retired from the services of Coconut Development Board on 31st July 2021. He served the Board for 30 years.

Though table 2 gives an indication of the magnitude of nutrients to be applied to coconut annually, the exact quantity should be adjusted in accordance with the soil test data. Table 3 gives the rating of primary, secondary and micronutrients in the soil.

Considering the soil and leaf nutrient status of coconut growing areas, ICAR-CPCRI developed two nutrient mixtures viz., 'Kalpa Poshak' and 'Kalpa Vardhini' for the growth of young palms and for the productivity of bearing palms respectively. Kalpa Poshak has to be applied up to three years @ 40g per palm in the first year and 100g per palm annually in the second and third year. Kalpa Vardhini has to be applied @ 500g per palm annually in two splits. Incremental yield to the extent of thirty-three per cent has been recorded with the application of Kalpa Vardhini. It should be remembered that these nutrient mixtures are to be added apart from the general recommendations and that at 10days after the application of major nutrients.

Coconut, the tree of life can be sustained as a remunerative crop to farmers by the adoption of timely soil health management practices, which encompasses the diagnosis and correction of nutrient deficiency symptoms. This should be taken in a time bound manner, without deterioration of soil and palm health. ■

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Management of Root-knot nematode Infestation in Coconut Cropping System

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Introduction

Plant parasitic nematodes are obligate root parasites with well developed protrusible stylet (Fig.1) used for puncturing the plant tissues for food intake and toxin release. Among the plant parasitic nematodes reported, root knot nematode (Meloidogyne spp.) infests various intercrops including vegetables, spices, fruits, tuber crops etc grown in the interspaces of coconut (Fig.2). The estimated crop losses due to nematode infestation is up to 40 - 60 % especially in the coastal sandy soils in our country.

Fig.1.Second stage juvenile of M. incognita having well developed stylet at head region

Fig.2 .Brinjal and okra intercropped in coconut garden

Damage Symptoms

The characteristic symptoms of root knot nematode (RKN), Meloidogyne incognita infestation is galls or knots formed in the roots (Fig. 3 - 4) of infested plants. Under severe conditions, the affected plants show yellowing of leaves, wilting and stunted growth, inability to absorb and transport water and nutrients and reduced crop yield are prominently seen. Degree of root galling depends on the nematode population density in the soil and host plant species. The number of galls per plant increases with increase in density of nematode population in the rhizosphere. Nematode infestation becomes a pre disposing factor for the infestation of fungi, bacteria and viruses which in turn cause more severe damage than either of the pathogen alone and may even lead to death infected plants.

Integrated nematode management (INM) strategies

Integrated nematode management (INM) is a strategy that integrates various methods of cultural, physical, mechanical, biological control and selection of nematicides as the last option. It is not only cost effective but also eco-friendly management practice. The following INM measures are suggested for affective management of M. incognita infestation in various intercrops grown in coconut gardens *(Rajkumar et al., 2016).*

1. Selection of nematode free (absence of root galls) healthy seedlings for transplanting.

2. Crop rotation with non host crops like sorghum, maize etc. (Fig.5) which suppress the nematode multiplication by sustained release of active ingredients from the root exudates

3. Selection of less susceptible inter crops such as nutmeg, cinnamon, cloves, colocassia and tapioca in coconut cropping system reduce the nematode population in gardens.

4. Monocropping on same field for long period should be avoided.

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Fig3. Amaranthus healthy & infested roots by M incognita

5. Growing of antagonistic crops like marigold in alternate rows or in patches to reduce the nematode build up in soil (Fig. 6) as they produce a substance called alpha-terthienyl which inhibits the hatching of root knot nematode eggs.

6. Regular application of biological agents such as Trichoderma, VAM and Paecilomyces lilacinus reduces the nematodes infestation.

7. Sequential planting of sorghum followed by turmeric or ginger with 20% marigold (Tagetes sp.) suppresses the root knot nematode population in the interspaces of coconut garden.

8. Weed control in coconut garden reduces the nematode multiplication during off season as weeds acts as alternate host for *M. incognita* (Fig.7)

9. Application of Trichoderma enriched neem seed kernel powder @ 0.5 to 1 kg/plant during pre & post monsoon period in papaya, noni and black pepper in coconut system effectively reduce the nematode multiplication in soil.

10. In severe cases, soil drenching of nematicide, Carbosulfan (Marshal 25 EC) to the soil root zone @ 0.1%. (1 ml/liter of water) is recommended.

References

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Fig 4 Infected okra roots covered by numerous knots caused by M incognita

Fig 5. Sorghum- non host crop growing in coconut interspace

Fig 6. Marigold cultivation in interspaces of coconut

'Coconut Sap Chiller'-
Patent granted to ICAR-CPCRI and a Farmer Entrepreneur

An invention of collecting sap (neera) from coconut spadix under cool condition using ice box by ICAR-Central Plantation Crops Research Institute as early as 2013 was a breakthrough technology for the collection of hygienic and unfermented neera. In the tradional method which is collected in open earthern pots with lime coating from inside, the sap was unhygienic (contamination from insects, ants, pollen, dust etc) and partially fermented under ambient condition and mostly used for the preparation of alcoholic drink toddy. Due to non-availability of scientific collection methods coconut tapping was under control of Excise Department in most of the states and hence its tapping and marketing was restricted.

The ice-box technology developed by ICAR-CPCRI is very simple. Dr. K.B.Hebbar, Head Plant Physiology, Biochemistry and Post Harvest Technology, CPCRI has invented the technology. The collection involved attaching a PVC adaptor to the cut end of spadix, a pipe drains the sap to a container housed in the commercial ice box with ice cubicles. However, when this technology was commercialised to Mr. Augustine Joseph a farmer and started tapping, day time collected neera would be partially fermented due to its exposure to sunlight during the flow through the pipe. Moreover, the ice in the commercial box would last only 6 to 8 hours whereas it would be required to last atleast 12 to 14 hours in between the two tappings, followed in a day.

Hence, the need was felt for a customised box where the spadix to be tapped would be inside the box and neera from cut end would directly trickle to the container placed inside the box. CPCRI and Mr. Augustine, who is a technology transferee from CPCRI jointly worked and developed a box from locally available material which was later called as "Coconut sap chiller'. It is a simple PVC pipe base is modified like a box, insulated externally by thermocol and rexin, having an inlet (spadix insertion) and at the top end cap for inserting ice cubes and extracting filled neera collection container. As it is completely closed from all the sides, there is no chance for entry of insects and ants and also ice cube last for 12 to 13 hours and the temperature inside is maintained at around 4^{o}C. The neera collected at 4^{o}C is in its original form and retained all its qualities intact. It is not only a very good health drink in its original form but also easily amenable for processing into various value added products. Looking at its commercial potential it was filed for a patent in 2014 with Dr. K.B. Hebbar, Head PB& PHT CPCRI and MR. Augustine Joseph, currently running S J Agro Technologies,(Manufacturer, Supplier of Farm equipments, Accessories & Products), Udupi District,Karnataka as inventors. The patent has been granted with patent NO. 373309, by Intellectual Property of India, Govt. of India on 30th July 2021.

Meanwhile, the physical, chemical, biochemical, sensory and microbial analysis conducted on its sugar, protein, amino acids, vitamins, phenolics, antioxidants, minerals etc. found that the neera collected by the chiller is far superior to not only above parameters but also taste, flavor aroma etc. from neera collected by traditional method. Hence, sap collected by chiller method is christened as Kalparasa and registered under trademark as non alcoholic beverage (Trade Mark No. 2813919 dated: 22-09-2014. It is ideal to be sold as fresh beverage or nutritive drink because of its nutritional qualities. The natural, chemical free value added products developed viz. coconut sugar, jaggery, syrup, concentrate, vinegar etc. developed from Kalparasa are far superior quality. Second line products like sweets, confectionary items, bean to bite chocolate, ice creams etc can be prepared with this neera.

Because of the availability of scientific way of tapping and collecting zero alcoholic neera and the economic interest it elicited in farming community, most of the state governments have eased the restrictions on tapping and marketing and started granting license to registered coconut federations. Initial adoption by the individual enterpreuners and small groups of farmers in Karnataka, Goa, Tamil Nadu and West Bengal, for tapping and to sell it either as beverage or processing into coconut sugar or concentrate is very encouraging. It not only improved the income of the farmers, generate employment in terms of tapper, marketing personnel, technical person but also ensured a quality product to consumer. As it is a highly perishable product, collecting, processing, branding and marketing by the coconut producing companies alone may not be feasible and hence most of them may not be successful at this juncture. However, some of the latest initiatives by the government for forming Farmer Collectives, establishing common processing center, assistance to branding, packaging, capacity building would certainly help in promoting this kind of products.

As there was increasing in tapping in different states, it was difficult to meet the demand for the chiller needs of the enterpreuner/CPC timely and it was costly. Hence it was decided to develop a mould for the manufacture of the chillers which was done with the financial support of Coconut Development Board (CDB).

Cultivation Practices in Coconut Garden - September

Planting

In low lying areas, planting of coconut seedlings can be undertaken in small sized pits or on mounts raised to one metre above water table. Prevent accumulation of rain water in the seedling pits by ensuring adequate drainage. In regions like Tamil Nadu field preparation should be done for new planting.

Manuring

Circular basins of 1.8m in radius and 25 cm depth may be dug and green leaf or compost or farm yard manure at the rate 50 kg per palm may be spread in the basin. Two third of the recommended dose of chemical fertilizers may be spread over the green leaf or compost and covered. Application of 500 g N, 320 g P_2O_5 and 1200 g K_2O per palm per year is generally recommended for adult plantations. To supply two-third of the above nutrients it is necessary to apply about 0.72 kg urea, 1 kg rock phosphate (in acidic soil) or 1.33 kg Super Phosphate (in other soils) and 1.33 kg of Muriate of potash (MOP). Under irrigated conditions, one fourth of the recommended dose of chemical fertilizers can be applied during September.

It is always recommended to apply chemical fertilizers based on the soil test results rather than going by the general recommendations.

Wherever Boron deficiency is noticed 100 g Borax may be applied in the basin. For coconut palms showing yellowing of leaves due to Magnesium deficiency, 0.5 kg of magnesium sulphate can be applied in the basins along with other fertilizers.

The above schedule of manuring is suitable for all the major coconut growing regions which are mostly benefitted by South-West monsoon during the season. In localities of Tamil Nadu, which are mostly benefitted by North- East monsoon the first dose (one third of recommended dose) of chemical fertilizers can be given during September. Under such situations, lime or dolomite or gypsum @ 1kg/ palm need to be applied two weeks before the first dose of chemical fertilizers are applied.

Green manuring

Wherever green manure crops are grown, plough in the green manure crop (after attaining 50 per cent flowering) and incorporate into the soil.

Intercultural operations

Ploughing/digging of interspace is to be undertaken to keep the plantation free of weeds. Care should be taken to avoid injury to coconut palm while ploughing.

Nursery management

Weeding should be done in the nursery. Five month old ungerminated nuts and dead sprouts should be removed from the nursery. In localities of Tamil Nadu, which are mostly benefitted by North-East monsoon, land preparation can be taken up for sowing seednuts.

Crown cleaning

Wherever crown cleaning has not undertaken during August the same may be done during this month.

Mulching

Mulching of palm basins can be undertaken during the second fortnight of September to conserve moisture

Plant protection

▶ *Integrated Pest Management*

▶ *Rhinoceros beetle*

Adopt mechanical method of control by extracting beetles with beetle hooks, without causing further injury to the growing point of the palm. The top most leaf axils may be filled with powdered neem cake/ marotti cake (*Hydrocarpus sp/ pongamia*) @ 250 g + fine sand (250g) per palm as a prophylactic measure. Fill the innermost three leaf axils with 4 g each of naphthalene balls covered with sand (12 g/palm) for juvenile palms. Placement of two perforated sachets containing *chlorantraniliprole a.i.* 0.4% (5 g) or fipronil (3 g) or one botanical cake (2 g) developed by ICAR-CPCRI and incorporation of the biomass of weed plant *Clerodendron infortunatum Linn.* in the cow dung/compost pit can also be done. The breeding sites may be treated with green muscardine fungus (*Metarhizium anisopliae*)

▶ *Red Palm Weevil*

Avoid causing injury to the palms, as they would attract the weevil to lay eggs. Mechanical injury if any, caused should be treated with coal tar. While cutting fronds, petiole to a length of 120 cm is to be left on the trunk to prevent the entry of weevils into the trunk. Removal and burning of palm at advanced stage of infestation would aid in destruction of various stages of the pest harboured in the trunk. Prophylactic leaf axil filling suggested for rhinoceros beetle is very essential as this pest pave way for red palm weevil.

If damage occurs in the crown, the damaged tissue has to be removed and insecticide suspension, *imidacloprid* (0.02%) @1 ml/L of water may be poured in. In case of entry of weevil through the trunk, the hole in trunk may be plugged with cement/tar and the top most hole is made slanting with the aid of an auger and the insecticide solution is poured through this hole with funnel.

▶ *Eriophyid mite*

Spraying on the terminal five pollinated coconut bunches with neem oil garlic soap mixture @ 2 per cent concentration (neem oil 200 ml, soap 50 g and garlic 200 g mixed in 10 litres of water) or spraying neem formulations containing 1 per cent azadirachtin @ 4 ml per litre of water or spraying palm oil (200 ml) and sulphur (5g) emulsion in 800 ml of water and root feeding azadirachtin 10,000ppm @ 10 ml + 10 ml water is effective. Along with the recommended dose of manures and fertilizers, 5 kg neem cake should also be applied.

▶ *Coreid bug*

Spray neem oil-soap emulsion (0.5%) on the pollinated bunches. The emulsion can be prepared by adding 5 ml neem oil and 8 g bar soap in one litre water.

▶ *Rugose Spiralling Whitefly*

No chemical insecticide should be sprayed on leaves. Apply 1% starch solution on leaflets to flake out the sooty moulds.

In severe cases, spray neem oil 0.5% and no insecticide is recommended. Install yellow sticky traps on the palm trunk to trap adult whiteflies. Encourage build up of parasitoids (*Encarsia guadeloupae*) and re-introduce parasitized pupae to emerging zones of whitefly outbreak.

In situ habitat conservation of the sooty mould scavenger beetle, Leiochrinus. nilgirianus

Integrated Disease Management

▶ *Bud rot*

Remove the infected tissues of the spindle completely. Two or three healthy leaves adjacent to the spindle may have to be removed, if necessary, for easy removal of all rotten portions and thorough cleaning. After removing the affected tissues apply 10% Bordeaux paste and cover the wound with a polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges. Destroy the infected tissues removed by burning or deep burying in the soil. Spray 1% Bordeaux mixture to the surrounding palms

▶ *Stem bleeding*

Avoid burning of trashes near the tree trunk. Avoid injury to the tree trunk. The affected tissues should be completely removed using a chisel and smear the wound with 5% hexaconazole (5 ml in 100 ml of water) and drench the basins @ 25 lit. of 0.1% solution

Smearing paste of talc based formulation of *Trichoderma harzianum* on the bleeding patches on the stem can be done (The paste can be prepared by adding 50 g of Trichoderma formulation in 25 ml of water)

Soil application of *Trichoderma harzianum* enriched neem cake @ 5kg per palm and adopt recommended irrigation/ moisture conservation practices.

▶ *Leaf rot*

Remove rotten portion of the spindle leaf and 2-3 successive leaves and pour fungicide solution containing 2 ml hexaconazole 5 EC in 300 ml water/ palm or talc based formulation of *Pseudomonas fluorescens* or *Bacillus subtilis* @ 50 g in 500 ml water/palm into the well around the base of the spindle leaf

Undertake prophylactic measures to prevent rhinoceros beetle attack

▶ *Basal Stem Rot/Ganoderma wilt*

Remove dead palms, palms in advanced stages of the disease and destruct the bole and root bits of these palms. Isolation of diseased palms from healthy palms by digging isolation trenches of 2 feet depth and one feet width around the basin can also be done. Avoid flood irrigation or ploughing in infected gardens to prevent spread of the inoculum.

Addition of 50 kg of farmyard manure or green leaves per palm per year and application of Trichoderma harzianum enriched neem cake@ 5 kg per palm and irrigating the palm once in 4 days and mulching around the basin is also useful.

Raise banana as intercrop wherever irrigation is possible Root feeding of hexaconazole @ 2% (100 ml solution per palm) or soil drenching with 0.2% hexaconazole / 1 % Bordeaux mixture @ 40 litre solution per palm can also be done.

Field sanitation

Special care should be taken to remove the organic debris/fallen trees etc in the coconut gardens in Kerala state affected by the recent heavy rainfall/ flood situation. ■

(Prepared by: Thamban, C. and Subramanian, P., ICAR-CPCRI Kasaragod and Joseph Rajkumar ICAR-CPCRI Regional Station, Kayamkulam)

Market Review – July 2021

Domestic Price

Coconut Oil

During the month of July 2021 the price of coconut oil opened at Rs. 17900 per quintal at Kochi and Alappuzha markets and Rs. 18400 per quintal at Kozhikode market. The price of coconut oil at Kochi, Alappuzha and Kozhikode market expressed a downward trend during the month.

The price of coconut oil closed at Rs. 17400 per quintal at Kochi and Alappuzha markets and Rs. 18000 per quintal at Kozhikode and Kochi markets with a net loss of Rs. 500 for quintal at Kochi and Alappuzha and Rs.400 for quintal at Kozhikode market.

During the month the price of coconut oil at Kangayam market opened at Rs. 15467 per quintal and closed at Rs. 15333 per quintal with a net loss of Rs. 134 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.07.2021	17900	17900	18400	15467
03.07.2021	17700	17800	18300	15000
10.07.2021	17200	17200	17300	14533
17.07.2021	17200	17200	17400	14733
24.07.2021	17200	17200	17400	15667
31.07.2021	17400	17400	18000	15333

Milling copra

During the month, the price of milling copra opened at Rs.11200 per quintal at Kochi, Rs.11350 per quintal at Alappuzha market and Rs. 11100 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 10900 per quintal at Kochi, Rs. 10650 per quintal at Alappuzha market and Rs. 11000 per quintal at Kozhikode market with a net loss of Rs.300 at Kochi and Rs.700 at Alappuzha and Rs.100 per quintal at Kozhikode market.

During the month the price of milling copra at Kangayam market opened at Rs. 10300 per quintal and expressed a downward trend and closed at Rs.10200 per quintal.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.07.2021	11200	11350	11100	10300
03.07.2021	11000	11050	10700	10100
10.07.2021	10400	10300	10350	9650
17.07.2021	10400	10300	10450	10000
24.07.2021	10700	10300	10700	10300
31.07.2021	10900	10650	11000	10200

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 17100 and closed at Rs. 18500 per quintal with a net gain of Rs.1400 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.07.2021	17100
03.07.2021	16900
10.07.2021	16400
17.07.2021	16500
24.07.2021	17200
31.07.2021	18500

Ball copra

The price of ball copra at Tiptur market opened at Rs. 15800 per quintal closed at Rs. 16200 per quintal with a net gain of Rs.400 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
01.07.2021	15800
03.07.2021	15600
10.07.2021	15500
17.07.2021	15800
24.07.2021	15500
31.07.2021	16200

**NR-Not reported*

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.15250 and closed at Rs.15750 per quintal with a net gain of Rs.500 per quintal.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.07.2021	15250
03.07.2021	15250
10.07.2021	15250
17.07.2021	15250
24.07.2021	15250
31.07.2021	15750

Coconut

At Nedumangad market in Kerala, the price of coconut opened and closed at Rs. 16000 per thousand nuts during the month.

At Pollachi market in Tamilnadu, the price of coconut opened and closed at Rs. 12000 per Metric tonne nuts during the month

At Bangalore market in Karnataka, the price of coconut opened and closed at Rs. 27500 per thousand nuts during the month.

Weekly price of coconut at major markets			
	Nedumangad (Rs./1000 coconuts)	Pollachi (Rs./MT)	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts)
01.07.2021	16000	12000	27500
03.07.2021	16000	12000	27500
10.07.2021	16000	12000	27500
17.07.2021	16000	12000	27500
24.07.2021	16000	12000	27500
31.07.2021	16000	12000	27500

International price

Coconut

The price of coconut quoted at different domestic markets in Philippines, Indonesia, Srilanka and India are given below.

Weekly price of dehusked coconut with water				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India*
03.07.2021	209	185	257	371
10.07.2021	205	186	270	364
17.07.2021	197	179	301	371
24.07.2021	NR	179	302	384
31.07.2021	187	180	NR	391
				*Pollachi market

Coconut Oil

International price of coconut oil expressed a mixed trend during the month.

The price of coconut oil quoted at different international/ domestic markets are given below.

Weekly price of coconut oil in major coconut oil producing countries					
	International Price(US$/MT)	Domestic Price(US$/MT)			
	Philippines/ Indonesia (CIF Europe)	Philip-pines	Indo-nesia	Sri lanka	India*
03.07.2021	1582	NR	1487	3064	2022
10.07.2021	1576	NR	1493	3064	1960
17.07.2021	1604	NR	1497	3052	1987
24.07.2021	1590	NR	1490	3127	2113
31.07.2021	1538	NR	1514	NR	2068
					* Kangayam

Copra

The price of copra at Srilanka and Philippines expressed a slight downward trend during the month. The price of copra quoted at different domestic markets in Philippines, Indonesia, India and Sri lanka are given below.

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
03.07.2021	938	915	1551	1362
10.07.2021	925	922	1526	1302
17.07.2021	915	928	1526	1348
24.07.2021	NR	962	1526	1389
31.07.2021	918	938	NR	1375

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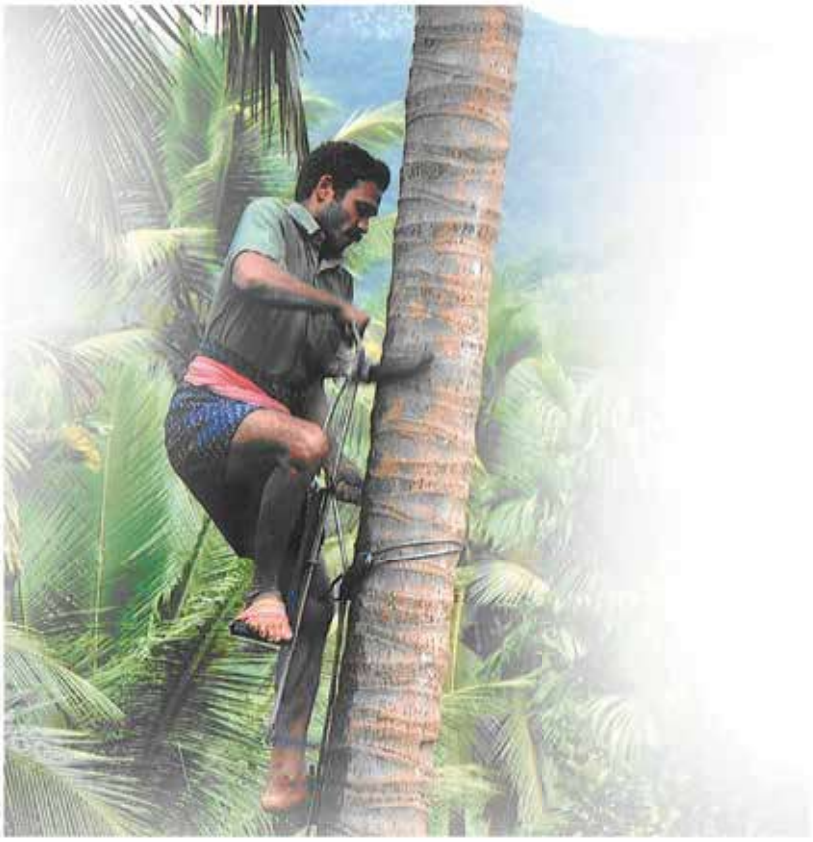

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