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Enhancing farm income
through coconut based cropping systems

Integrated technology for coconut garden management
in hot weather season

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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,

It is heartening to note that under the Pradhan Mantri Formalisation of Micro Food Enterprises (PM-FME) Scheme, coconut products have been included in One District One Product programme of 15 major coconut growing districts spread across 8 States/UTs of the country. The Board has been promoting development of coconut processing industries since 2001-02 through its scheme of Technology Mission on Coconut wherein project based credit linked back ended capital subsidy is provided to processing units at the rate of 25% of the project cost limited to Rs. 50 lakhs. The PM-FME Scheme will further help to increase the momentum of coconut processing especially in the micro food processing sector. The March 2021 edition of the e-bulletin of the PM-FME Scheme has been dedicated to coconut sector.

Coconut is truly called the Kalpavriksha since there is zero waste and all plant parts can be put to economic use. The prospects for increasing the utilization of different parts of coconut are enormous and we are yet to realise the full potential. A concerted drive to utilize the large volumes of mature coconut water generated in coconut processing units is by itself an opportunity not only for providing the consumer with a natural drink, rich in minerals but also in ensuring sustainable and environment friendly development of the coconut sector. The adoption of Food Safety and Quality Assurance mechanisms such as Total Quality Management (TQM) including ISO 9000, ISO 22000, Hazard Analysis and Critical Control Points (HACCP), Good Manufacturing Practices (GMP) and Good Hygienic Practices (GHP) by coconut processing industry will further boost the income benefits to growers by way of export promotions.

The pandemic situation has turned out to be the new normal and the coconut sector is moving back to normalcy especially in the export of coconut products. The export of coconut products up to December 2020 was valued at Rs. 1674.68 crores and it is expected that the total export of coconut products would cross Rs. 2000 crores by the end of the financial year. Coconut shell based activated carbon continues to be the highest exported product accounting for almost 66 percent of the total export value. Enhancement of Minimum Support Price of Milling Copra and Ball Copra by the Central Government will further boost the income of Coconut growers.

Coconut being a small holder crop, responsible investments in its cultivation and coconut industry with due concern for smallholder livelihoods is important to make the sector more efficient, inclusive and resilient.

Rajbir Singh IFS

Chairman

Integrated technology for coconut garden management in hot weather season

V.V. Shinde[1], S.L. Ghavale[2], S.M.Wankhede[3] H.P. Maheswarappa[4]

Coconut sector in Maharashtra

Coconut is a major irrigated horticultural crop of Konkan region of Maharashtra. The agro-climatic conditions are very much congenial for its cultivation in Konkan and Western Maharashtra. Maharashtra Government has launched an ambitious Employment Guarantee Scheme (EGS) for fruit crop cultivation in 1990, because of which the total area has been increased to 43320 ha with productivity of 4885 nuts/ha. Maharashtra occupies the 7th place in area under coconut and the 9th place in production with the annual production of 209.87 million nuts. Over a period of 33 years from 1986-87 to 2020-21, the area under coconut has increased from 6900 ha to 43320 ha and production from 76.32 million nuts to 209.87 million nuts. The maximum area under coconut is in Sindhudurg district followed by Ratnagiri districts.

The coconut based multistoried cropping system studied under AICRP on palms and recommended by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli and developed at Regional Coconut Research Station, Bhatye is popular as "Lakhi Baug" among the farmers which generate income of Rs. one lakh from one acre per year.

[1]Agronomist, [2] Research Officer and [3]Jr.Entomologist, ICAR-AICRP on Palms, Regional Coconut Research Station, Bhatye, Ratnagiri, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, (M.S.), India

[4]Project Coordinator, ICAR-AICRP on Palms, ICAR-CPCRI, Kasaragod, Kerala.

District wise area, production and productivity of coconut in Maharashtra State				
Sr. No	Districts	Area (ha)	Production (Lakh nuts)	Productivity (Nuts/ha)
1	Sindhudurg	17929	1457.0	4845.0
2	Ratnagiri	5556.0	406.0	
3	Raigad	2248.0	107.0	
4	Thane	1161.7	8.0	
5	Palghar	1473.9	16.0	
6	Other	14852	96.0	
	Total	43320	2098	
(Source: Joint Director of Agriculture report.2019)				

Regional Coconut Research Station, Bhatye, Dr. Balasheb Sawant Konkan Krishi Vidyapeeth, Dapoli situated in Ratnagiri district of Maharashtra is catering to the needs of coconut growers in this region through the network of All India Coordinated Research Project on Palm since its establishment in the year 1955. This research station has contributed to develop one variety Pratap and one hybrid Konkan Bhatye coconut hybrid (GBGD x ECT) and seven recommended varieties of coconut which are popularly planted by coconut growers in this region. The technology of coconut developed at this station is helpful for coconut growers. The coconut based multistoried cropping system studied under AICRP on palms and recommended by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli developed at Regional Coconut Research Station, Bhatye which is popular as "Lakhi Baug" among the farmers to generate income of Rs. one lakh from one acre area per year. Now, the hot summer season is approach and the growers need to be aware of the technologies to mitigate the hot summer issues.

Agronomical crop management

1) Clean cultivation

The clean cultivation of coconut was recommended as it was revealed that clean cultivation with frequent intercultural operations such as digging or ploughing had a beneficial effect on the growth and yield of coconut trees. The "no cultivation" treatment produced only 15 nuts/palm/year whereas the tree receiving three ploughing or digging produced 48 nuts per tree annually (i.e. 68.66% increase).

2) Plant health management

Proper nutrition with timely irrigation management as per palm age and past yield history is an important consideration in plant health care during hot summer season.

a) Fertilizer application

A fertilizer dose of 1000g nitrogen, 500g Phosphorous and 1000g of Potash per palm per year in three splits (June, October, and February) was recommended for coconut cultivation in sandy soils of the Konkan region of Maharashtra state. Making the palm nutritionally strong and healthy will equip it to survive against hot summer.

Intercropping of lily flowers

b) Fertilizer requirement for hybrid coconut

On the basis of cumulative yield and economics the following dose is recommended for coconut hybrid palms.

Sr. No.	Age	Quantity of FYM kg/palm	NPK kg/palm/year			
			N (g)	P_2O_5 (g)	K_2O (g)	
					Im-proved variety	Hybrid variety
1.	1st	10	200	100	200	400
2.	2nd	20	400	200	400	800
3.	3rd	30	600	300	600	1200
4.	4th	40	800	400	800	1600
5.	5th	50	1000	500	1000	2000

The dose should be applied in three splits. 1/3 N and K2O, full dose of P2O5 and FYM should be applied in the month of June and remaining 2/3 N and K2O is in two splits (October & February).

c) Fertilizer application through micro-irrigation technique

Application of 1 kg N, 0.5 kg P2O5 and 1 kg K2O per palm per year (recommended dose) is recommended through drip irrigation in eight splits from October to May.

d) Micronutrient application

Application of recommended dose (1:0.5:1 Kg NPK/palm/year) with 1.5 Kg Ormichem Micronutrient (Zn 3.15 %, Mg 1.8 %, Cu 0.65 %, Fe 1.97 %, Mn 2 %, Mo 0.05 % and B 0.68 %) recorded the maximum yield (129 nut/palm/year) in coconut and also the percentage increase in yield was higher in post treatment period yield when compared with pretreatment period yield. Therefore the application of recommended dose of fertilizer with 1.5 Kg Ormichem micronutrient in three splits is recommended for adult coconut palm.

3) Irrigation management

a) Effect of water quality on survival and growth of coconut seedling

An experiment was conducted to assess the influence of quality of irrigation water on growth of one year old newly planted "West Coast Tall" coconut seedling in coastal sandy soil. Irrigation with sea water had detrimental effects, at any growth phase throughout the duration of the experiment, due to primary salt stress, which was responsible for membrane disintegration and disturbance in metabolic process. The dilution of seawater with sweet water reduced the extent of primary stress injury but imposed salt injury causing decrease in uptake of mineral elements, which resulted into poor growth of seedling.

b) Irrigation to coconut palm by drip method

The drip irrigation with 30 liters water/palm/day during October to January and 40 liters during Feb to May with six drippers placed at a distance of 1.25 mts away from the bole in the sandy loam soils of Konkan region is recommended for adult coconut palm.

c) Fertilizer application through micro-irrigation technique in coconut

For getting higher yield in coconut, application of recommended dose 1 kg N, 0.5 kg P2O5 and 1 kg K2O per palm per year is recommended through drip irrigation in eight splits from October to May.

4) Coconut based cropping system

a) Intercropping of chilli in coconut

The cultivation of Chilli (variety "Jawala" and "Konkan Kirti") is recommended due to its higher yield and best net returns as inter crop in coconut orchard.


Intercropping of banana

b) Intercropping of vegetables in coconut

On the basis of economic returns obtained per man days per hectare, Dolichus bean could be rated as the most remunerative vegetable crop, whereas tomato cultivation provided better employment opportunities and gave attractive yield.

c) Intercropping of rainfed vegetables in coconut

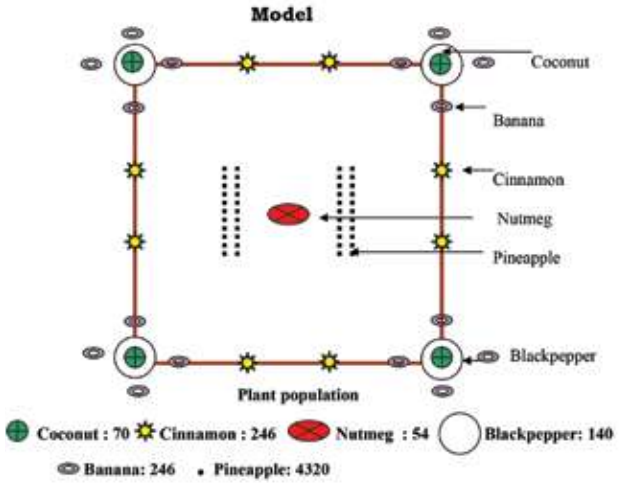
Rainfed vegetables such as ridge gourd, cucumber, snake gourd and bitter gourd is recommended in coconut plantation during rainy season.

d) Mixed cropping of spices in coconut

The excellent growth and good bearing capacity of cinnamon, nutmeg, black pepper and clove planted in coconut as intercrops proved that these crops can be cultivated on commercial scale in the Konkan region of Maharashtra. After planting spice crops as intercrops in coconut plantation the average yield of coconut per palm has increased from 25 to 93 percent at the end of 26th years as compared to the average yield of previous four experimental years. Nutmeg (at 22 years age) proved as the best intercrop in coconut plantation. Nutmeg and coconut together gave Rs. 1,23,970/- as net returns per hectare, whereas only nutmeg gave 47,240/-. Coconut as a monocrop recorded net profit of Rs. 31,349/- per hectare. On the strength of the net economic returns released, it is recommended to interplant nutmeg, cinnamon and clove in well spaced coconut garden in the Konkan region of Maharashtra state.

e) Lakhi Baug:

On the basis of mixed cropping experiment on spices, University has propagated the Lakhi Baug concept. That is intercropping of spices particularly Cinnamon, Nutmeg and Black pepper in the coconut orchard and from one acre of this kind of system farmer can get one Lakh rupees, thus it is called as Lakhi Baug which includes model-I.




Regional Coconut Research Station Bhatye office

f) Intercropping with fruits and spice tuber crops

Four intercrops viz. turmeric, banana, pineapple and tapioca is recommended in coconut plantation in Konkan region of Maharshtra for getting more economic returns.

g) Biomass collection and utilization in coconut based cropping system

The biomass productivity of coconut was ranged from 3.4 to 5.1 t/ha while it was ranged from 161 kg to 4450 kg/ha in different spices. The vermicompost productivity of coconut ranged from 2 to 3 t/ha where as it was 48 kg to 1.5 t/ha in different spice crops. Nutrient recycling rate of 43.62 kg N2, 9.64 kg. P, 30.13 kg K, 21.81 Ca and 16.56 Kg Mg per ha. in coconut can be achieved through proper utilization of available biomass. In organic fertilizer substitution of about 33% N, 3.67% P2O5 and 22.96% K2O is coconut and 20.40% N, 2.7% P2O5 and 20.67% K2O in spice tree species can be achieved by organic recycling.

h) Production of medicinal and aromatic plants in coconut garden

Considering the performance of different medicinal crops as an intercrop and market demand, the arrowroot, lemongrass, shatavari, adulsa and citronella have been recommended as a intercrops in coconut plantation for Konkan region of Maharashtra.

i) Mulching by dried coconut leaves, husk burial and the coir dust application is well known and is an adopted practice by most of the growers. This material acts as sponge and absorb water six times more of its weight.

Bordeaux paste application

Vermicompost application

5) Indigenous Technical knowledge (ITK)

Some knowledge based information regarding the management of palm against hot summer is available with palm grower based on their tradition and experience. This is nothing but the Indigenous Technical knowledge (ITK) that is unique knowledge to given circumstances. This knowledge is presented in table 3.

Table 3

Sr. No.	ITK knowledge	Scientific reasons behind knowledge
1	Earthling up the palms regularly to prevent root exposure by making gentle slope in basin.	Palm is monocotyledon crop. It has fibrous root system, not tap root exist. If it is protected by proper soil covering, it develops better root nettings. This netting is much active for water and nutrients uptake, which ultimately improve productivity and palm growth. The root nettings remain active.
2	Surface irrigation/flood irrigation be given in binding mode and away 1.25 m from the root collar zone of palm	Many places the surface water moves and runs intact with palm root zone through channels. It develops intimate contact of fiber tissue and moisture which causes cracks and micro burning at root collar during hot summer from where entry point for pest like RPW and fungus. And during rainy season it leads to development of aerial roots which looks ugly and abnormal.
3	Digging of basin and creation of channel for surface water storage around	Digging of root nettings in basin area once in three year helps to cut old roots and develops new active root netting zone for better absorption.
4	Soaking of seed nuts in water one month before sowing for germination	During hot the water temperature is little more than normal, this helps to degradation of the husk, losses the tight husk cover and plumule can easily comes out with uniform growth and elite development.
5	Application of Bordeaux Paste 10% to palms trunks during summer hot.	It covers the basal trunk region 1.25 m from where entry of various fungus & insects get checked during hot summer. It works as protection layer to trunk against sun burning/ sunstroke scorching.

Varietal interventions by Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli					
Sr. No	Name	Parents	Year of release/ recommended	Yield (nuts/ palm/year)	Special features
Released varieties					
1	Pratap	-	1987	140-145	Age at 1st flowering (years) - 6-7 Average dry copra/nut (g) - 120-160 Oil percentage (%) - 68
2	Konkan Bhatye coconut hybrid 1	GBGD x ECT	2007	120-122	Age at 1st flowering (years) - 4.5-5 Average dry copra/nut (g) - 160-169 Oil percentage (%) - 67.10
Recommended Varieties					
1	Lakshdweep Ordinary (ChandraKalpa)	-	1985	146-150	Age at 1st flowering (years) - 6-7 Average dry copra/nut (g) - 140-180 Oil percentage (%) - 72
2	Kera Sankara (T x D)	WCT x COD	1989	135-140	Age at 1st flowering (years) - 4.5-5 Average dry copra/nut (g) - 170-190 Oil percentage (%) - 68
3	Philippines Ordinary (Kera Chandra)	-	1995	100-105	Age at 1st flowering (years) - 6-7 Average dry copra/nut (g) - 215-225 Oil percentage (%) - 69
4	Banawali	-	2007	80-150	Age at 1st flowering (years) - 7-8 Average dry copra/nut (g) - 100-195 Oil percentage (%) - 68-70
5	Chandra Sankara (D x T)	COD x WCT	2003	145-150	Age at 1st flowering (years) - 4.5-5 Average dry copra/nut (g) - 160-200 Oil percentage (%) - 68
6	Fiji (Kera Bastar)	-	2007	116-120	Age at 1st flowering (years) - 6-7 Average dry copra/nut (g) - 169 Oil percentage (%) - 67.10
7	Godavari Ganga	-	2007	96	Age at 1st flowering (years) - 4.5-5 Average dry copra/nut (g) - 230 Oil percentage (%) - 64.05

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Integrated farming system approach through coconut: A success story from Attappady Hills

Regi Jacob Thomas, M. Shareefa and E.R. Ashokan
ICAR-CPCRI, Regional Station, Kayamkulam, Kerala

Shri. P. A. Mathew, Puthuparambil House, is an enterprising farmer from Agali (under Sholayur Krishi Bhavan of Attappady) of Palakkad District. He is 73 years old and has 61 years of experience in farming. He started assisting his father when he was a school student (at 12 years of age). His parents are from Melukavu Panchayat of Kottayam District and afterwards moved to Chittur Village of Attapady. During 1960's their family had estates at Kuruvanpadi and Puliyara in Chittur Village of Attapady.

Crop diversification

During 1999, he sold his property at Kuruvanpadi and moved to Agali and purchased 17 acres of land. The land at Agali had coconut palms alone. Agali village located in Attappady in general has a tropical climate and is about 505 m above mean sea level. The average annual temperature in Agali is 23.4 °C. The soil is lateritic with neutral pH but low in Nitrogen. The annual rainfall is around 500-800 mm.

When he purchased the plot, the coconut palms in

his plot at Agali were weak and showed pencil point symptoms. However, his Agricultural Officer advised him to purchase the land considering its fertility status. Gradually he introduced other crops like Coffee, Mandarin, Orange, Lime, Rambutan, Banana and spices crops like Nutmeg, Black pepper, Ginger and Turmeric. He also started integrated farming with components like cow, goose (12 nos.), chicken (20 nos.) and two honey bee colony. The cropping system consists of coconut intercropped with Coffee -Nutmeg - Black pepper (trailed on coconut palms) - Banana/tuber crops. He has intercropped one part of his coconut garden with fruit crops like orange, mandarin, guava, mango and amla (Gooseberry). He has more than 675 coconut palms of which 650 are yielding palms in 12 acre area. In addition, he has arecanut in 3.0 acres (2000 nos.), coffee as mixed crops (3000 nos.) and nutmeg 520 nos.

Parentage (Pedigree) of crops

The importance of quality planting materials in agriculture has been recognized from the time immemorial. Manu smrithi says 'Subeejam, sukshethre jayate sampadyathe', ie. Good seed in good soil yield abundantly. His success lies in identifying good mother palms/source of planting materials of all crops from different farmers' plots and he purchases the planting materials from those farmers once he is convinced about its quality. He has raised all coconut seedlings from the seed nuts procured from Nellipathy Village (near Attapady). In addition to these WCT, few hybrid varieties viz. Kerasree and Kera Sankara are also grown in his farm. He is keen in selecting best varieties in terms of yield; quality and adaptability of all crops which are cultivated in his orchard. Based on experience, he has selected banana varieties like Zanzibar, Nendran and Popoulu, Nagpur Mandarin, Hima Pasand and Hybrid varieties of mango for cultivation in his farm. Nutmeg varieties are Viswasree variety from IISR-Calicut and two farmer's variety viz., Kadukanmakkal and Kinnattukara).

Nutrient management

He adopts organic farming to the maximum possible extent. Initial planting is done with bone meal (5 kg) and FYM (75 kg). This is followed by application of fertilizers once the coconut palms are three years old. He applies fertilizers in three dozes (first dose in June-July, second dose during October and third dose in November). In addition, he applies the fertilizer mixture (10:5:20) @ 4 kg/palm and Dolomite @2 kg/palm along with 5 kg of Fish meal. He purchases organic compost (procured from Kottakkal Estate run by Kottakkal Arya Vaidya Sala, having different medicinal tree crops) and applies the organic compost @ 5 kg to each palm basin depending on availability. He also applies 100 kg FYM (50 + 50 kg) in two split doze (during June & October).

Soil and water management

He is keen to form a basin of 2.0 meter radius in the basin of all coconut palms and he advices farmers to apply fertilizer only in the peripheral area (and not near the trunk) for maximum fertilizer absorption as feeder roots and active only in and around 1.5-2.0 meter radius. His approach of forming

wide basins supplemented with balanced fertilizers and proper irrigation, followed by timely weeding and mulching is the success of his coconut farm. Recently, after implementation of 'Kera Gramam' programme in Sholayur Krishi Bhavan area, his farm (he has adopted Half moon micro catchment method for water harvesting). Before adopting half moon micro catchment, he had to irrigate the coconut palms once in a week. But after adopting half moon method, he needs to irrigate only once in two weeks. The productivity recorded was 170 nuts /palm/ year during 2013-14 and after adopting half moon micro catchment the yield has gone up to 200 nuts/palm (2014-15). He is still getting more than 200 nuts/ palm/year. His entire farm is irrigated using hose irrigation. He has constructed one 8.5 feet deep ferro-cement tank (with 3.60 lakh litres capacity) at the top most point of his estate. The tank was constructed with funding from State Horticultural Mission, Govt. of Kerala. His land is mostly on sloppy terrain and he depends on nearby Bhavani river for his irrigation needs.

Economics

He sells mature coconuts to merchants from Kankayam (Tamilnadu) in bulk and local markets of Changanacherry and Kottayam. It fetches him Rs.44.50/kg of husked nuts (as per 2020 price). He get nearly 1,50,000 coconuts from 650 palms (revenue of Rs. 28 to 30 lakhs) and arecanut (ripe nut yield of 10 tonnes @ Rs.48/kg which fetches Rs. 4.80 lakhs, Nutmeg for Rs. 5.0 lakhs, and Coffee for 2.4 lakhs, black pepper for 15 lakhs and from Banana Rs. 1.0 lakhs. The gross return is Rs.54-55 lakhs and the expenditure comes to Rs. 45 lakhs, of which major chunk is to meet labour charges and cost of fertilizers. On an average net income is around 8 to 8.5 lakhs. But his drawback is that he doesn't adopt mechanization. His opinion is that if he depends too much on mechanization, the cost of cultivation will go up and he may not be in a position to complete farm operations in time. Farm labour (from Tamilnadu and Jharkand) is cheap and easily available near Agali.

Advice to farmers based on experience

His major focus is on wider basin for coconut palms and systematic soil and water conservation techniques. Soil and water conservation practices will reduce loss of moisture and nutrients from top soil. Water shed approach adopted helps to harvest rain water in the palm basin itself. He recommends timely adoption of various agro techniques like weeding, mulching and irrigation. If weeding is not done continuously it will affect productivity.

Setback faced during COVID period

His over dependence on human labour has directly affected the farming especially during the COVID pandemic period. Because of shortage of labour,

he could not do even essential farm operations like irrigation, manuring, weeding etc and that has resulted in some reduction in nut production.

Pest and Disease management

In Mathew's farm, pest and disease incidence is very less especially in coconut and other component crops. He has two cows (one local breed and one Holstein Friesian). The occasional problems he noticed in coconut are bud rot, eriophyid mite and rhinoceros beetle. But the extent of rhinoceros beetle damage noticed is less that 1%. The recent outbreak of whitefly and associated sooty mould affected most of the palms in his orchard also and for managing the whitefly, he had applied neem based insecticide 'Azadiractin'. According to his experience this was very effective and presently the whitefly infestation has reduced naturally.

Mathew has received 'Kera Kesrari' award instituted by Department of Agriculture, Govt. of Kerala during 2008-09 and Kshoni Samrakshana award of Directorate of Soil Survey & Soil Conservation, Govt. of Kerala during 2014-15. His wife Smt. Thresiamma Mathew assists him in all farm operations. He has also received many awards and recognitions from different agencies and Krishi Bhavan. Considering the demand of planting materials of coconut and intercrops especially fruit trees and tree spices, he also initiated a nursery business 'Puthenpurayil nursery'. According to him, nursery business is also a very successful enterprise as he is selling planting materials of assured quality at a reasonable price. He is always happy to share his experiences and expertise with other farmers.

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(Mini Mathew)

Enhancing farm income by coconut based cropping systems involving climate resilient tuber crops

A Success story of participatory demonstrations

D. Jaganathan, G. Suja and G. Byju

ICAR- Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram -695017, Kerala

Coconut, the most important of all cultivated palms, provides livelihood security to several millions of people across the world, and the capacity of coconut in providing improved nutrition, employment and income generation are well known. In India, the palm is cultivated in 18 states and 3 Union Territories and supports the livelihood of over twelve million people. It is of greater importance in the agrarian economy of the four southern states of Kerala, Tamil Nadu, Karnataka and Andhra Pradesh, which account for 90% of the coconut cultivation in India. Coconut cultivation in the country is mainly in the hands of small and marginal farmers with more than 90% of the coconut holdings being less than 0.40 ha size. The area, production and productivity of coconut in India and Kerala are given in Table 1.

Table 1. Area, production and productivity of coconut in Kerala and India (Source: GOI, 2017-18)

S.No.	State/ Country	Area ('000 ha)	% to all India	Production ('000 MT)	% to all India	Productivity (Kg/ ha)
1	Kerala	807.13	38.50	5829	35.52	7828
2	India	2097.00	100.00	16413	100.00	7222

Though, Kerala occupies the largest area (38.50%) under coconut, majority of the coconut holdings are small, which neither provides gainful employment opportunities to the family throughout the year nor generate sufficient income to meet the family requirement. The coconut farmers are also

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exposed to economic risks and uncertainties due to high degree of price fluctuations. The domestic price of coconut in India has also been showing a declining trend. The phyllotaxy and the unique plant architecture of the coconut tree offer ample scope for utilizing the greater portion (75%) of the unutilized area between the trees for intercropping with annuals and perennials.

Tropical tuber crops such as cassava, elephant foot yam and greater yam are ethnic starchy vegetables with good production potential, cooking quality and taste besides medicinal and nutritive values. Hence these are important as traditional food in the diets of the people of Kerala. It is estimated that tuber crops provide about 6% of the dietary energy, apart from being good sources of β-carotene, antioxidants, dietary fibre and minerals. They have higher biological efficiency, can tolerate drought and shade, withstand flood and salinity to some extent, are adapted to marginal environments, low input situations and adverse soil and climatic conditions. Hence these crops are known as 'climate resilient' or 'future crops'.

Cultivation of these tropical tuber crops in the interspaces of coconut palms will enhance farmers' income and enable employment opportunities and the compatibility/flexibility of tuber crops in coconut gardens have been documented by ICAR-CTCRI. Experiments on cropping systems conducted over the years revealed that tuber crops were able to provide an average additional yield of 10-12 tonne ha-1, additional profit of Rs. 1 to 1.25 lakh ha-1 and employment generation of 150-200 man days ha-1 making the system economical and sustainable (Suja and Nedunchezhiyan, 2018).

ICAR Institutes, State Agricultural and Horticultural Universities under All India Coordinated Research Project on Tuber Crops (AICRP TC) and other research and extension organizations have been working on tuber crops based cropping systems for generation and dissemination of technologies for enhancing the production and farm income from unit area with minimum resources. ICAR-Central Tuber Crops Research Institute, the premier research institute solely dedicated to tropical tuber crops in the world, has been pioneering systematically in the research and field experiments cum demonstrations on cropping systems for popularizing the technologies among farmers and other stakeholders.

Several studies reported that coconut based cropping system involving tuber crops is effective for increasing the production per unit area and maximizing the economic returns through better utilization of natural resources. In order to follow this cropping system, farmers need to be convinced about the socio- economic and technical feasibility in their local conditions. Due to various constraints, many coconut growers are not able to adopt the cropping system to the desired level. Establishing participatory demonstration plots in farmer's gardens will encourage many others to follow cropping system for the improvement of their livelihood. Coconut is one of the major crops in Thiruvananthapuram

Table 2. Planting system for tuber crops intercropped in coconut gardens

Main crop	Intercrops/ Variety	Time of planting	Method of planting, spacing and plant population per ha	Duration (months)
Coconut (West Coast Tall)	Cassava (Sree Pavithra: 35-45 t/ha; 27 % starch and K efficient variety)	May-June, 2018	Mounds, 90x90 cm (9000 plants)	8-10
	Greater yam (Sree Keerthi: 25-30t/ha; 22% starch and tolerant to anthracnose disease)	May-June, 2018	Pits, 90x90cm (9000 plants)	8-9

SSNM technology in cassava

Table 3. Demonstrations in cassava and greater yam in Thiruvananthapuram district		
S.No.	Name & address of the coconut grower	Technology
1	Mr. Thulasidas R., Susheeldhara, Ponvila, Ayira P.O. Chenkal Panchayat, Thiruvananthapuram	SSNM in cassava
2	Mr. Narayanan Nair R., Souparnika, Ambadi Nagar, Russelpuram P.O., Thiruvananthapuram	SSNM in cassava
3	Mr. Krishnan Nair V., Kalivilakathu veedu, Poozhanadu P.O. Ottsekharamangalam , Thiruvananthapuram	SSNM in cassava
4	Mr. Sasidharan Nair, Saranya Bhavan, Valicode, Ottasekharamangalam Panchayat,Thiruvananthapuram	SSNM in greater yam
5	Mr. Elizebeth Thankachan, TC5/785/2, Salom, Mannamoola, Peroorkada, Thiruvananthapuram	SSNM in greater yam
6	Mr. Thulasidas R., Susheeldhara, Ponvila, Ayira P.O. Chenkal Panchayat, Thiruvananthapuram	Organic farming in cassava
7	Mr. Narayanan Nair R., Souparnika, Ambadi Nagar, Russelpuram P.O., Thiruvananthapuram	Organic farming in cassava
8	Mr. Swami Mokshavratananda, Sree Ramakrishna Ashramam, Malamukal, Nettayam, Thiruvananthapuram	Organic farming in cassava
9	Mr. Sreekandan Nair K., Kachani, Karakulam, Thiruvananthapuram	Organic farming in greater yam
10	Mr. Sujith D., Punnamen mele Puthenveedu, Mullilavinmodode, Aruvikkara P.O.,Thiruvananthapuram	Organic farming in greater yam


Organic farming in cassava

district with an area, production and productivity of 68110 ha, 562 million nuts and 8251 nuts /ha, respectively (GoK, 2020). Keeping this in view, ten demonstration plots on Coconut based cropping system involving tuber crops vis-à-vis soil health management' sponsored by Coconut Development Board, Ministry of Agriculture and Farmers' Welfare, Kochi were established in Thiruvananthapuram district for enhancing productivity and profitability of farming per unit area.

Selection of coconut growers

Farmers who had interest in taking up intercrops were selected with the support of officials of CDB/ Krishi Bhavans/KVKs after following the principles of participatory demonstration. Socio–economic background, available resources, farming details, farming practices, knowledge on cropping system, yield details, constraints in farming etc. were collected in detail with the active participation of the farmers. Ten coconut gardens with minimum area of 50 cents each aged more than 20 years were selected for establishing demonstration plots on SSNM and organic farming with cassava and greater yam as intercrops in the cropping system (Table 2). Planting materials of tuber crops were supplied and expenditures for planting and critical inputs were provided through funding from CDB, Kochi. Soil samples were collected prior to the start of the demonstrations for analyzing the nutrient status and chemical properties. Demonstrations were carried out based on the soil nutrient status and as per the standardized technologies.

Capacity building and providing resources

Farmers were supplied with quality planting materials of improved varieties/selections of tuber crops for planting in coconut gardens as per the recommendations. Ten demonstrations were established as per the technological specifications. Farmers' were trained on latest technologies with respect to coconut and tuber crops. Frequent farm

Table 5. Economics of coconut + tuber crops cropping system vis-a vis soil health management						
Technology	Coconut yield (Nuts/ha)	Tuber yield (t/ ha)	Gross Income (Rs.)	Gross Cost (Rs.)	Net Income (Rs.)	BC Ratio
Economics of coconut + cassava cropping system : SSNM Vs POP Vs FP						
SSNM	16625	31.50	733310	235000	498310	3.12
POP	14875	26.48	625330	280000	345330	2.23
FP	14000	20.93	516680	260000	256680	1.99
Economics of coconut + cassava cropping system : OF Vs POP Vs FP						
OF	15400	24.08	587380	236050	351330	2.49
POP	14175	16.10	431490	280000	151490	1.54
FP	13650	17.40	462513	260000	202513	1.78
Economics of coconut + greater yam cropping system: SSNM Vs POP Vs FP						
SSNM	15750	4.00	297325	215000	82325	1.38
POP	14175	4.74	307650	240000	67650	1.28
FP	13475	3.39	253575	230000	23575	1.10
Economics of coconut + greater yam cropping system: OF Vs POP Vs FP						
OF	15050	3.65	278075	225000	53075	1.24
POP	13825	3.34	255325	240000	15325	1.06
FP	12950	3.60	255500	230000	25500	1.11

advisory visits were carried out by the scientists to monitor the growth and yield performance of coconut and intercrops. The list of beneficiaries is given in Table 3.

Technological interventions

Customized fertilizers based on SSNM: Technologies for SSNM in cassava and greater yam which could enhance the yield by 24% over farmers' fertilizer practice, besides maintaining soil quality. Customized fertilizers consisting of macro and micronutrients based on soil test values are used for managing the nutrient requirements in tuber crops to attain specific yield goals.

Organic farming package: Organic farming technologies of tropical tuber crops at ICAR-CTCRI, indicated that organic farming resulted in 10-20% higher yield, 20-40% profit, besides improvement in tuber quality and soil health. Organic production technologies developed for cassava and greater yam were used. Organic farming technology consisting of organically produced planting materials, organic manures, green manuring, bio-fertilizers, bio-control agents, biopesticides etc. are used for managing the nutrient requirements of tuber crops.

Layout and implementation: The layout and plot preparation were done during May- June 2018 strictly under the guidance and supervision of scientists of ICAR-CTCRI and team members of the project. In those demonstrations designated for validating SSNM, the field was laid out into three, SSNM technology (T1), present POP recommendation (T2) and Farmers practice (T3). Likewise, in demonstrations identified for validating organic farming, the field was laid out into three, Organic Farming technology (T1), present POP recommendation (T2) and Farmers practice (T3). This methodology was followed for cassava

SSNM technology in greater yam

and greater yam. The critical inputs were weighed and applied as per the technical programme. The chemical properties and nutrient status of the soil viz., soil pH, organic carbon, primary, secondary and micronutrients in ten coconut gardens were analyzed before and after the demonstrations to maintain the soil fertility.

Economics of cropping systems vis-a-vis soil health management in coconut + tuber crops systems

On-station proven sustainable nutrient management technologies viz., site specific nutrient management and organic farming technologies were separately demonstrated and validated (in comparison with POP and farmer's practice) in cassava and greater yam under intercropping in 10 coconut gardens of Thiruvananthapuram district and the findings are given below.

Pre-assessment of the coconut gardens before introducing the cropping system and sustainable nutrient management technologies were done in selected ten gardens of Thiruvananthapuram district and the results are given in Table 4. An average yield of 83 nuts per palm was obtained by the farmers during 2017-18, which resulted in net income of Rs. 17250 per year from one ha area with a B:C ratio of 1.13.

Table 4. Economics of coconut cultivation before the intervention (One ha)

Coconut (Nuts/ Palm)	Coconut yield (Nuts/ha)	Gross Income (Rs.)	Gross Cost (Rs.)	Net Income (Rs.)	BC Ratio
83	14525	145250	128000	17250	1.13

The results of the economics of coconut + tuber crops cropping system vis-a vis soil health management viz., SSNM and organic farming technologies are given in Table 5.

The coconut + cassava cropping system experiment on SSNM technology conducted in Thiruvananthapuram district during 2018-19 revealed that (Table 5) the maximum tuber yield was obtained from SSNM treated plot with 31.5 t/ha followed by POP (26.48 t/ha) and farmers' practices (20.93 t/ha). Similar trend was observed with regard to coconut yield. The net income of Rs. 4.98 lakhs per ha was obtained in SSNM plot followed by POP (Rs. 3.45 lakhs) and Farmers' practices (Rs. 2.56 lakhs). With regard to benefit: cost ratio SSNM plot had the maximum value with 3.12 followed by POP (2.23) and farmers practices (1.99).

Organic farming in greater yam

The coconut + cassava cropping system experiment on organic farming technology conducted in Thiruvananthapuram district during 2018-19 revealed that the maximum tuber yield was obtained from organic farming treated plot with 24.08 t/ha followed by farmers practice (17.4 t/ha) and POP (16.1 t/ha). Coconut yield was maximum in organic farming plot followed by POP and farmers' practices. The net income of Rs. 3.51 lakhs per ha was obtained in organic farming plot followed by farmers' practices (Rs. 2.02 lakhs) and POP (Rs. 1.51 lakhs) and similar trend was observed with regard to benefit: cost ratio viz., organic farming (2.49), farmers practices (1.78) and POP (1.54).

In the case of coconut + greater yam cropping system experiment on SSNM technology, maximum tuber yield was obtained from POP treated plot with 4.74 t/ha followed by SSNM (4 t/ha), and farmers' practices (3.39 t/ha) (Fig. 1). The yield of coconut was higher in SSNM plot followed by POP and farmers practices. The net income was higher with respect to SSNM (Rs. 82325) followed by POP (Rs.67650) and farmers practices (Rs.23575). Benefit cost ratio of 1.38 was obtained from SSNM followed by POP (1.28) and farmers' practices (1.10).

Coconut + greater yam cropping system experiment on organic farming technology revealed that maximum tuber yield was obtained from organic farming (3.65 t/ha) followed by farmers' practices (3.60 t/ha) and POP treated plot with 3.34 t/ha (Fig.3). The coconut yield was higher in organic farming plot followed by POP and farmers practices. The net income was higher with respect to organic farming (Rs. 53075) followed by farmers practices (Rs. 25500) and POP (Rs.15325). Benefit cost ratio of 1.24 was obtained from organic farming followed by farmers' practices (1.11) and POP (1.06).

Fig.1. Harvested produce of greater yam from three different treatments of SSNM technology

Fig. 2. Harvested produce of greater yam from three different treatmetns of organic farming technology

Based on the results from the Table 4, it is understood that sustainable soil health management of tuber crops based cropping systems in coconut gardens resulted in higher productivity and profitability in comparison to monocrop.

Advantages of cropping system as perceived by coconut growers

- Efficient use of farm and natural resources (land, water, sun light, labour, capital, etc.)
- Additional yield with minimum resources per unit area
- Reduction in cost of cultivation
- Improvement in soil fertility with abundant soil flora and fauna
- Less incidence of pests and diseases
- Crop residues can effectively be recycled as organic manure in the system
- Easy to adopt and suitable for different agro-climatic conditions
- High energy food for farm family and feed for farm animals
- Behave as insurance crop against risk and natural calamities
- Ensure food security, augment net income and enhance employment opportunities

Conclusion

Adoption of tuber crops based cropping systems in coconut gardens are technically feasible, economically viable and sustainable in the long run. It enhances food production, provides additional farm income and employment opportunities. It also enables better utilization of resources and safeguards the farm family from risks and natural calamities. On-farm demonstrations on customized fertilizers and organic farming technologies in tuber crops will help in increasing the productivity and profitability of coconut as well as upliftment of tuber crop growers. These trials and demonstrations will serve as model plots for other farmers to adopt improved technologies in coconut farming, which warrant the efforts from all stakeholders viz., ICAR-CTCRI, CDB, Kochi, Department of Agriculture, Krishi Vigyan Kendra, farmers, input agencies, marketing traders etc. The demonstrated technologies are given to KVKs, Department of Agriculture and other line departments for popularization and scaling up of the technologies in larger areas for doubling farmers' income on a sustainable basis. The successful tuber crops based cropping system models are to be emulated in large scale in the context of 'doubling farmers' income' and 'self reliance'.

Hindi Fortnight 2020 Valedictory Function held at CDB

Hindi fortnight valedictory function of CDB was held at Kochi on 10th March 2021. Shri. Saradindu Das, Chief Coconut Development Officer chaired the function and delivered presidential address. Shri R.Madhu, Secretary, CDB offered felicitations.

The winners of various competitions held at Headquarters in connection with Hindi Fortnight 2020 from 14th to 25th September 2020 were present during the occassion. All other officials of the Board attended the function through online. Shri. Saradindu Das, Chief Coconut Development Officer distributed prizes to the children of officers and staff of Board who have scored highest marks in Hindi in the SSLC/CBSE/ICSE 10th and 12th standard exams. Shri R. Madhu, Secretary, CDB distributed prizes to the winners of the competitions conducted for the Officers and staff of the Board. He also distributed prizes for winners of team competitions and distributed certificates to the officers and staff who participated in the Hindi incentive scheme 2019-2020.

Smt. S. Beena, Assistant Director(OL), CDB welcomed the gathering and Dr. Surya Pratyush, Junior Translation Officer proposed vote of thanks.

Acknowledgement

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Rerirement

Shri. T.K. Soman retired from the services of Coconut Development Board on 28th February 2021 on super annuation. He has served the Board for around 34 years.

A novel technique to guard juvenile palms from rhinoceros beetle attack

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Rhinoceros beetle, Oryctes rhinoceros Linn. (Coleoptera: Scarabaeidae) is a major pest of the coconut palms. Adult beetles damage the unopened spear leaves, spathes and inflorescences and chewed up tissues as fibers are seen intruding from the entry points. The damaged fronds show characteristic V- or wedge-shaped cuts as they unfold (Fig 1& 2). Repeated attack by this black beetle causes stunted growth of the palms and occasionally, palm death could also happen at severe infestation. Besides the injury due to direct feeding damage, the bore holes serve as entry points for the lethal pests and pathogens like red palm weevil and fungi causing bud rot, respectively. Seedlings and juvenile palms (of 3 - 4 years old) are highly susceptible to the rhinoceros beetle attack than the tall palms (Fig. 3). Twisting of the spear leaves, stunted growth and improper establishment of seedlings was observed in the field conditions when the seedlings get severe beetle attack in the initial stages of its growth (Fig. 4).

Fig 1 Rhinoceros beetle

Fig 2. Damage symptoms of Rhinoceros beetle

Although O. rhinoceros is persistently active and reproductive throughout the year, its detection is often cumbersome due to its nocturnal habit and cryptic nature of residence within the palms. Damage monitoring is possible only by visual inspection of symptoms developed in the host palms.

Integrated Pest Management (IPM) for rhinoceros beetle comprises of a series of phyto – sanitary, preventive and curative methods. However, major constraints for non-adoption of IPM practices include high labour cost, low produce cost, uneconomical land holding size and lack of technical knowhow among farmers. Currently, management of rhinoceros beetle in palms is either non – existent especially with farmers of small land holdings or by growers who rely greatly on insecticide application in larger areas. Due to awareness of adverse effects on human health, unavailability of skilled personnel for adopting timely management practices and non-feasibility of adopting various strategies in homestead gardens and small and marginal hold farmers warrants an alternative strategy.

In IPM programs, physical control methods aim at limiting the pest access to plant parts or to induce behavioral changes, or to cause direct pest damage/ death. Exclusion nets are commonly used as safer physical pest control tool in many agricultural and horticultural crops because of its easy – to - use and eco - friendly attributes. It acts as a barrier for the insect pests to attack the crop. In order to

Fig 3 Severity of beetle attack in seedlings and juvenile palms

Fig 4 Improper growth and spear leaf twisting

Fig 5. Loosely wrapping spear leaf with adjacent leaf base

Fig. 6 Beetles entrapped in the nylon net mesh

protect the growing tips of seedlings and juvenile palms from beetle attack, an experiment was carried out on the effect of nylon nets as a pest exclusion barrier technique at ICAR – Central Plantation Crops Research Institute, Kasaragod, Kerala, India (12°30' N, 75°00' E and 10.7 m) during 2017 - 2018, wherein 1 meter length of nylon net / fish net (3.2 x 3.2 cm) was used to loosely wrap the unopened spindle leaf along with 2 - 4 topmost adjacent leaf base of each palm in a circular fashion (Fig. 5).

The study results indicated that loose wrapping of unopened spear leaf with adjacent leaf base with nylon nets had significantly reduced the per cent leaf damage due to beetle attack in juvenile palms by 64 % during 2017- 2018. In contrast, in the control plot, the damage was increased by 27 % from the pre treatment. As an indirect effect, it was also observed that adult beetles (more than 700 numbers) were entangled in the mesh of the nylon nets of what was tested which was indeed an unexpected result of the experiment which provided benefit by trapping adult beetle population in the open fields (Fig. 6). So, the use of nylon nets as pest exclusion barrier not only restricted the pest entry but also acted as a passive trapping mechanism. It was noticed that the implementation of this technique did not affect any of the crop physiological activities as the net material used was of coarse and clear type. Further loose wrapping of nylon nets allowed to open and remove the entangled beetles at regular intervals. The study has demonstrated the use of locally available nylon nets as physical barrier could be a less expensive alternative practice against rhinoceros beetle in young palms. These types of exclusion systems can be deployed rapidly especially in the organic farming system as well as in the small and marginal gardens and forms sustainable way to manage the pest by reducing the need for pesticides. ■

Value Added Products from coconut

Being a zero wastage product, the product basket from coconut is enormous. Some of the value added products from coconut are Desiccated Coconut (DC), Virgin Coconut oil, Coconut chips, Coconut milk, Coconut milk powder, Coconut Vinegar, Coconut oil, Tender Coconut water, Ball copra, Neera and Neera products, Coconut ice cream, Coconut body lotion and so on. As part of the product promotion, commercial production units have been started in various parts of the country under Technology Mission on Coconut (TMoC).

CDB is providing financial assistance @ 25% of the project cost limited to Rs.50 lakh for entrepreneurs and 33.3% of the project cost limited to Rs. 50 lakh per project for SC/ST Women entrepreneurs for establishment of coconut processing units.

Coconut Chips

Coconut chips is a ready-to-eat snack food. It is prepared in salted and sweetened forms. The Central Plantation Crops Research Institute, Kasaragod has standardized the process for preparation of chips. Coconuts of 9-10 months are used for the preparation of chips.

Composition of Coconut Chips		
Sl. No	Parameters	per 20 g
1	Fat	9.42g
2	Lauric acid	4.82g
3	Calcium	2.10mg
4	Fiber	1.93g
5	Iron	1.30mg
6	Cholesterol	0.00

Installed Capacity - 10000 nuts/day

Investment - Rs. 35 lakhs

IRR - 22 %

Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Coconut Oil

Coconut oil is rather a unique cooking oil as it contains the short and the medium chain saturated fatty acids. It finds extensive use in the food industry due to its characteristics such as easy melting behaviour, resistance to oxidative rancidity, pleasing flavour and good digestibility. Coconut oil has gained importance as a dietary fat because of its high content of lauric acid, the source of monolaurin in the body and 16W content of Omega 6. It can be used for manufacturing margarine and shortenings. Coconut oil is preferred as a fat in the preparation of filled milk, infant milk powder, ice-cream and confectionery and bakery products. Because of its stable character, coconut oil is the preferred fat for deep frying.

Coconut oil - Product Specification	
(IS-542-1968)	
Moisture % wt., Max.	0.25
Colour in 1/4 cell Lovibond Y+5R, not Deeper than	4
Acid value, Max.	2.0
Unsap. matter % by wt., Max.	0.8
Polenske Value, Min.	0.8

Installed Capacity - 3 tonnes/day
IRR - 28%
Investment - 65 lakhs
Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Studies undertaken by the Biochemistry Department, University of Kerala showed that coconut oil:

- Does not elevate blood total cholesterol and increases blood HDL cholesterol
- If consumed along with coconut kernel, lowers blood cholesterol
- Does not elevate LDL cholesterol or LDL cholesterol/HDL cholesterol ratio
- Decreases serum triglycerides

Parameters	In 100 ml
Total solids%	6.5
Reducing sugars %	4.4
Minerals %	0.6
Protein %	0.01
Fat %	0.01
Acidity mg %	120.0
pH	4.5

Parameters	In 100 ml
Potassium mg%	290.0
Sodium mg%	42.0
Calcium mg%	44.0
Magnesium mg %	10.0
Phosphorous mg%	9.2
Iron mg%	106.0
Copper mg%	26.0

A large number of branded coconut oil in consumer packs are marketed in the country. Coconut oil is refined for industrial use. The refined coconut oil is water white in colour with no aroma. Since coconut oil has the lowest level of unsaturated fatty acids among all vegetable oils, the cost of hydrogenation is much less than all other oils.

Copra

Two types of copra, namely the milling and the edible, are made in India. The milling copra is used to extract oil while the edible copra is consumed as a dry fruit. Edible copra is made in the forms of balls and cups. Copra contains the highest percentage of oil compared to other oil seeds. It contains 15-20 percent carbohydrates, 9 percent protein and 4.10 percent crude fibre besides 65-68 percent fat. The carbohydrate fraction consists of a large percentage of cellulose and sucrose together with other sugars. Besides glucose and fructose the presence of galactose, raffinose and pentoses is also reported.

Installed Capacity - 10000 nuts/day **Investment - Rs. 35 lakhs**

IRR - 18 % **Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs**

Coconut Water based Products

Tender Coconut Water

The water of tender coconut (TCW) is a sterile, nutritious and thirst quenching health drink. It possesses therapeutic properties. The TCW has a calorific value of 17.4 per 100gm.

TCW is rich in potassium and other minerals. Sugars form an important constituent of the TCW. The concentration of sugars in the nut water steadily increases from about 1.5 per cent to 5-5.5 per cent in the early months of maturation and then slowly falls reaching about 2 per cent at the stage of the full maturity of the nut.

Installed Capacity - 10000 litres/day
IRR - 22%
Investment - Rs. 1.5 crore
Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Vinegar

Coconut vinegar is made from fermented coconut water and is used extensively as a preservative and flavouring agent in pickles, salads, sauces and many other condiments. Coconut vinegar is also made from the sap of the coconut tree and is similar to the fresh coconut water. Naturally fermented coconut vinegar is rich in minerals and vitamins such as beta carotene, calcium, iron, magnesium, phosphorous, potassium and sodium. Raw, unfiltered organic coconut vinegar is similar to the one that is fermented naturally. Coconut vinegar helps in digestion and improves the quality of cooked meat and fish. It is a healthier alternative to synthetic vinegar.

Installed Capacity - 1000 litres/day
IRR - 20%
Investment - Rs. 10 lakhs
Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Coconut squash

It is a nourishing and refreshing healthy soft drink concentrate prepared by mixing coconut water, sugar and natural preservatives like lemon and ginger. It is rich in vitamins and minerals with low calorie. The product has a shelf life of three months under ambient conditions. The product is a new item and is gaining popularity in Asia and Pacific countries.

Installed Capacity - 1000 litres/day
IRR - 20%
Investment - Rs. 50 lakhs
Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Nata-de-coco

Nata-de-coco a cellulosic white to creamy yellow substance formed by acetobacter aceti subspecies Xylinium, on the surface of sugar enriched coconut water / coconut milk / plant extract / fruit juices or other waste materials rich in sugar.

It is popularly used as a dessert. It is also used as an ingredient in food products, such as ice cream, fruit cocktails, etc.

"Nata" is a Spanish word, derived from the latin word "Natare" meaning "to float". Nata making plays an important role in the development of our coconut industry because of the growing interest in its production from coconut water, an abundant waste product of coconut processing units.

Nata can be prepared from various fruits like banana, pineapple, tomato etc. and the product is named after the media used, like "Nata de coco" from coconut, "Nata de pina" from pineapple etc. We can also use coconut milk, finely shredded coconut meat or coconut water in preparing Nata.

Installed Capacity - 50 kg/day

IRR - 20%

Investment - Rs. 10 lakhs
Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

COCONUT INFLORESCENCE Based Food Products

Neera

The vascular sap collected from immature unopened coconut inflorescence is popularly known as Neera in fresh form. It is a sugar containing juice and is a delicious health drink and a rich source of sugars, minerals and vitamins. It is sweet and oyster white in colour and translucent. It is tapped from the coconut inflorescence and is filtered, pasteurized and bio preservatives are added to preserve the product. Treated Neera can be preserved in cans upto two months at room temperature. It can also be packed in tetra packs or glass bottles. Tapping can be done for six months in a year. It is an abundant source of minerals, 17 amino acids, vitamin C, broad spectrum B vitamins and has a nearly neutral pH.

Composition of Neera			
Sl. No	Parameters	Raw Neera	Packed Neera
1	pH	6.2	5.2
2	Brix/TSS	15.13%	15.37%
3	Total sugar	15.00 %	15.00 %
4	Total mineral matter	0.27 %	0.26 %
5	Protein	0.106 %	0.106 %
6	Fat	traces	nil

Installed Capacity - 5000 litres/day

IRR - 28%

Investment - Rs. 2.5 crore

Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Coconut Jaggery

Coconut jaggery is prepared by boiling fresh neera to 118-120^{o} C and allowed to cool for solidification. The solid mass is known as coconut jaggery or 'gur'. Coconut jaggery is made in traditional coconut growing tracts in the country on a cottage scale. Calcium and phosphorus are the important minerals contained in coconut jaggery. Treacle is another product manufactured from sweet toddy. It is obtained by boiling down the toddy. Fresh toddy is also a good source of baker's yeast. The fresh neera rapidly ferments and the sugar is replaced by about 5-8 per cent alcohol, which on distillation yields arrack. Fermented neera on acetic fermentation yields vinegar containing 4-7% acetic acid.

Nutritional value of jaggery		
Sl No	Parameters	Amount (%)
1	Moisture	9.1
2	Carbohydrate	87.54
3	Protein	0.72
4	Minerals	1.97
5	Fibre	0.46

Installed Capacity - 200 Kg/day

IRR - 18%

Investment - Rs. 15 lakhs

Incentive: 25% of the project cost or a maximum of Rs. 50 lakhs

Coconut Palm Sugar

The coconut palm syrup or jaggery can be crystallized to produce fine granules of sugar. Transition of coconut jaggery into a ground granule sweetener is more accepted by global markets. The recovery of palm sugar from coconut palm jaggery is 15%. The application of this sugar is tremendous and offers huge potential owing to its most important health attributes, the low Glycemic index and the high nutrient content. It can be the most suited alternative sweetener, especially when agave sugar is being rejected owing to the high fructose content. This alternative sugar industry is estimated to be a $1.3 billion industry and hence the market prospects are enormous.

Continued on next issue...

Training programs of CDB Institute of Technology

Training programs at CDB Institute of Technology (CIT) are resumed after a short break due to COVID-19 pandemic. Training programs of various durations are being conducted at the Training Institute in Aluva, Kerala under the auspices of the Coconut Development Board for individuals interested in starting coconut based ventures.

Training for coconut based value added products like coconut chips, coconut chocolate, coconut cookies, coconut lemonade, coconut chutney powder, coconut candy, tender coconut jam, vinegar made from matured coconut water, Nata de coco etc. with a duration of one to four days are being offered at CIT. Hands on training will also be provided by dividing the participants into groups. Practical training is provided with the help of coconut processing machineries.

In addition to the practical training programs, there will be theory classes on various schemes of CDB, Good Manufacturing Practices, Food Safety etc.

So far in this financial year, 103 persons have been trained in 17 batches.Participants were from various walks of society like entrepreneurs employees, housewives, students etc.

In addition to coconut food products' processing, training will be also provided in Chemical and Microbiological analysis of coconut food products.

Apart from this, CIT is providing facilities for students pursuing life science / food science based courses to carry out their academic project works.

Name of training programme	Duration	Fees per person	Topics/Products covered	Targeted participants	Minimum participants needed for a batch
Coconut Convenience Foods-Demonstration only	1 Day	Rs.500/-	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
Coconut Convenience Foods	4 Days	Rs.2000/-	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
Coconut Vinegar from coconut water by slow process/Nata de coco.	1 Day	Rs.1000/-	Coconut Vinegar	Basic science knowledge Kudmbasree units, Individuals, other groups, FPOs	5
Training on Chemical analysis.	1 week	Rs.2500/-	Chemical analysis of coconut products	Minimum qualification- Graduation in Chemistry/Biochemistry/ Food chemistry/Food Technology	1
Training on Microbiological analysis	2 weeks	Rs.5,000/-	Microbiological analysis	Minimum Qualification – Graduation in Microbiology/other life sciences with microbiology as one of the subjects	1
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

Farmers Field Day Programmes

CDB RO Patna

CDB, RO, Patna organised a field day programme on 5th March 2021 at Mandan Bharati College and Regional Research Institute, Bihar Agriculture University, Agwanpur, Saharsa.

Dr. Umakant Singh, Asst. Professor cum Jr. Scientist (Horticulture), Mandan Bharati College and Regional Research Institute, Bihar Agriculture University, Agwanpur, Saharsa was the chief guest of the function. Shri Rajiv Bhushan Prasad, Director, CDB, RO, Patna inaugurated the programme and Shri Ravindra Kumar, Development Officer, CDB , RO, Patna , Shri Rajiv Ranjan, Farm Manager, Mandan Bharati College and Regional Research Institute, Bihar Agriculture University, Agwanpur and progressive farmers attended in the function. Shri Ravindra Kumar, Development Officer, CDB , RO, Patna briefed about the importance of field day programme and spoke on various aspects of coconut cultivation. He gave emphasis on identification of various diseases that affect coconut tree and the measures to be adopted for management of pests and diseases.

In his address, Shri Rajiv Ranjan, Farm Manager, Mandan Bharati College and Regional Research Institute, Bihar Agriculture University, Agwanpur mentioned that coconut is a useful fruit for mankind and it has importance in many cultural activities like Durga Pooja, Diwali Pooja, Chhat pooja etc. He told that farmers should avail the benefit of various schemes implemented by CDB and plant at least 10 to 20 coconut trees in their farms.

Dr. Umakant Singh, Asst. Professor cum Jr. Scientist(Horticulture), Mandan Bharati College and Regional Research Institute, Bihar Agriculture University, Agwanpur, Saharsa talked about methods for producing organic manure in coconut gardens and its uses. He also emphasised on intercropping with medicinal plants and other plants like turmeric, ginger etc. He talked about nutrition management in coconut garden and encouraged farmers for coconut cultivation.

Shri Rajiv Bhushan Prasad, Director, CDB , RO, Patna spoke about various methods of scientific coconut cultivation, various products of coconut, economic and social importance of coconut. He also talked in detail about the various schemes implemented by CDB in Bihar state and answered the queries raised by farmers.

Approximately 25 farmers participated in the programme. Programme was concluded with the vote of thanks by Shri Ravindra Kumar, Development Officer, CDB, RO, Patna.

CDB, RO, Patna organised another field day programme on 7th March 2021 at Gram: Khopouti, Block-Puniyahi, District Madhepura.

Shri Vidyadhar Mukhiya, Social Activist, Khopouti was the chief guest of the function. Shri Rajiv Bhushan Prasad, Director and Shri Ravindra Kumar, Development Officer, CDB , RO, Patna , Shri Bal Kishore Kumar, Former Mukhiya, Gram Panchayat, Balamgadhiya, Madepura district and other dignitaries participated in the function. Shri Vidyadhar Mukhiya, Social Activist, Khopouti and Shri Rajiv Bhushan Prasad, Director, CDB , RO, Patna jointly inaugurated the programme by lighting the lamp. Shri Bal Kishore Kumar, Former Mukhiya, Gram Panchayat, Balamgadhiya, Madepura district welcomed the gathering.

Shri Ravindra Kumar, Development Officer, CDB, RO, Patna demonstrated the planting method of coconut seedling in the field and spoke on various aspects of coconut cultivation. He talked about the importance of organic and chemical fertilizer application for increasing coconut production and spoke in detail about irrigation methods..

Shri Bal Kishore Kumar, Former Mukhiya, Gram Panchayat, Balamgadhiya, Madhepura district talked about various uses of coconut and encouraged farmers for cultivation of coconut. He said that the soil and climate of this region is suitable for coconut cultivation. While talking about the uses of coconut he mentioned that it is very effective in curing various diseases.

While addressing the farmers Shri Vidyadhar Mukhiya, Social Activist, Khopouti told that he has adopted cultivation of various horticulture crops along with coconut. He opined that farmers should take advantage of Area Expansion Programme implemented by CDB and they should plant coconut seedlings in their field.

Shri Rajiv Bhushan Prasad, Director, CDB , RO, Patna spoke on identification and management of various pests and diseases that affect coconut tree. He encouraged the farmers for adopting coconut cultivation for increasing their income. He said that in Bihar state tall varieties are more remunerative. He also emphasised on its economic importance and created awareness among farmers about coconut cultivation and encouraged them for availing benefits of various schemes implemented by the Board. .

Approximately 26 farmers participated in the programme. Programme was concluded with the vote of thanks by Shri Subhash Chandra, Progressive farmer.

CDB RO, Assam

Coconut Development Board, Regional Office, Guwahati organized a Farmer's Field day programme on scientific coconut cultivation technology on 3rd March 2021 at Khatalpara Village in collaboration with Krishi Vigyan Kendra, Barpeta. Shri Mridul Talukdar, H.A, R.O, Guwahti welcomed the guests and 20 farmers participated in the programme.

Shri Pinku Dhar Barman, SMS (Agronomy), KVK,Barpeta spoke on importance of coconut cultivation and value addition of coconut. He also informed about the economic value of coconut and its products.

Smt. Lipka Nath, SMS(Horticulture), KVK,Barpeta

briefed on scientific coconut cultivation technologies and water management and soil conservation methods and also explained about processing and value addition of coconut. She mentioned about the various food items that can be processed from coconut. She also explained about the various coconut disease and pest management.

Shri Mridul Talukdar, H.A, R.O, Guwahti explained about the activities of the Coconut Development Board and also explained about CDB scheme, activities and training programmes.

During interaction with farmers, their various queries on coconut plantation, plant protection etc. were suitably answerd by the experts.

After the training programme Field visit was done in a best farm Mrs. Lipka Nath, SMS (Horticulture), KVK, Barpeta explained on how to maintain the coconut palm and demonstratied fertilizer application on coconut palm and seed bed preparation.

Minimum Support Price for mature dehusked coconut for the season 2021 declared

Government of India has declared Minimum Support Price for mature dehusked coconut for the season 2021 at Rs. 2800/- per quintal, hiking the MSP from Rs. 2700/- per quintal during season 2020. National Agricultural Cooperative Marketing Federation of India Limited (NAFED) and National Cooperative Consumer Federation of India Limited (NCCF) will continue to act as Central Nodal Agencies to undertake price support operations for procurement of mature dehusked coconut at the Minimum Support Price in the coconut growing States

Coconut Handicraft Training

CDB, RO, Patna organised a handicraft training programme at Mushari, Farbisganj, Arariya district from 10th to 15th March 2021. Shri Ravindra Kumar, Development Officer, RO, Patna welcomed the gathering. Chief Guest Shri Lakshmi Narayan Mehta, Former MLA, Farbisganj, Shri Rajiv Bhushan Prasad, Director, CDB, RO, Patna, Shri Manishankar, Master Trainer and other dignitaries jointly inaugurated the programme.

Shri Lakshmi Narayan Mehta, Former MLA, Farbisganj and Shri Dilip Kumar Mehta, President, Adarsh Krishak Hit Samooh, Mushari addressed the gathering.

Shri. Manishankar, Master Trainer explained the trainees about the curios made from coconut shell and dry coconut and the process of making various handcrafted products. He also spoke about various handicrafts made from coconut and the market prices available for these products.

Shri Ravindra Kumar, Development Officer, CDB, RO, Patna said that the programme is organised at Mushari Gram for the benefit of the people in this area so that after acquiring training they can adopt this as a means for income generation

Shri Rajiv Bhushan Prasad, Director, RO, Patna briefed the objective of conducting this programme and pointed out that after successful completion of this training, the trainees will be capable for self employement under Skill Development Programme. He also told that there is a huge demand for handicrafts made from coconut shell.

15 trainees participated in the programme. Valedictory session was held on 15th March 2021. Chief Guest Shri Lakshmi Narayan Mehta, Former MLA, Farbisganj congratulated the trainees for participating in the training programme. Trainees displayed the handicrafts made by them and prizes were distributed to the best works. The trainees were provided stipend, tool kit and certificate. Shri Sadanand Mehta, Adarsh Krishak Hit Samooh, Mushari proposed vote of thanks. ■

Udyan Mahotsav

CDB, RO, Patna participated in Udyan Mahotsav 2021 held from 26th to 28th February 2021 at Desharatna Udyan, Patna organised by Horticulture Directorate, Bihar. Shri Amarendra Pratap Singh, Hon'ble Agriculture Minister, Bihar inaugurated the programme. Shri N.Saravana, Secretary, Dept. Of Agriculture, Shri Nanda Kishore, Director Horticulture, Shri A.C.Jain, Joint Director, Dr.Rakesh Kumar, Deputy Director, Horticulture Directorate, Bihar and District Horticulture Officers of other districts attended the function. Shri. Ravindra Kumar, Development Officer, Shri Hariom Kumar, Jr. Stenographer and Shri Rajiv Ranjan Sinha, LDC, CDB, RO, Patna also participated in the function.

CDB, RO, Patna displayed various coconut products like coconut oil, coconut milk powder, coconut jam, coconut water, neera, biscuits, chocolate, virgin coconut oil and VCO capsule etc. in the stall and explained about the products. In addition to that detailed information on various schemes implemented by the Board such as area expansion, LoDP, FOCT, Coconut Handicraft training and other schemes were provided to the farmers. Officials also provided information on coconut cultivation, pest and disease management as well as income obtained from coconut cultivation.

Hon'ble Agriculture Minister, Bihar visited Board's stall and Shri Ravindra Kumar, Development Officer explained about various schemes implemented by CDB in Bihar state and Hon'ble minister admired the products and handicraft items showcased in the stall made of Coconut.

Agri Vision 2021

Agri Vision 2021, an International conference on Plant Science in Post Genomics Era was held at Institute of Life Science, Bhubaneswar from 14th to 16th March 2021. CDB State Centre Odisha participated the programme. Agri Vision inaugurated by Shri. Pratap Chandra Sarangi, Hon'ble Minister of State for Micro, Small and Medium Enterprises and Fisheries, Animal Husbandry and Dairying, Govt. of India. CDB displayed coconut value added products and around 500 visitors including farmers and students visited the Board's Stall.

Shri. Rajat Kumar Pal, Dy. Director, CDB briefed on the various schemes and programmes of CDB, coconut varieties suitable for Odisha condition and on coconut cultivation.

Cultivation practices for coconut - April

Collection and storage of seed nuts

Continue seed nut collection from the identified mother palms. Seed nuts should be carefully harvested and properly stored to prevent drying of nut water. Wherever the ground surface is hard, harvested bunch should be lowered to the ground using a rope.

Nursery management

Continue irrigation for the seedlings in the nursery. Weeding has to be done wherever necessary. If termite infestation is noted in the nursery drenching with chlorpyriphos (2ml chlorpyriphos in one litre of water) should be done. Spiralling white fly infestation is observed in coconut nurseries in many localities. Spraying of water on the lower surface of leaves of seedlings can be done against spiralling white fly attack.

Fertilizer application

In irrigated coconut gardens, apply one fourth of the recommended dose of chemical fertilizers to the coconut palms, if not applied during March.

Irrigation

Irrigation has to be continued in coconut gardens. If basin irrigation method is adopted, provide irrigation once in four days @ 200 litres per palm. Drip irrigation is the ideal method of irrigation for coconut, especially under water scarce situation. The number of dripping points should be six for sandy soils and four for other soil types.

Moisture conservation

Hot dry weather continues in most of the coconut growing tracts and scarcity of water for irrigation is going to be a major problem in coconut farming. Hence, coconut growers need to judiciously use water for irrigation. Drip irrigation has to be adopted to save water. Thick mulch need to be provided in the palm basin within two metre radius. In water scarce

areas, wherever feasible, life saving/protective irrigation has to be provided to coconut palms. Mulched materials are to be removed in the basin before giving such life saving/protective irrigation and immediately after providing irrigation the basin should be covered again with the mulching materials.

Shading

Shade has to be provided for the newly planted seedlings, if not already provided.

Management of pests and diseases

As the dry hot summer continued in this month, the pest population is all on the rise especially the weather sensitive pests such as black headed caterpillar, rugose spiralling whitefly and nesting whiteflies. Moisture deficit, diminishing relative humidity and rise in temperature favours the outbreak of these aforesaid pests. Coconut palm needs continuous moisture and nutrition for sustaining production and withstanding pressure from pest outbreak. Once the month accelerates population build up of pest coupled with moisture deficit situation would lead to palm ill health thereby reducing yield. Sustenance of palm itself would become very difficult under reduced humidity and rise in temperature. Nut setting gets reduced and palm health would divert for mere survival mechanism than for enhancing yield. Henceforth, the strategies outlined under soil and water management would turn more crucial in the general upkeep of palm health. Palm health management is therefore very crucial for the bio-suppression of black headed caterpillar and rugose spiralling whitefly.

Black headed caterpillar, *Opisina arenosella*

The coconut black headed caterpillar, *Opisina arenosella*, is a major pest distributed in almost all coconut growing tracts across the country especially along the water bodies during winter. The infested portions get dried and form conspicuous grey patches on the upper surface of the lower fronds. Severe pest damage results in complete drying of middle to inner whorl of fronds leaving a burnt appearance. Presence of black headed caterpillars, webbing of leaflets and occurrence of dried faecal matter on the leaflets are the characteristic features of pest incidence. In the absence of natural enemies in the new area of emergence, the outbreak becomes faster and expands at high speed. Damage results in tremendous reduction in photosynthetic area, decline in rate of production of spikes, increased premature nut fall and retarded growth. Extensive feeding of caterpillars causes a crop loss of 45.4% in terms of nut yield in addition to rendering the fronds unsuitable for thatching and other purposes.

Pest infested field

Black headed caterpillar

Goniozus nephantidis

Farmers need not panic and this approach is one of the classical examples of successful augmentative biological control suppressed by natural enemies.

▶ Management

- Regular monitoring of palm fronds for pest occurrence in endemic zones.
- Removal and destruction of 2-3 older and dried leaves harbouring various stages of the pest. The leaflets could be burnt to reduce the caterpillar/ pupal population.
- Domestic quarantine should be strengthened by not transporting coconut fronds from pest-infested zone to pest free zone.
- Augmentative release of the larval parasitoids viz., *Goniozus nephantidis* (20 parasitoids per palm) and Bracon brevicornis(30 parasitoids per palm) if the pest stages is at third-instar larvae and above. The pre-pupal parasitoid (*Elasmus nephantidis*) and pupal parasitoid (*Brachymeria nosatoi*) are equally effective in pest suppression and are released at the rates of 49% and 32%, respectively for every 100 pre-pupae and pupae estimated.
- Before releasing, the parasitoids are adequately fed with honey and exposed to host odours (gallery volatiles) for enhancing host searching ability.
- Ensure adequate irrigation and recommended application of nutrients for improvement of palm health.

Rugose Spiralling Whitefly *(Aleurodicus rugioperculatus)*

This period could also witness the establishment of the invasive rugose spiralling whitefly (*Aleurodicus rugioperculatus*) in new areas as well as re-emergence in already reported areas. Presence of whitefly colonies on the lower surface of palm leaflets and appearance of black coloured sooty mould deposits on the upper surface of palm leaflets are characteristic visual symptoms of pest attack. In severe cases, advancement in senescence and drying of old leaflets was observed. Leaflets, petioles and nuts were also attacked by the whitefly pest and a wide array of host plants including banana, bird of paradise, Heliconia sp. were also reported.

▶ Management

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms

Rugose spiralling whitefly Parasitized pupae

Encarsia guadeloupae

Sooty mould scavenger beetle

- No insecticide should be used as this causes resurgence of the pest and complete kill of the natural aphelinid parasitoid, *Encarsia guadeloupae.* A pesticide holiday approach is advocated for the build up of the parasitoid.
- Installation of yellow sticky traps and conservatory biological control using *E. guadeloupae* could reduce the pest incidence by 70% and enhance parasitism by 80%.
- Habitat preservation of the sooty mould scavenger beetle, *Leiochrinus nilgirianus* could eat away all the sooty moulds deposited on palm leaflets and cleanse them reviving the photosynthetic efficiency of palms.
- A close scrutiny should be made for the presence of other whiteflies including the nesting whiteflies on coconut system.

Nesting whiteflies (Paraleyrodes bondari and Paraleyrodes minei)

In addition to the rugose spiralling whitefly, two more nesting whiteflies (*Paraleyrodes bondari and Paraleyrodes minei*) are found associated with palm leaflets. Nesting whiteflies are smaller in size (1.1 mm) than rugose spiralling whitefly (2.5 mm). The nymphs are flatter with fibreglass like strands emerging form dorsum whereas the nymphs of rugose spiralling whitefly are convex in shape. Adult nesting whiteflies construct bird's nest like brooding chamber and sustains in the chamber. *P. bondari* had X-shaped oblique black marking on wings with two

P. bondari

P minei

Cybocephalus sp.

minute projections on rod shaped male genitalia whereas *P.minei* is devoid of black markings on wings and possesses cock-head like genitalia.

▶ Management

- In juvenile palms, spraying of water with jet speed could dislodge the whitefly and reduce the feeding as well as breeding potential of the pest.
- Ensure good nutrition and adequate watering to improve the health of juvenile and adult palms
- Effective nitidulid predators belonging to *Cybocephalus sp.* were observed on the palm system and pesticide holiday is advised for conservation biological control.

Disease

Leaf blight of coconut *(Lasiodiplodia theobromae)*

Leaf blight is an emerging disease in Coimbatore, Erode, Dindigul, Tirunelveli and Kanyakumari districts of Tamil Nadu. The pathogen causes damage in leaf and nuts. Affected leaflets start drying from the tip downwards and exhibit a charred or burnt appearance. The leaves in lower 3 to 4 whorls are affected. Leaf blight causes apical necrosis of lower leaves with an inverted "V" shape, and symptoms similar to those induced by drought (water deficit) and other stresses. The leaflets have extensive necrotic lesions with defined edges and without transition areas between the necrotic and healthy tissues. The pathogen can internally colonize the rachis, inducing internal necrosis that moves upward towards the stem (systemic invasion). The necrotic tissues develop exposed cracks that release gums under the leaf rachis and at petiole insertion. On coconuts, small black sunken region appear near the perianth of immature nuts.When nearly mature /mature nuts were infected, the infection spread internally into mesocarp without any external symptoms. The affected nuts are desiccated, shrunk, deformed and drop prematurely causing 10% to 25 % loss in nut yield.

▶ Management

- Improving the palm health by application of 5 kg neem cake enriched with Trichoderma harzianum and soil test based nutrition.
- Adequate irrigation and adoption of soil and water conservation measures is advised.
- Root feeding of hexaconazole @ 2% (100 ml solution per palm) thrice a year.

The dynamics of insect pests and diseases in coconut system vis-à-vis weather change pattern is so critical in population build up. Timely prophylactic measures to safeguard palms and enhancing palm health through need-based nutrition is very essential to withstand the pressure exerted by pests and diseases in outbreak situation. ■

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

Market Review – February 2021

Domestic Price

Coconut Oil

During the month of February 2021 the price of coconut oil opened at Rs. 19800 per quintal at Kochi and at Alappuzha market and Rs. 22000 per quintal at Kozhikode market. The price of coconut oil at Kochi, Alappuzha and Kozhikode market expressed an upward trend during the month.

The price of coconut oil closed at Rs. 21550 per quintal at Kochi and at Alappuzha market and Rs. 22000 per quintal at Kozhikode market with a net gain of Rs.1750 for quintal at Kochi and Alappuzha market.

The prices of coconut oil at Kangayam market in Tamilnadu, which opened at Rs. 18000 per quintal and expressed a mixed trend during the month and closed at Rs. 18867 with a net gain of Rs. 867 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.02.2021	19800	19800	22000	18000
06.02.2021	20600	20500	22000	18833
13.02.2021	20550	20550	21900	18667
20.02.2021	21100	21050	21800	18867
27.02.2021	21550	21550	22000	18867

Milling copra

During the month, the price of milling copra opened at Rs.13000 per quintal at Kochi and Rs.12850 per quintal at Alappuzha market and Rs. 13800 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 14200 per quintal at Kochi and Alappuzha market and Rs. 13950 per quintal at Kozhikode market with a net gain of Rs.1200 at Kochi and Rs.1100 at Alappuzha and Rs.150 per quintal at Kozhikode market.

At Kangayam market in Tamilnadu, the prices opened at Rs. 12000 per quintal and closed at Rs. 12700 per quintal with a net gain of Rs. 700 per quintal.

**NR-Not reported*

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kan-gayam
01.02.2021	13000	12850	13800	12000
06.02.2021	13500	13350	14000	12500
13.02.2021	13450	13350	13900	12400
20.02.2021	13800	13700	13900	12700
27.02.2021	14200	13950	13950	12700

Edible copra

During the month under report the price of Rajpur copra at Kozhikode market opened at Rs. 15500 and closed at Rs.16900 per quintal with a net gain of Rs.1400 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.02.2021	15500
06.02.2021	16000
13.02.2021	15800
20.02.2021	16300
27.02.2021	16900

Ball copra

The price of ball copra at Tiptur market opened at Rs. 14100 per quintal and closed at Rs.15200 per quintal with a net gain of Rs.1100 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal)	
01.02.2021	14100
06.02.2021	14800
13.02.2021	14500
20.02.2021	14600
27.02.2021	15200

Dry coconut

At Kozhikode market, the price of dry coconut opened at Rs.11750 and continued without change during the month.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.02.2021	11750
06.02.2021	11750
13.02.2021	11750
20.02.2021	11750
27.02.2021	11750

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs.21000 per thousand nuts and closed at Rs. 20000 during the month with a net loss of Rs. 1000 per thousand nuts.

At Pollachi market, the price of coconut opened at Rs.16000 per thousand nuts and closed at Rs. 17000 with a net gain of Rs. 1000 per thousand nuts.

At Bangalore market in Karnataka, the price of coconut opened at Rs.22500 per thousand nuts and closed at Rs. 12500 during the month with a net loss of Rs. 10000 per thousand nuts.

Weekly price of coconut at major markets (Rs /1000 coconuts)				
	Nedumangad	Pollachi	Man-glore	Banglore
01.02.2021	21000	16000	22500	22500
06.02.2021	20000	16000	19000	NR
13.02.2021	20000	NR	NR	27500
20.02.2021	20000	16000	12500	NR
27.02.2021	20000	17000	12500	25000

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*
06.02.2021	245	231	NR	502
13.02.2021	247	214	NR	NR
20.02.2021	245	192	NR	508
27.02.2021	NR	203	NR	522
*Pollachi market				

Coconut Oil

International price of coconut oil expressed an upward trend during the month. However domestic price of Indonesia expressed a downward trend and Sri Lanka and India expressed an upward 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*
06.02.2021	1395	NR	1340	2636	2587
13.02.2021	1428	NR	1359	2693	2565
20.02.2021	1430	NR	1353	2673	2592
27.02.2021	1460	NR	1338	2682	2592
* Kangayam					

Copra

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

Weekly International price of copra in major copra producing countries				
Date	Domestic Price (US$/MT)			
	Philippines	Indonesia	Srilanka	India* * Kangayam
06.02.2021	874	812	1657	1718
13.02.2021	887	830	1600	1704
20.02.2021	888	847	1601	1745
27.02.2021	NR	793	1589	1745

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