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Sustainable Nutmeg Production in coconut plantations

Traditional Coconut Varieties

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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

Dear Readers,

A new financial year has started and it's a new beginning. The world is still in the aftermath of the pandemic, but life is moving along in the new adopted lifestyle. The importance of agriculture is once again in the forefront of discussions across the globe. The policy initiatives and developmental activities in the agriculture sector are ongoing, with increased thrust on quality of production and environmental sustainability. But at the same time food shortages have been reported from different parts of the world. There is crisis in the economic front and in trade in many countries, owing to man-made calamities in the form of war; issues in logistics and container costs are affecting trade and increasing retail prices and supply chain disruption in many commodities, especially cereals and edible oils has affected the consumers.

The coconut sector is silently moving ahead with the planting season for coconut having started in the coconut growing areas which depend on the South West monsoon. In this globalised world, trade of agricultural products is not confined to a country, it is global and highly inter-linked. It is very encouraging to note that the processors and manufacturers have woken up to the increased opportunities that have opened up in global trade; the international prices and domestic prices of coconut products moving almost on par have created a good competitive atmosphere for export. The economic crisis in other coconut producing countries has also resulted in foreign buyers seeking Indian manufacturers for various value added products of coconut. The issues in import of edible oils will create shortage in an oil deficit in a country like India which is highly dependent on import of edible oils. This is a situation which could be utilized by coconut oil manufacturers by providing quality coconut oil at reasonable prices to the consumers.

The Board is organizing a Virtual Trade Fair during 26-28, April 2022, showcasing the coconut products of manufacturers and processors to the domestic and international market. This will provide an opportunity for the micro and small enterprises to reach out to the consuming world with quality products. It will be a learning experience for the small scale manufacturers of coconut products to package and present their products in the virtual world portraying their strong points –nutritive, medicinal or health attributes and also look ahead for improving quality, packaging and promotions. The Virtual Trade fair is an effort to exploit the potential of the virtual platform to the benefit of the numerous coconut product manufacturers. Let us hope coconut production and trade move hand in hand thereby benefitting the small and marginal farmer, the processor and the consumer.

Editor

Elephant Foot Yam - a profitable intercrop for coconut gardens of Andaman and Nicobar Islands

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Coconut is the most widely grown crop in the Andaman and Nicobar Islands, either as monocrop or in combination with multiple crops and animal components. It is grown in over 20,000 ha area in Andaman and Nicobar Islands, out of which over 15,000 ha are in Nicobar district and remaining in Andaman Islands. The coconut area is fragmented in several islands making it impossible to follow any single type of cropping or farming systems. Growing various annuals and perennials in the interspaces of coconut plantations with a recommended spacing of 7.5 mx7.5 m have been proven to be successful as coconut based farming systems. However, depending upon the availability of inputs and management conditions, proper selection of crop species or combination of crops with adaption of appropriate management practices are lacking in many gardens of South Andaman which results in lesser income generation and under-utilization of natural resources.

Intercropping models with higher utility of horizontal and vertical space in the plantations are suggested as the best alternative to boost the income of the coconut growers as well to increase the productivity.

Elephant Foot Yam (EFY) *(Amorphophallus paeoniifolius)*, commonly known as Suranor Jimmikandis a tuber crop which produces underground stem tuber. The crop is gaining popularity due to of its yield potential under marginal management conditions of the Island cropping systems and its culinary properties.

The crop is largely cultivated in the Philippines, Java, Indonesia, Sumatra, Malaysia, Bangladesh, India and China. In India, it is cultivated widely in the states of Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh, Bihar and Jharkhand. The tubers (called corms) are used as a vegetable after boiling or baking or frying. It is reported to be a rich sources of carbohydrates, calcium, (50 mg/g), phosphorus(34 mg/g) and vitamin A (260 IU/g). The leaves are also used as a vegetable by some local tribes in India which are reported to be rich in vitamin A.

It is a preferred tuber by different island communities in Andaman and Nicobar Islands for variety of culinary preparations such as fry, chips, curries either alone or in combination with other vegetables, tubers and coconut. Wild relatives under *Amorphophallus genus* and many introduced local types of EFY are used in the Islands which vary in the size, taste, and yield potential. Due to introduction of high yielding, non-acrid varieties, the crop is being adopted for commercial cultivation at many places in the country. In Andaman and Nicobar Islands, ICAR-CIARI has introduced and demonstrated the cultivation of improved varieties such as Gajendra, Sree Padma varieties of EFY. Demonstration of organic production of elephant foot yam under coconut based cropping system by ICAR-CIARI have shown to enhance productivity and profitability under Island cropping systems of marginal management conditions.This crop also offers excellent export potential from India,since it is not generally cultivated commercially in other countries.Cultivation practices of EFY under coconut plantations of Andaman is detailed here.

Soil and climate

Generally, Amorphophallus species grows well under tropical and subtropical humid climatic conditions with a mean annual temperature of 30-35^{o}C and a well distributed rain fall of 1000-1500 mm spread over a period of 6-8 months. It can come up on variety soils but a well-drained sandy loam soil (or) sandy clay loam soil with a pH of 5.5-7.0 is ideal for the growth of this crop. The climate and soil of Andaman and Nicobar Islands is ideally suited for cultivation of this crop.

Seed tubers of Elephant foot yam and preparation of cuttings

Treating the cut tubers in cow dung slurry and planting in interspaces of coconut plantation

Propagation

EFY is propagated by the use of offsets (or) corms. The off sets are nothing but miniature tubers arising from the mother corm. In some varieties/ types, the daughter corms are not produced in which the mother corm is cut vertically into pieces in such a way that each piece has portion of the central bud from where the plant grow after planting. Depending on the size of mother corm, it is cut into 4 or 6 or more pieces making them to about 300 to 500g weighing pieces. Dipping of planting material in cow dung slurry followed by drying in a shaded place is effective in accelerating the sprouting.

Field preparation and planting

Most coconut gardens in South Andaman are undulated. Hence use of tractors and mechanical devises is difficult. In such places, only manual field preparation is done with pickaxe. Wherever possible, the interspaces could be subjected to ploughing two to three times. Pits of 45 x 45 x 45 cm are dug at a spacing of 90 x 90 cm and the filled with 4-5 kg of FYM and topsoil. About 25 to 40 EFY plants could be accommodated per interspace of coconut depending on the presence of other intercrops such as cinnamon, nutmeg etc. The pretreated planting material is placed vertically in the pits and then covered with soil and compacted lightly. The ideal planting time is March-April under Island conditions. Delayed planting after commencement of monsoon rains may cause rotting of tubers. Hence, planting should be done at the right time.

Intercultural operations

Mulching: Immediately after planting, the pits are to be mulched with dried leaves which will induce better sprouting by conservation of moisture and helps controlling weed growth. Coconut leaves and arecanut leaves, both dried and fresh are used as mulch in the interspaces of coconut plantations. Application of Gliricidia leaves is also beneficial as it adds more nutrient to the soil.

Weeding: One (or) two manual weeding is necessary depending upon the amount of weed growth, first at 45 days after planting and the second, about one month after the first. Proper mulching decreases the need for second weeding which helps in manpower efficiency.

Plant protection

Not any major pests and diseases are noticed under Island conditions. Collar rot is an important disease, which occurs mainly due to poor drainage, water logging and mechanical injury at collar regions. Brownish lesions first occur on collar regions which spread to the entire pseudo stem and cause complete yellowing of the plant. Using disease free planting materials, maintaining good field sanitation, providing proper drainage and application of neem

Luxuriant growth of EFY under coconut

Harvested tubers, ready for sale

cake with Trichoderma will help in managing the collar rot.

Sucking pests like aphids and mealy bugs are also noticed occasionally which could be managed well with spraying neem oil @ 2ml per litre of water.

Harvesting

The crop can be harvested in about 8-9 months after planting. The tubers are harvested in November-December. The harvestable maturity is indicated by yellowing and drooping of the leaves. A light irrigation may be required before harvest of tubers to loosen the soil and to avoid damage of tubers during digging. The corms are dug out, cleaned and stored in well under ventilated places for several months without damage. The corm yield ranges from 40 to 50 t/ha depending on the soil conditions and management. This provides a reasonable additional income to the farmers as the price of EFY is about Rs. 30 to 40 per kg at farm gate. About 20 per cent of the harvest need to be kept as seed tubers for the next planting season after 3 or 4 months and the rest can be marketed.

Conclusion

Under the demonstrations by ICAR-CIARI, the selected farmers from South Andaman were provided with the planting material of Elephant foot yam (100 kg) each and imparted training on scientific cultivation practices. The scientific practices that were adopted by the farmers include basal application of organic manure; seed treatment with cow dung slurry and Trichoderma viride before sowing; Glyricidia green leaf mulching after sowing and once again after 45 days; Weeding after 45 days followed by earthing up. The farmers have realized average yield of 800 to 1000 kg elephant foot yam from 0.02 ha area plot after about nine months. Considering the market rate of Rs 30- 40 per kg of elephant foot yam tubers, they earned about Rs 24000- 30000 from 0.02 ha as additional income from the coconut system.Hence, Elephant Foot Yam is an ideally suitable intercrop in coconut plantation with high yield and high returns in Andaman and Nicobar Islands under rainfed and organic production. Use of improved varieties such as Gajendra, Sree Padma and adoption of scientific cultivation along with other suitable intercrops such as Cinnamon, Clove, Nutmeg and Black Pepper under coconut plantations will make the coconut based cropping systems profitable and productive in Andaman and Nicobar Islands. ■

Sustainable nutmeg production in coconut plantations:

the role of site specific nutrient management

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Nutmeg can be successfully grown as an intercrop in multiple cropping system based on coconut. The available space and shade in the coconut gardens which are more than 15 years old can be best utilized by planting nutmeg as the it is a shade loving plant. Adoption of such multiple cropping system emerges as a viable means for improving the economic status of farmers. The addition of nutmeg crop component in the coconut based cropping system does not reduce the yield of coconut. However, the practice of intercropping nutmeg in coconut plantations is not very common in Kerala except in districts like Thrissur, Ernakulam, Idukky and Kottayam. District wise details of nutmeg cultivation in kerala is furnished in table 1 below. Nutmeg is planted in between two rows of coconut palm so as to accommodate 50-60 plants per acre. Trees of 15 years of age and above will yield about 1000-2000 or more fruits and large trees, which are over 30 years of age, may yield about 3000-10000 fruits per year. The yield per acre may vary from 300-350 kg of nutmeg and 50-60 kg of mace per annum.

There is no specific recommendation for such intercropped nutmeg in coconut-based land use systems. The current levels of output of nutmeg from coconut-nutmeg intercropping system can be enhanced through technology interventions. The studies on agro-ecology and soil qualities pointed to the fact that factors like strong soil acidity, extensive deficiency of secondary nutrients like calcium and magnesium and wide spread deficiency of micro-nutrients tend to limit the productivity of both nutmeg and coconut in Kerala. It was in this context that a focused technology refinement and demonstration programme for addressing such specific constraints was implemented for coconut based nutmeg cultivation.

Based on the detailed background study on intervention points for enhancing sustainable nutmeg production in coconut based intercropping systems, the critical role of site specific nutrient management was identified. A multi Institutional Project led by National Bureau for Soil Survey and land Use planning, focused on developing

Table 1. Area, Production and Productivity of Nutmeg in Kerala (2019-2020)				
Sl No.	District	Area (ha)	Production (tonnes)	Productivity (kg/ha)
1	Thiruvanthapuram	87	38	437
2	Kollam	85	37	435
3	Pathanamthitta	586	209	357
4	Alappuzha	345	113	328
5	Kottayam	2448	1444	590
6	Idukki	4142	3558	859
7	Ernakulam	6637	5214	786
8	Thrissur	6777	3448	509
9	Palakkad	413	150	363
10	Malappuram	479	172	359
11	Kozhikode	782	350	448
12	Wayanad	87	31	356
13	Kannur	302	140	464
14	Kasaragod	159	106	667
Total	23329	15010		
State average				**643**
(Source : Farm Guide 2022)				

sustainable soil nutrient management strategies for specific intercrops in coconut was initiated in 2015. The project was funded by Kerala State Planning Board. The collaborating institutes for the nutmeg component included Central Plantation Crop Research Institute, ICAR Indian Institute of Spices Research and the ICAR Central Marine Fisheries Research Institute, Kochi.

Objectives

One of the key objectives of the collaboration was to develop site specific nutrient management strategies for the nutmeg-coconut intercropping system by mitigating the productivity constraints arising from soil related factors. The project also aimed to demonstrate that productivity of coconut–nutmeg intercropping system in Kerala can be substantially enhanced through appropriate external inputs and site specific nutrient management at minimum cost and effort, while maintaining plant health at optimum levels. The project activities included the following.

- Scientific documentation of soil related constraints in cultivation of nutmegas an intercrop in coconut garden.
- Development of Best Management Practices (BMP), from scientific study based on analysis of soil nutrient status and plant tissue samples from nutmeg gardens in representative agro-ecological unit.

- Successful validation and demonstration of the BMP for enhancing crop production in farmer's fields in the selected agro-ecological units

The farmer participatory technology intervention demonstrations were carried out in Mookkannur Panchayath of Ernakulam District.

As part of the study, initial soil samples were collected from varying depths (0-20, 21-40 and 41-60 cm) from coconut and nutmeg basins and from interspaces as per the laid procedures and processed. Leaf samples were also collected, prior to the interventions, and analyzed for nutrient status. For nutmeg, most recently matured leaf from the base of a fruiting terminal/ current season flush (or) last fully matured leaf of the previous year's flush was collected as index leaf.Based on the initial soil and leaf nutrient status best management practice (BMP) were designed and treatments were imposed at both experimental fields and demonstration plots in two splits in each year. The impact of the best management practice was studied by periodic analysis of soil samples at the end of each year. The physicochemical properties along with soil and plant health status was also recorded. The components of the best management practice developed for nutmeg is given in Table 2 below.

Table 2. Elements of Best management Practice in Nutmeg
Activities/inputs for nutmeg management
Lime/ Dolomite (based on soil analysis) – 2000 g/tree
Urea/Rock Phosphate/MOP – based on the soil test per tree basis (500: 250: 1000 g of NPK is the recommendation per tree of 10 years & above)
Micronutrient spray – thrice (Jan/Feb, March/April and May/June - @ 5 g/ L)
Application of Bordeaux mixture (at onset/ post monsoon)

The initial samples from the base and interspace of nutmeg trees showed that the soils are highly acidic with medium to low organic carbon content, which restricted the nitrogen supply to the trees. Available potassium and Boron were also low. The phospohorus availability was high in nutmeg basins with traces of aluminium. The soil nutrient management strategies implemented as part of the best management practice and experimental studies yielded several key insights on soil health management in nutmeg intercropped in coconut gardens.

Key findings on soil reaction and nutrient status

• The soil pH in both surface layer and subsurface soil improved significantly over the initial value with application of Lime (L) or Lime + Gypsum (G).

• With the application of best management practice, there was a significant increase in the soil available K status over the Farmers practice (FP) and the initial status

• The best management practice adopted in the intercropped nutmeg improved the balanced availability of P to its optimum range of 14-22 mg/kg which was slightly higher than in FP.

• The available Calcium and magnesium in the soil increased significantly with the application of Lime and Lime + Gypsum amendment and the increase was 2 fold in case of Calcium as compared to the existing farmers practice.

• Along with other micronutrients,availability of Boron also showed significant improvement with the increase of soil pH on addition of Lime + Gypsum.

Effect of BMP treatments on nut and mace yield

The yield increase was up to 22% in the treated plots in the experimental condition for nut and mace yield. An yield increase of 10-25% in nut and mace from farmer's demonstration plots were observed as compared to the farmers practice (Figure 1 and 2).

A comprehensive evaluation of the intervention strategy was undertaken to understand the economic viability of the interventions in nutmeg intercropped in coconut gardens. The results are presented in Table 3. The additional cost incurred on adoption of the recommended best management practice in nutmeg was justified as the interventions resulted in higher yield with an estimated incremental benefit cost ratio of 2.1. The value of incremental output due to the intervention was estimated to be Rs 103620 per hectare.

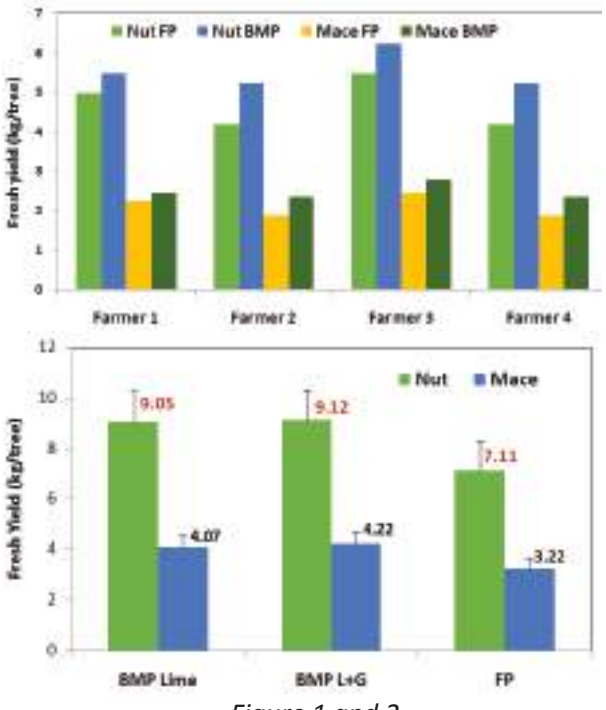

Figure 1 and 2

Project Approval Committee of CDB approved 26 Projects worth Rs 2464.33 lakh

The 58th meeting of the Project Approval Committee (PAC) on Technology Mission on Coconut (TMOC) of CDB was held at Kochi through videoconferencing on 21st March 2022. 'Shri. Rajbir Singh Panwar IFS, Chairman, Coconut Development Board and Chairman PAC chaired the meeting in which 16 projects with an outlay of Rs. 1368.73 lakhs was approved by the meeting. Out of the 16 projects, seven projects were from entrepreneurs for setting up of coconut based industries and nine projects were from various research institutes from across India. 58th PAC also approved 10 projects subject to conditions with an outlay of Rs. 1095.60 lakh. Out of the 10 projects approved by 58th PAC subject to conditions, four projects were from entrepreneurs for setting up of coconut based industries and six projects were from various research institutes all over India.

Table 2: Economic evaluation of technology intervention in nutmeg

Particulars	Value
Incremental cost	
Cost of inputs in BMP	Rs 145 per tree
Cost of additional inputs per hectare	Rs 25665
Total additional investment for adopting BMP including labour and input cost	Rs 50665 per hectare (2018-19 prices)
Incremental returns	
Incremental output -nut	159.3 kg/ha
Incremental output -mace	70.8 kg/ha
Value of incremental output@	Rs. 103620/ha
Incremental Benefit Cost Ratio (IBCR)	2.1
#Labour valued at Rs 500 per manday	

The successful implementation and validation of the site specific nutrient management strategy in nutmeg has implications for nutmeg cultivation across the state. The performance and profitability of nutmeg as an intercrop can be enhanced through adoption of the recommendations arising out of this study. The key recommendations are

Recommendations

- For soil acidity amelioration: If the soil pH is < 6.0, apply 1kg dolomite lime + 1 kg gypsum along the drip line/ canopy periphery during May-June at the onset of monsoon, every year. For the soil pH > 6.0, this may be applied during alternate years.
- Apply nitrogen, phosphorus and potassium fertilizers at the rates recommended based on soil test values: 800 g Urea, 500 g Factamfos and 1.50 kg Muriate of Potash in two equal splits (rates based on Nutrient Index of Ernakulam District).
- Enrich 100 kg of FYM: neem cake mixture (mixed in 9:1 proportion) with Trichoderma harzianum @ 1-2 kg formulation per 100 kg and apply @ 20-25 kg of enriched mixture per tree during the onset of monsoon.
- Apply foliar spray of IISR nutmeg micronutrient mixture - @ 5 g/ L water at flowering and flower development stages at monthly intervals (2-3 sprays).
- Cut and remove the dried or infected branches (due to thread blight infection) and spray Bordeaux mixture (1%) on leaves at the onset of monsoon (May-June).and repeat the spray one month after first application.

Conclusion

Nutmeg is a beneficial intercrop in coconut and can provide a sustainable source of income to the farmer.The economic viability of the soil health centric technology intervention packages including the best management practices in nutmeg clearly demonstrated the superiority of the technologies in enhancing output while maintaining economic viability. The technology dissemination efforts need to highlight the economic viability of the technology package to draw the farming community towards adoption of these technologies. Soil test based site specific nutrient management can enhance the yield levels in nutmeg across the state and enhance the supply of the commodity. ■

Wax from coconut oil

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Coconut oil is widely used as hair oil, massage oil, cooking oil, lubricant, oil blends for fuels, cosmetics and medicine industries, etc. But only few know that wax can also be produced from coconut oil.

Waxes find applications in a wide range of sectors like packaging, coatings, cosmetics, food, adhesives, inks, castings, crayons, chewing gum, polishes and candles. Paraffin wax is the largely used wax type, which is derived from petroleum, coal or oil shale. Most commercially available candles are made from paraffin wax. Bee wax is one of the main products of the apiculture sector. Camel milk wax is also available in the market. Besides, soyabean oil, palm oil, coconut oil, apricot oil, rice bran oil, etc. are also used for making wax.

Wax from vegetable oils is manufactured through a process of hydrogenation, to extend the shelflife and help maintain its solid texture in warm temperatures. Hydrogenation is the process to change the physical characteristics of natural fats and oils. Hydrogenation of vegetable oils/fatty acids involves the addition of hydrogen, in the presence of a Nickel catalyst, to the carbon-carbon double bonds present in the fatty acid chains.

The difference between a wax and oil is that a wax remains solid at room temperature while an oil liquefies. Given its tendency to melt at room temperature, coconut oil is not a wax. Coconut oil has the natural sweet taste of coconut and contains 92% of saturated fatty acids (in the form of triglycerides), most of them (about 70%) are lower chain saturated fatty acids known as medium chain fatty acids (MCFAs). Hydrogenation in coconut oil means that in high heat, hydrogen atoms are added to the coconut oil to turn its small amount of unsaturated fat components into saturated fats. Hydrogenation is a means of converting the Liquid Fats to Plastic Fats or, in other words, reducing the Iodine value by reducing the double bonds in the fatty acid chain. Hydrogenation increases the melt point substantially from 75^{o} F to 100^{o} F.

Coconut wax and other natural waxes

Coconut wax is colorless and odorless. It is considered as one of the best and healthiest types of wax to make candles because candles made from coconut wax burn the cleanest compared to other types of wax. It produces less soot unlike other types of wax. Coconut candle waxes are perfect for those who enjoy using their candles for aromatherapy. It

has a superior scent throw which means you can produce long lasting and strongly scented candles using this wax. Throw means that when the candle is lit, a strong boost of scent is filled in the room in a short space of time, which later spreads the entire house.

The coconut wax candles burn slower than other wax and it can blend perfectly with other natural, harder waxes. Coconut wax candle is eco-friendly due to its non-toxic and cleaner burning quality, as it does not emit smoke and is soot-free.

The most popular natural waxes used by candle industry are soy wax, paraffin wax and palm wax. Affordability, availability, ability to hold scent and physical appearance or the finish it gives to the candle are the major factors considered by the candle makers in choosing the type of wax.

Soy wax made from soybean oil, is having good burning quality, produces minimum soot and is also cheap. But it is reported to look crumbly and has a more subtle scent. It is commonly used to make container candles and is usually blended with other types of wax. Paraffin wax, derived from petroleum, is relatively cheaper and comes in different melting points which is suitable for making various types of candles like pillars, container candles, etc.. Paraffin wax candles are stated to hold a stronger scent but burn quickly. Palm wax, obtained from palm oil, is a very firm and almost brittle kind of wax and suitable for pillar and votive type of candles. The burn quality is rated similar to paraffin wax. Palm wax has high contraction which makes its demolding easy. Palm wax creates features such as feathers and crystals when it is allowed to cool slowly. It has the highest melt point of 180°F (82°C).

Wax Blends:

'Wax blends' refer to mixture of two or more wax types for the combined advantages of the types used. Coconut wax is blended with other natural vegetable waxes to bring up the melt point further to avoid any 'liquefying' issues. Similarly, coconut wax can be blended with palm wax to create candles with good burning quality and throw. Blends are normally labelled according to the majority type of the wax. For example, if the candle is made of minimum 51% coconut wax, then it is labelled as 'Coconut blend'.

Bees wax, which is a very common natural wax for candle making, is harder with high melt point (144-149°F (62-65°C) and is a pillar type wax without any additives. However it generally requires larger, square braid wicks in order to get a large enough flame to produce a proper candle. Hence, coconut oil, with a melting point of 77°F, is added to help soften the bees wax for container candles.

Paraffin wax has a melting point of 115-142°F (46-61°C). It is the best preferred wax by the candle makers as it has the best throws of all waxes. It also holds the colours well, without fading. However, it has a low melting point and also burns quickly.

The smooth and silky soy wax is preferred for its affordability, all natural appeal and is best suited for hand crafts. It's melting point is 113-127°F (45-53°C). But, few reports mention that the colour holding capacity, slight odour, frosting, sink holes and cracks are its drawbacks.

Coconut blend waxes (melting point 124-127°F (51- 53°C)) are the mixture of coconut wax, soy wax as well as small quantity of coconut oil. This will have a consistency between coconut oil and soy wax. The coconut wax blends generally have good colour and fragrance holding capacity and well suited for creating a natural and sustainable wax for candle making.

Coconut wax, is a 100 % natural product. It is almost the coconut oil, gone through only hydrogenation, unlike several chemical & physical processes used for making paraffin wax from crude oil. Hence, coconut wax is packed with vitamins, minerals and anti-oxidants that moisturizes skin, hair and nails, giving them a youthful, vibrant look. It also reduces blemishes on the skin and even skin tone. In view of this, besides candle making, coconut wax can also be used in a range of safe skin and hair products like skin moisturizer, nail enhancer, makeup remover, hair moisturizer, eye dark circle remover, foundation, hair remover, etc.

The market for coconut wax exists in the US and European countries. Though no much data about the production, manufacturers, exports, and other details of coconut wax is available; from the ecommerce sites, it is understood that coconut wax manufacturing and trading is taking place in India also. Chunks, cubes, pellets, granules, flakes and gel wax are the major grades of coconut waxes available all over the world. However, it may be noted that all 'coconut candle' search results from the internet, may not be lead to coconut wax, and the 'coconut' prefixed to 'candle' may also mention about the 'coconut shell' which is used as the container for any type of wax candle.

As per the ICC Statistical Year Book, 2019, India is the world leader in coconut production. The major part of the coconut oil produced in India is utilized as raw coconut oil itself for cooking, toiletries, medicaments and cosmetic industries. Converting coconut oil to coconut wax is yet another avenue in value addition of coconut. Further this may find place in the aggressively expanding vegan market too.

Though coconut wax is a bit expensive than other natural waxes, with its rich colors and fantastic aroma, coconut wax candles are undoubtedly worth it. Its longevity and clean-burning are outstanding. However, as far as India is concerned, the focus may be ensured for edible oil industry followed by medicaments, toiletries & cosmetics, later for these minor and miscellaneous products.

References:

www.stonecandles.com; www.keapbk.com; https://cocoandsoy.com; www.sensualcandle.co; www.fosseliving.co.uk; www.puresoapsandcandles.com; https://light4lifecause.com; https://flyingfarmcandles.com; www.hsph.harvard.edu; https://brookotascreations.com; https://www.aqua-calc.com

https://www.csir.res.in/india-importing-exporting-wax-indigenously-developed-csir-technology-turns-tide

https://www.mectech.co.in/hydrogenation-plant

Gopala Krishna A.G. et. al. 2010. Coconut Oil: Chemistry, Production and Its Applications - A Review, Indian Coconut Journal; LIII-3, pp 1 5-27. ■

Traditional Coconut Varieties

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Introduction

The Regional Agricultural Research Station (RARS) aims to strengthen agricultural research in the northern, comprising the districts of Kasaragod, Kannur, Kozhikode and Malappuram of Kerala state. The thrust area of research is to perform as the leading centre for research on coconut and coconut-based farming system. Regional Agricultural Research Station, Pilicode of Kerala Agricultural University which completed 100 years of its service since 1916 conserves unique coconut germplasm of indigenous and exotic types. The station maintains a unique collection of over 106 coconut germplasm in different blocks consisting of 56 indigenous collections along with 50 old germplasm including exotic species previously preserved in the station. The research station has developed various coconut varieties including Kerasree, using the germplasm maintained. The genetic makeup of indigenous species is an important contribution that will pave the way for future new varietal development. Germplasm conservation is of paramount importance for the preservation of valuable genetic material and also for future new varietal development as these are storehouse of many qualities like resistance to pests and diseases, drought resistance, yield potential, qualities related to enhance production. Traditional plant breeding methods like introduction, selection and hybridisation, with necessary modifications have been successfully employed for yield improvement in coconut. Hybrid vigour in coconut was first reported from this station. The first ever hybrid T x D (WCT x CDG) was developed and planted at Nileswar campus during 1936 which still exists at this campus. Later under the crop improvement programme the station had released eight high yielding coconut varieties.

Plant Habit

The major classification of coconut based on stature or height is as follows:

(1) Tall palms: Which are also referred to as var. typica.They are commonly cultivated in all regions of the world both for household and commercial purposes. They grow to a height of 20-30 m. They are slow maturing and starts flowering 6-10 years after planting. They are long-lived with an economic life of about 60-70 years. They are normally cross-pollinated and therefore considered to be heterozygous. Among the indigenous tall cultivars, West coast tall, Komadan, Kappadam, Andaman Ordinary, Lakshwadweep ordinary, Ayiramkachi, Basanda, Benaulim, Kuttiyadi etc. are popular and has good nut production and copra yield.

(2) Dwarf palms: Which are also referred to as var.nana.The dwarf palms are assumed to be mutants from tall types. The dwarf palm is short in stature and grows to a height of 5-7m. They start bearing early at about third year of planting. They have a short productive life of 30-40 years. They are normally self-pollinated and therefore considered to be homozygous. The dwarf palms occur with three nut colours viz. green, yellow, and orange. These are generally grown for tender nuts and also for hybrid production.

Four of the most popular indigenous dwarf cultivars are Chowghat Green Dwarf, Chowghat Orange Dwarf and Gangabondam.

The details of some popular tall and dwarf germplasm varieties conserved at Regional Agricultural Research Station, Pilicode are given below.

West Coast Tall

West Coast Tall (WCT) is a popular tall cultivar along the west coast of India. It is a high yielder under good management conditions. WCT has been extensively cultivated as it can grow in varied agroclimatic conditions and soil types. The inflorescences have distinct male and female phases. The palm is cross pollinated. The fruits vary in colour from green to greenish yellow to different shades of brown. The shape of the fruit varies from oval to oblong. This cultivar commences to yield in about 6 to 8 years after planting under favourable conditions. This variety is useful for household purposes such as production of copra, coconut oil, coir etc. The palm yields good quality and quantity of coconut sap or toddy which can be used for producing into jaggery

or sugar. It produces good quality husk which is extensively used in making coir and coir products. It is tolerant to drought. Annual average yield is 60 to 80 nuts per palm. Copra content is 165 g/ nut. The variety is excellent for tapping and tender coconut production. The WCT variety shows greater resistance to pests and diseases.

Kappadam

This variety is seen most predominantly in Thrissur district of Kerala. Kappadam has large sized nuts with relatively low husk content. Kappadam nuts are predominantly green and round, ellipsoidal to oval shape and end in quite a pronounced point. The palms are strictly cross-pollinating since there is no intra- or inter-spadix overlapping between male and female phases. Kappadam has long pre bearing period of 8 to 10 years after planting. Average annual yield is 60-80 fruits per palm. Copra content per nut is 285 g.

Komadan

This variety is seen most predominantly in Central Kerala and Northern Kerala. Komadan with its regular bearing habit is a tall variety that produces green coloured nuts. Komadan has greater nut production potential than WCT. Average annual yield is 120 nuts per palm. Copra content per nut is 150 -180 g. This variety is good for cooking purposes, making

copra and also for coir production. This variety is highly suitable for tender coconut water and also for making toddy. It yields more than 300 ml volume of tender nut water.

Spicata

This is a tall variety of coconut having unbranched inflorescence or sometimes with one or two spikelets. The number of female flowers is very high. The branches are heavily packed with medium-sized nuts. The palms start flowering in around five to eight years after planting. The fruit is oblong in shape with a beak. The fruit is either green or greenish yellow with a thin husk. This variety is suitable for making copra and for household purposes. Average annual yield is 60 to 80 nuts per palm. Copra content per nut is 180g.

Lakshadweep Ordinary

This variety is a native of Lakshadweep. which is a Tall variety, similar to West Coast Tall in almost all characters. The palms start flowering from about 5 to 6 years after planting and is drought tolerant. Nut colour at maturity is orange green and round in shape. The average annual yield is 100 to 120 nuts per palm. These are recommended for good quality copra production. This variety is suitable for household purposes, tender coconut water and toddy. The tapping of this variety yields almost double the quantity of toddy produced from WCT. The copra content per nut is 160 g and the quantity of tender coconut water is 300ml which is very sweet.

Andaman Ordinary

This variery is largely grown in Andaman Islands. The palms are tall and massive in nature. This variety is drought tolerant suitable for rainfed and irrigated conditions. The variety starts producing fruits from 5 to 6 years after planting. This type is comparatively more vigorous than West Coast Tall in vegetative characteristics. These produces ovoid shaped nuts which are pale green in colour at maturity. Average annual yield is 80 nuts per palm. Copra content per nut is 173 g. The palm is also a good yielder of toddy. The variety is popular due to high yield and high

copra content even under rainfed conditions.

Sanramon

This variety is largely grown in Philippines. The palms produce bigger nuts and also a high yielder. Wide variation occurs in this type especially in relation to size and colour of nuts. Nut colour at maturity is green and it is round in shape. The variety is characterized by large fruits with average copra out turn of 377 g per nut and tender nut volume of 612 ml per nut. Annual average nut yield is 80 to 100 nuts per palm.

Chowghat Orange Dwarf

This variety is extensively grown in Chowghat regions of Thrissur district which is commonly known as " Gowrigathram or Chenthengu". This is an early flowering cultivar and takes around 3 to 4 years for initial flowering. The palms have characteristic orange colour on leaf petioles, inflorescences and fruits. Overlapping of male and female phase is noticed in this type. The palms show both self and cross pollination and hence it is noted that 80

percent of the progenies breed true to type, and the remaining 20 percent progenies as off types. The nuts are spherical and medium sized. Average annual yield is 80-100 nuts per palm¬ and copra content is 99 g. This has large number of female flowers in the inflorescence. This variety produces good quality tender coconut water and the quantity of tender nut water is 400 ml.

Chowghat Green Dwarf

This variety is one of the famous dwarf varieties of coconut in India which is extensively grown in Chowghat regions of Thrissur district. This variety is commonly known as "Pathinettam Patta". Which takes only 3-4 years to produce fruits. This is characterized by dark green colored nuts and leaves. This variety produces oblong nuts with a characteristic tapering end. There is overlapping of male and female phases and also has large number of female flowers in the spadix. It has alternate bearing nature. Average annual yield is 120 nuts per palm and copra yield is 90 g per nut.

Gangabondam

This is a semi tall type variety showing early bearing nature which produces dark green colored leaves and nuts and produce medium sized oblong nuts. This variety is widely used in many hybridization programmes for making hybrid seedlings. This type is early bearing and starts flowering in about 4 to 5 years after planting. Average annual yield is 80 nuts per palm and copra yield is 148 g per nut. It produces good quality and quantity of copra.

Conclusion

Studies on the trend analysis of area and production in coconut farming of Kerala state clearly shows that the state is gradually losing its days of coconut glory. Interventions are needed to be implemented to enhance the productivity and income from coconut farming as coconut is very closely associated with the socio-economic and cultural life of Keralites.Improvement in productivity has been the primary focus area of research to increase production which has resulted in the development of high yielding varieties and the hybridization programs in many countries. In addition to this, further strengthening of research and conservation of coconut palms is necessary to improve coconut farming and thereby benefit farmers in increasing the revenue.Thus collection, characterization, conservation and regeneration of both the indigenous and exotic germplasm is a growing need to meet the challenges of the breeder for long term crop improvement and also reducing the threat of losing the availability of wide genetic base of local varieties. ■

Valorization of coconut processing industry by-products for preparation of energy mixes

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Healthy food is well balanced concerning the superiority and magnitude of ingredients from different food groups which give rise to the concept of multi-grain foods. Apart from health significance, convenience foods are also a recent trend in the food market. Porridge produced from various cereals and coarse cereals like wheat, oats, maize and sorghum are widely consumed owing to their ease of making and acceptability among all age groups. Porridges are used as breakfast foods for adults as well as complementary foods for infant and are also dietary adjuncts for convalescents *(Michaelsen, 1998; Ojijo and Shimoni, 2004).* At pre-sent porridges are made only from cereals only, thereby limiting their nutritional benefits. However, due to abundant in protein versatility concerning ingredients used, and convenience concerning time taken for cooking and serving it can offer the unique advantage to incorporate concept in ready-to-eat, wholesome food.

Health is one of the primary concerns, in our day to day life, nutritious and health beneficial products are in high demand. Keeping this in mind, a new innovative idea of making a value added energy mix was introduced. Virgin Coconut oil meal and Haustorium powder are the main ingredients of the recipe. The Germinated green gram flour also included. The fundamental purpose of introducing this Valorization of coconut processing industry by products for preparation of energy mix; is to provide high protein and variety to their diet. There is also increasing interest amongst consumers in accessing health benefits through food to maintain good health as they age *(Hensel, 2012)*. Several ingredients have been identi-fied as benefits for improved memory and eyesight *(Milo, 2013)*.

Functional foods can be used not only to solve consumer starvation and provide health needs by having the necessary nutrients. They can also prevent nutrient shortages-related diseases *(Luan 2000).* Diet plays the primary role in human health as people are suffering from a variety of health problems, which is a great concern. Health and nutrition professionals advise consumers to limit consumption of unhealthy fast foods. Therefore, there is a demand for such foods and due to its health benefits, people are making efforts to incorporate them into their diet.

VCO meal used is a rich source of protein which is white in colour and is usually considered as waste after the extraction of virgin coconut oil by a wet process. The development of this mix has enabled in the utilization of the waste that is generated during the processing of coconut. Utilisation of food by-products and wastes receive more attention in the food industry. These wastes would be minimized through the utilization of available resources into various types of food products. Therefore, an effective effort is needed to solve those problems by developing high nutritional and industrial potential of by-products, wastes and which is utilized directly for human consumption.

Virgin coconut oil is a recently emerging high demand product in the world. Defatted coconut flour is one of the major by-products generated from the virgin coconut oil industry. However, the defatted coconut flour is often discarded. The whitish residue remained after extracting virgin coconut oil can be milled into flour. The coconut flour can then provide value added income and is a nutritious and healthy source of dietary fiber *(Trinidad et al., 2003)*.

Other than coconut, many other nutritionally rich ingredients are being used in the preparation of mix. The ingredients include Haustorium powder which gives high protein and the effect of starch, oats. All the other ingredients used are claimed to

have excellent health benefits. Here the product was developed or prepared by hot air oven drying method wherein this method of drying will remove the moisture from the food and helps in drying it without losing much of its nutrients. The method of drying is regarded as one of the best methods of preservation. Since the newly developed product is thoroughly dried, it has an excellent shelf life. The product can be taken by people belonging to all age group.

Materials and method

Raw Materials. The VCO meal was procured from a local supplier (Keratech coconut oil manufacturing unit) and brought to the laboratory at most safe conditions. Coconuts with Haustorium (matured), Arrowroot (Marantaarun-dinacea), oats (Avenasativa) and sprouted green gram (Vignaradiata), skimmed milk, salt, sugar and vanilla essence were purchased from local market.

Pre preparation of Ingredients

Coconuts shell was removed by using conventional methods and haustorium was collected. All ingredients excluding skimmed milk powder ,sugar and salt were dried at 55 ± 3°C before alter in to powder by using a blender. (M/s Preethi Kitchen Appliances Pvt Ltd. In-dia).

Methods

Product Preparation

The product which has potential health benefits was made by following different formulations mentioned. For the preparation of the energy mix, all the ingredients were dried and powdered. Powdered form of the ingredients were mixed in different proportions and a batter was prepared by addition of required amount of water, and then dried in oven at 180 °C for 40 min. For serving, the dried powdered mix was mixed with either hot milk or hot water as per the serving size and boiled for a minute (Fig. 1)

Analysis of chemical and biofunctional characteristics:

▶ *Proximate composition:*

The proximate composition of product was estimated. Crude protein, crude fat, ash, crude fiber and the moisture content of all the products were determined according to the methods described in the year book of AOAC 2010

▶ Determination of moisture:

Weighed accurately about 5gm of the sample in a previously dried titre dish. Place the dish in the oven, maintained at 105˚C for 4hrs. Cool in a desiccators and weigh. Repeat the process of drying, cooling and weighing at 30 minutes intervals. Until the difference between two consecutive weightings is less than 1mg. Record the lower weight and calculate the moisture content.

▶ *Calculations:*

Whereas W1 is the weight of the dish (g) ,W2is the weight of dish + sample before heating (g) ,W3 is the weight of dish + sample after drying (g),Weight of the sample (g) (W2-W1),Loss in moisture (g) = (W2-W3)

▶ *Percentage of Moisture = (W2-W3) / (W2-W1)× 100*

Determination of total nitrogen by microkjeldahl method

Protein content was determined by Kjeldahl method. Weighed accurately 0.7 – 2.2g of test sample in to the kjeldhal flask, precaution was taken to see that particle of the material do not stick on to the neck of the flask . 0.7g of mercuric oxide was added, followed by 15g of anhydrous sodium sulphate and 25ml of conc. Sulphuric acid (if test portion >2.2g is used, increase acid by 10 ml each gram test portion) were added. Flask was placed in an inclined position and was heated gently until frothing ceases.

The temperature was increased and the mixture was digested for more than 4 hours until the solution clears. Content of the flask was cooled and transferred quantitatively to the RB flask with approx. 200ml water and 25ml of sodium sulphate solution was added and mixed to precipitate mercury. Then zinc granules to prevent bumping and layer of NaOH solution was added without agitation. Kjeldhal flask was connected immediately with the protein distillation apparatus with tipoff condenser immersed in standard H2SO4 and 5-7 drops indicator in to the receiver. Mixture was distilled until all Ammonia has passed over in to the standard H_2SO_4 . Then shut off the burner, remove receiver, and the condenser was rinsed thoroughly with water into the receiver. Tip of the condenser was washed in to the receiver. And titra-tion of excess standard acid in distillate with standard NaOH solution and blank was also done. (AOAC)

Calculation

Nitrogen % = (B-S) X N X 0.014 X 100/W

Whereas, B= ml of NaOH used for blank titration; S = ml of NaOH used for sample titration; N= Normality of NaOH; W= Weight of sample in gram

Protein = Nitrogen % X Protein factor

Reference factors for Tree nuts and coconuts - 5.30; for dairy/other products - 6.38 and other products - 6.25

Determination of fat content by Soxhlet method.

Fats and oils are glyceride esters of either saturated or unsaturated fatty acids. Fats are usually solids at room temperature and rich in saturated fatty acids whereas; oils are rich in unsaturated fatty acids and are usually liquids at room temperature.

Weigh accurately 5g of powdered and moisture free sample. 8×8cm of whatman filter paper was taken and thimble was prepared out of it, weighed sample was held in it. Thimble with sample was inserted into soxhlet apparatus. Weight of the thimble with sample should be accurate so that it is below the siphon. About 20-25 ml of acetone or ether and few glass beads were taken in RB flask. The receiving flask was connected to the extractor and entire setup was kept over a heating mantle. The ether or acetone was introduced to extractor so that the thimble would be immersed into it. Then condenser was connected, closed tightly using aluminium foil in order to avoid the evaporation of ether. Water circulation was provided in condenser and temperature was adjusted to about 40 – 60 °C. Apparatus was removed after 6- 8 hours i.e., 15 cycles.

Calculation:

% of fat content = (W1 - W2)/W3× 100

Whereas, W1 is Weight of the flask and oil (g); W2 is Initial weight of the flask (g) , W3is weight of the sample taken (g)

Determination of crude fibre content

During the acid and subsequent alkali treatment, oxidative hydrolytic degradation of the native cellulose and considerable degradation of lignin occur. The residue obtained after final filtration is weighed, incinerated, cooled and weighed again. The loss in weight gives the crude fibre content.2g of the given sample was weighed into a 200ml beaker and 100ml of 0.25N H_2SO_4 was added. The mixture was boiled for 30 minutes, keeping the volume constant by adding water at frequent intervals. At the end the mixture was filtered through the muslin cloth and the residue was washed with hot water till it free from acid. The mixture was then transferred into a beaker containing 100ml of 0.313N NaOH. After boiling for half an hour keeping the volume constant. The mixture was filtered through a muslin cloth and residue was washed with hot water until it was free from alkali. This was followed by washing with alcohol and ether and trans-ferred to a crucible whose weight was already taken. The crucible was dried in an oven and kept in the muffle furnace (Rotek instruments, Kerala, India) for 2-3 hours at 600˚C as cooled and then weight was taken again. This weight gives the weight of the ash. Therefore; the weight obtained after drying in the oven – The weight of the ash is the weight of the fibre.

Calculation:

Loss in weight × (W2 – W1) – (W3 – W1)

% Crude fibre content = (on ignition /Weight of sam-ple (g)) ×100

3.3.1.5. Determination of Total Carbohydrates

When the mixed Fehlings solutions boiled with a reducing sugar, the blue colour (cupric tartrate) is changed and a red precipitate forms (cuprous oxide).Weighed about 2 to 2.5gm sample into a 250ml conical flask. Add 10-20 ml water and 2.5 ml Hydrochloric acid.Heat at low temperature or in a water bath for 30 minutes. Neutralize by adding anhydrous sodium carbonate solution (if it became alkaline add little HCl 1N). Make up to 250 ml with distilled water. Filter through absorbent cotton into the burette. Take Fehling's solution A and B 5 ml each into 250 ml conical flask. Heat vigorously, titrate against solution from the burette. Add ethylene blue indicator, then add solution from the burette drop by drop until the blue color just disappear.

Standardization of Fehling's solution

- Weigh 1g dextrose anhydride purified into a 100 ml standard flask, add water and make up to the volume
- Pipette 20ml from the above solution into a 100ml flask and make up to the volume
- Take the dextrose solution in the burette. Fehling's solution A and B 5 ml each taken in the conical flask is titrated against the dextrose solution with vigorous boiling. Add 3-4 drops of methylene blue indi-cator and continue

the titration with boiling until the blue color disappears

Calculation

Factor F = Weight of dextrose × Dilution factor × Titre value/ 100

Determination of ash content

Ash is the residue remaining after food stuff is ignited until it is free from carbon usually at a temperature 55^{o}C. A porcelain, silica or platinum crucible is ignited cooled and weighed to constant weight. About 1 or 2 grams of the material is placed in the crucible and its weight determined. The sample is carbonised by burning a low red heat. If the material contains large amount of fat, preliminary ashing is done at low temperature to allow smoking of fat without burning the crucible is placed in a muffle at 55^{o} C ±20 ^{o}C until a white ash is obtained (for 6 hours). The ash content is weighed for constant weight for after successive cooling and heating operations.

Total ash (%) = (W3-W1) / (W2-W1) × 100

Whereas W1is the weight of the crucible in (g),W2is the weight of the crucible + sample (g) W3 is the weight of the crucible + ash (g)

Weight of the sample (g) = (W2-W1)

Weight of the ash (g) = (W3-W1)

3.3.1.7. pH

The pH of the sample was measured using pH meter (Systronix µpH system 361). The pH meter is measures the potential usable amount of free moving hydrogen atoms versus the amount of negatively charged protons. The sample was prepared by adding 10 ml of water to the 1g of sample. Place the electrodes in the sample, press the measure button and leave the electrodes for approximately 1-2 minutes. Once the reading has stabilised, press the measure button. This is the pH level of the sample. Rinse the electrodes with distilled water and dry.

More hydrogen = acidic = pH number less than 7.

More protons = basic = pH number greater than 7.

DPPH Assays

Different volume (2µ-20µl) of plant extracts were made up to 40µl with DMSO and 2.96ml DPPH (0.1mM) solution was added. The reaction mixture was incubated in dark condition at room temperature for 20 min.After 20 min, the absorbance of the mixture was read at room temperature for 20 min. After 20 min, the absorbance of the mixture was read 17 nm. 3ml of DPPH was taken as control. The percentage radical scavenging activity of the plant extracts was calculated using the following formula,

Percentage RSA = (Absorption control – Absorption-sample) / Absorption control×100

Where, RSA is the Radical Scavenging Activity; Abs control is the absorbance of DPPH radical + ethanol; Abs sample is the absorbance of DPPH radical + plant extract

Determination of reducing power

Reducing power was determined by method as described by chandini etal.(2008). Briefly 1.0ml different concentration (20,40,60,80,100µg) of sample was mixed with 2.5ml of phosphate buffer (0.2M, pH6.6) and 2.5ml potassium ferricyanide (1 %). Reaction mixture was incubated at 50°C for 20 min. After incubation, 2.5 ml of trichloroacetic acid (10 %) was added and centrifuged (6500g) for10min. From the upper layer 2.5ml solution was mixed with 2.5ml distilled water and 0.5ml FeCl3(0.1%).Absorbance of all the sample solutions was measured at 700nm using spectrophotometer (*Shimadzu, UV-150-02*) change in absorbance indicated reducing power with increased absorbance indicating increase reducing power.

ABTS Radical Scavenging activity

ABTS radical scavenging activity of the sample was carried out as published in Sachindra and Bhaskar (2008) ABTS radical solution was prepared by mixing 5ml of ready touse ABTS solution with 100ml acetate buffer (0.05M, pH 4.5) and 5 units of peroxidase and incubating for 15 h at 37°C . ABTS (1.9ml) was mixed with 0.1 ml sample and incubated at 37°C for 1hr. Control was prepared by adding 0.1ml of distilled water instead of sample .For sample blank buffer was added instead of ABTS .Scavenging activity was calculated as follows

Scavenging percentage = [1-(Asample– A blank)/A control)] x 100

Physical Properties

Water activity

Water activities of samples are analysed using Water activity meter (Aqua lab Seris 3TE, Decagon, USA). Briefly, sample was placed in the chamber of the water activity meter and measurement knob was turned on to read the sample. Water activity is expressed as a fraction, the water activity of pure water is 1, and in a sys-tem without any water content is 0.

Microbiological assays

Total plate count

The samples were prepared by mixing 25g of energy mix in 225ml of phosphate buffer Serial dilutions up to 103 were prepared and 1ml of each dilutions were pipetted on to sterile petriplates and then plate count agar was poured and solidified. These plates were in-cubated at 37^{O}C for 24-48 hrs. The colonies were counted in Quebec's colony counter. (BAM 2013)

$N=\sum C/ [(1\times n1) + (0.1\times n2)] \times (d)$

Whereas N is the number of colonies per ml or g of product, ∑C is sum of all colonies on all plates. n1is number of plates in first dilution counted, n2 is num-ber of plates in second dilution counted and D is dilu-tion from which the first counts were obtained.

Total coliforms

The samples were prepared by mixing 25g of energy mix in 225ml of phosphate buffer. Serial dilutions up to 103 were prepared and transferred 1ml portions to 3 LST tubes for each dilutions. LST tube were Incubated at 35^{O}C for 24± 2hrs for gas of efferve scence when tubes were gently agitated and confirmation test were done for presumptive positive gas tubes.(BAM 2013)

Salmonella

25gm of sample was added to 225ml of sterile lactose broth and incubated for 24± 2hrs at 35^{O}C .For the secondary enrichment from the above made mixture 0.1ml to 10ml Rappaport – Vassiliadis and 1ml to 10ml Tetrathionate broth was transferred and were incubated, RV medium for 24+2 hr at 42+0.2^{O}C and TT broth for 24+2 h at 35+2.0^{O}C.then selective streaking of incubated TT broth and RV medium were done on Bismuth sulphite agar, Xylose lysine desoxycholate agar, and Hektoen enteric agar these plates were incubated at 24+2 hrs at 35^{O}C.(BAM 2013)

E.Coli

The samples were prepared by mixing 25g of energy mix in 200ml of phosphate buffer. Serial dilutions up to 102 were prepared and transferred 1ml of inoculum (0.3, 0.3, 0.4) ml of each dilution to three plates of prepoured solidified tergitol 7 agar and was spreader using L rod then these plate were incubated at 37^{O}C for 24hrs.(BAM 2013)

Calculation

E.coli/gm = No. of colonies X dilution factor/wt of the sample.

Yeast & mold

25gm of sample was added to 225ml of mycological peptone, Serial dilutions up to 103 were prepared then 0.3,0.3,0.4 of each dilutions were pipetted on to three plate of pre-poured solidified DRBC agar plates and was spread using L rod these plates were incubated in dark at 25^{O}C for days.(BAM 2013)

Calculation

Yeast and Mold Count / g = Average count X Dilution factor X

Sensory evaluation

Sensory evaluation is an analytical method in which human senses serve as a measurement tool to determine the quality and/or to describe the condition of food product. Pre requisites for the success of the analytical process include; standardization of method, regular training and performance measurement of testers, a statistical evaluation of test results; and standardization of terms. The sensory tests were conducted based on 9 point hedonic scale for the evaluation energy mix by ten panel members.

Results and discussion

Energy mix was prepared by the utilization of virgin coconut oil meal, Haustorium powder and combination of other flours as ingredients. Different variations of energy mix were prepared.

Nutritional profile of prepared formulation

The proximate composition of the energy mix has been carried out and the values are given in table.4. From the data it has been observed that there is no significant variation in the macronutrient components. The product is a good source of carbohydrate 62.2±4.3% to 65.3±3.8% and moderate sources of pro-tein and fat 13.7±1.1 to19.5±2.1%, 4±0.53% to 4.9±0.51% respectively. The product delivers 349-408Kcal of energy per 100g and the major portion is contributed from carbohydrate. The moisture is in the range of 2.8±0.68% to 4.4±0.84 % these levels are found to be minimum and safe for good storage. The pH of the sample was found to be in the range of 5.9±0.5 to 6.1±0.2 which is slightly acidic in nature which has given the preservation effect. And water activity of the samples was found to be in the range of 0.32 ± 0.02 to0.45± 0.01 control of water activity in processing of food is of greater importance mainly in relation to the growth of food spoiling microorganisms. The growth

of microbes is accelerated at higher aw (Patricia and Theodore.,1974). The ingredients have been standardized and formulated to yield a product which can deliver these nutrient formulation and calories.

Antioxidant property

DPPH

Best sample among all samples which was selected after sensory analysis i.e. sample 4 (VCO 20%) was subjected for monitoring DPPH activity. The reduction capability of DPPH radical is determined by the de-crease in absorbance at 517 nm induced by antioxi-dants. Ascorbic acid is used as standard. The sample (VCO 20%) is able to reduce the stable radical DPPH to the yellow coloured diphenylpicrylhydrazine. The scavenging effect of sample 4 (VCO 20%) on the DPPH radicals is shown in Table 3. The results showed that sample 4 (VCO 20%) could terminate the radical chain reaction by converting free radicals into more stable products.

ABTS radical scavenging activity

ABTS radical scavenging activity of Sample 4 (VCO 20%) was studied by monitoring the decay of the radical-cation produced by the oxidation of 2, 2-azinobis (3-ethylbenzothiaziline-6-sulfonate) (ABTS) caused by the addition of a phenolic containing sample. The sample was exhibited ABTS radical scavenging activity (%) of 15.44±0.76 (Table 3)

Determination reducing power

To measure reductive ability of the sample, Fe3+ to Fe2+ transformation in the presence of sample 4 (VCO 20%) was investigated and the results were tabulated in table 3. In this context, the sample 4(VCO) exhibit an excellent ability to offer electrons thereby contributing their antioxidant activity.

Sensory analysis

The organoleptic quality of samples was evaluated by an expert panel of judges on a 9-point hedonic scale. The porridge samples were served in hot condition and analysed for sensory parameters like colour, appearance, flavour, body and texture, sweetness and overall acceptability, wherein a score of 1 represented dislike extremely and a score of 9 represented like extremely. The samples for evaluation were coded appropriately before serving the samples to the judges for sensory evaluation. Average of the scores given by the ten panel members for each sensory parameter was taken. Sensory evaluation of the samples was carried out in the sensory evaluation room under appropriate fluo-rescent lighting. According to the sensory evaluation the sample S4 (VCO 20%) was found to be acceptable by the sensory panelists. S4 (VCO 20%) was further subjected to analyze bio functional properties and microbiological studies to ensure the quality and safety aspects.

Microbial analysis

The Prevention of Food Adulteration Act (PFA, 1954) recommends a total bacterial count not more than 40,000 per g and absence of yeast and mould count in 0.1g of the sample in cereal based food products. The total bacterial count of the health mixes was nil initially and ranged between < 10 CFU - < 50 CFU/g at the end of two months storage period which was within safe limits. The yeast and mould counts were found to be below detectable limits in the energy mix both initially and after a two months storage period. This indicates that the energy mix were free from spoilage and safe for consumption up to two months after preparation.

Conclusion

Coconut is one of the most important commercial crops in tropical areas and usually referred as 'tree of heaven' or 'tree of abundance'. India is the third largest producer of coconut in the world. During the processing of coconut nutritious parts are wasted and underutilized. The study aims the valorization of coconut processing industry by products for the preparation of energy mix. The Value addition minimizes the waste and reduces the environmental degradation.In today's busy world this type of healthy instant mixes are more preferably and convenient. Nowadays, people were aware about the inclusion of healthier food in their daily life. The innovation was in coherent with consumers demand for a healthier choice of food product. The ingredients used especially Haustorium powder and VCO meals are nutritionally good for health. VCO meal and coconut Haustorium is a rich source of protein which is usually considered as a waste after the extraction of virgin coconut oil by cold process method. This project work also includes the utilization of by products of coconut which are generated as waste after the processing of coconut for value added products. The product developed is a suitable breakfast for children, adult as well as for old age people.

Reference

1. *Aruna, T. (2017). Utilization of defatted coconut meal for development of value added food products (Doctoral dissertation, Vasantrao-NaikMarathwadaKrishiVidyapeeth, Parbhani).*

2. Beegum, S., Sharma, M., Manikantan, M. R., & Gupta, R. K. (2017). Effect of virgin coco-nut oil cake on physical, textural, microbial and sensory attributes of muffins. International journal of food science & technolo-gy, 52(2),page no:540-549.

3. Chandrasekara, A., &Josheph Kumar, T.(2016). Roots and tuber crops as functional foods: a review on phytochemical constituents and their potential health benefits. International journal of food science, 2016 page no:440

4. Chaudhary, N., & Vyas, S. (2014). Effect of germination on proximate composition and an-ti-nutritional factor of millet (ragi) based pre-mixes. International Journal of Food and Nu-tritional Sciences, 3(4), page no:72-77

5. Erdman, M. D., & Erdman, B. A. (1984) Arrowroot (Marantaarundinacea), food, feed, fuel, and fiber resource. Economic bota-ny,38(3) page no;332-341.

6. Gan, R. Y., Lui, W. Y., Wu, K., Chan, C. L., Dai, S. H., Sui, Z. Q., &Corke, H. (2017). Bio-active compounds and bioactivities of germi-nated edible seeds and sprouts: An updated re-view. Trends in food science & technolo-gy,59,page no: 1-14.

7. Griffith, R. 1984. The problem of the coconut mite, E. GuerreronisKeifer, in the coconut groves of Trinidad and Tobago. Carib. Food Crops Soc. 20:128-23. Also published in 1995 J. of the Agric. Soc. of Trin. AndTob. 85:page no: 81-99.

8. Hagenmaier,R.,(1983)"Driedcoconutmilkandothernew foods from wet process", Coco-nuts Today, 1(1), page no:. 17–24.

9. Hall, R.A., N.W. Hussey, and D. Mariau. 1980. Resultatusd'unenenqueteconcernanties agents de luttebiologiquecontrel'acarien du cocotier E. guerreronis. Oleagineux (France) 35:page no: 395-400. Cited by Hall 1981.

10. Harmayani, E., Kumalasari, I. D., &Marsono, Y. (2011). Effect of arrowroot (Marantaarundi-nacea L.) diet on the selected bacterial popula-tion and chemical properties of caecaldigesta of Sprague Dawley rats. Int Res J Microbiol, 2, page no: 278-284.

11. Itagi, S. K. (2003). Development and evalua-tion of millet based composite food for diabet-ics (Doctoral dissertation, University of Agri-cultural Sciences; Dharwad).

12. Jayakumar,A., &Suganthi, A. Biochemical and phytochemical analysis of marantaarundinacea (L.) Rhizome. page no :218

13. Kahraman, A., Adali, M., Onder, M., Koc, N., & Kaya, C.(2014). MungBean [Vignaradiata (L.) Wilczek]as Human Food. International Journal of Agriculture and Economic Devel-opment, 2(2), page no:9.

14. Khan, M. A., Chitrashekarchar, M., Semwal, A. D., & Sharma, G. K. (2012). Studies on the optimization and storage stability of virgin co-conut meal incorporated instant soojihalwa mix. Food and Nutrition Sciences, 3(08), page no:1092.

15. Lamdande, A. G., Prakash, M., & KSMS, R. (2018) Storage study and quality evaluation of fresh coconut grating. Journal of Food Processing and Preservation,42(1).page no : 125

16. Lohekar, A. S. (2014). Development of cereal pulse based value added nutritious instant mixes (Doctoral dissertation, VasantraoNaik-MarathwadaKrishiVidyapeeth, Parbhani)page no: 187-240

17. Madhavan, K., Kumar, N.S., Azeez, S.,"Virgin Coconut oil by Fermentation Method" Indian Coconut Journal, Vol XXXV, page No:123.

18. MaliN.B, J. B. (2011). Studies on physicochemical properties and extraction of starch from sorghum bicolor L. Hybrids. Elixir Agriculture12(2) page no:87-91.

19. Manivannan, A., Bhardwaj, R., Padmanabhan, S., Suneja, P., Hebbar, K. B., &Kanade, S. R. (2018). Biochemical and nutritional characteri-zation of coconut (Cocos nucifera L.) hausto-rium. Food chemistry, 238, page no153-159.

20. Murugkar, D. A., Gulati, P., Kotwaliwale, N., Gupta, C., & Chakraborty, S. K. (2015). Ai-man. Optimization Of Nutritionally Rich In-stant Porridge With Sprouted Legumes, Malted Millets And Papaya And Its Comparison With Conventional Porridge In Terms Of Textural, Rheological And Particle Size Proper-ties. International Journal Of Food And Nutri-tional Sciences, page no: 49-55.

21. Naik, A., Raghavendra, S. N.&Raghavarao, K. S. M. S. (2012). Production of coconut protein powder from coconut wet processing waste and its characterization. Applied biochemistry and biotechnology,167(5), page no:1290-1302.

22. Nair, R. M., Yang, R. Y., Easdown, W. J., Thavarajah, D., Thavarajah, P., Hughes, J. D. A., &Keatinge, J. D. H. (2013). Biofortification of mungbean (Vignaradiata) as a whole food to enhance human health. Journal of the Science of Food and Agriculture, 93(8), page no:1805-1813.

23. Patel, A. M., Balakrishnan, S., Gokhale, A. J., Mallik, J. M., & Patel, H. G. Effect of wheat variety and germination period suitable for manufacture of halvasan–a milk cereal based indian sweetmeat.54(3)(page no:92-130)

24. Peiris, T.S.G., Peiris, T.U.S. And Rajapaksha, S. 2000. Prediction of annual national coconut production – a statistical approach. Sri Lankan J. Appl. Stat. 1(1), page no:25–31

25. Persley, G.J. 1992. Replanting the tree of life: Towards an international agenda for coconut palm research. Redwood Press Ltd. Melksham page no:156

26. Premakumari, S., Balasasirekha, R., Gomathi, K., Supriya, S., Jagan Mohan, R., &Alagusundram, K. (2012). Development and acceptability of fibre enriched ready mixes. Int. J. Pure Appl. Sci. Technol, 9(2), page no:74-83.

27. Raghavendra, S.N., Swamy, S.R., Rastogi, N.K., Raghavarao, K.S.M.S., Kumar, S. and Tharanathan, R.N., 2006. Grinding characteris-tics and hydration properties of coconut resi-due: A source of dietary fiber. Journal of Food Engineering, 72(3), page no:281-286.

28. Rahaie, S., Gharibzahedi, S. M. T., Razavi, S. H., &Jafari, S. M. (2014). Recent develop-ments on new formulations based on nutrient-dense ingredients for the production of healthy-functional bread: a review. Journal of food science and technology, 51(11), page no:2896-2906.

29. Rasane, P., Jha, A.,Sabikhi, L., Kumar, A., &Unnikrishnan, V. S. (2015). Nutritional ad-vantages of oats and opportunities for its processing as value added foods-a re-view. Journal of food science and technolo-gy, 52(2), page no:662-675.

30. Saha, R., &Dunkwal, V.(2009). Development and nutritional analysis of value added spread instant mix. Journal of Human Ecology, 28(3), page no:187-190.

31. Sangamithra, A., Swamy, G. J., Sorna, P. R., Chandrasekar, V., Sasikala, S., &Hasker, E. (2013). Coconut: an extensive review on value added products. Indian Food Industry Maga-zine, 32(6), page no:29-38.

32. Shintu, P. V., Radhakrishnan, V. V., &Mohanan, K. V. (2015). Pharmacognostic standardisation of Marantaarundinacea L.-An important ethnomedicine. Journal of Pharma-cognosy and Phytochemistry, 4(3),page no: 242.

33. Siro, I., Kapolna, E., Kapolna, B., &Lugasi, A.(2008). Functional food. Product develop-ment, marketing and consumer acceptance—A review. Appetite, 51(3), page no:456-467.

34. Srilatha, D., &Rajini, N.(2015). Developement and acceptability of health mixes. narayana nursing journal, 4(3), page no:11-13

35. Sugimura, Y Murakami:Structure and Func-tion of the Haustorium in Germinated Coco-nut Palm Tree" Japan Agricultural Research Quarterly 1990 Vol.24 No.1 pp.1-14 ref.18.

36. Swathi, M., Waghray, K., Babu, N., &Golla, R.(2017). Development of malted millet mixes for pregnant women and lactating moth-ers. Ijitr,4(6), 5323-5328.page no : 7-10

37. Świeca, M., &Baraniak, B.(2014). Nutritional and antioxidant potential of lentil sprouts af-fected by elicitation with temperature stress. Journal of agricultural and food chemi-stry, 62(14),page no: 3306-3313.

38. USFDA (BA M) Chapter 5, 8th edition, June 2006.

39. USFDA (BAM) Chapter 4, 8th edition, Sep-tember 2002.

40. Usharani, R., & Lakshmi, U. K. Formulation and Evaluation of Functional Food Mixes As A Nutritional Approach For Chronic Diseas-es.(2013): 6.14, page no:1218-1224

Evolution and functions of ICAR-Central Plantation Crops Research Institute, Regional Station, Kayamkulam

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History

Coconut is known to mankind from time immemorial, due to its suitability for his basic needs (viz., food, fuel and shelter). Let us look back how the coconut palm disease and thereafter a research station took shape even before India's independence mainly to address farmer's concerns related to the disease and to decode the cause and solution for the disease. The history recollects how Kerala and coconut become synonymous.

In 1882, after the great floods in Erattupetta in Meenachil taluk, farmers in the region observed the coconut palm disease. Thereafter, the coconut farmers of Kaviyoor, Kalloopara (Thiruvalla Taluk) complained to the State of Travancore about the rampant occurrence of coconut palm disease in 1887. The petitions received from coconut farmers from Kaviyoor, Kalloopara (Thiruvalla Taluk) were referred to Shri. M.S. Narayanswami Iyer (Superintendent of Agricultural Farm, Karamana) in the year 1900. This was followed by Mr. T.F. Bourdillion's (Chief Conservator of Forest) report in 1907 and he concluded the disease to be of fungoidal origin. The State of Travancore later appointed Sir. E.J.Butler, the imperial Mycologist and he gave a report in 1908 titled 'Coconut palm disease in Travancore'. Department of Agriculture under State of Travancore started one separate Mycology Section and Mr. T. Padmanabha Pillai was appointed as the first State Mycologist. Later, Mr. M.K. Varghese, who joined Agricultural Research Laboratory (Office of the Plant Pathologist) at Kollam as Mycologist prepared and submitted a detailed report titled 'Diseases on the Coconut Palm' which was published in 1934.

A scheme on 'Root disease of coconut' was sanctioned during 1937 to M.K. Varghese at

Agricultural Research Laboratory (ARL), Kollam with financial aid from the Indian Council of Agricultural Research for a period of three years (1937-1940). Dr. K. P. V. Menon, Plant Pathologist was appointed at ARL, Kollam and he worked along with M.K. Varghese. The funding for the project at ARL, Kollam from ICAR was extended for a period of two years (1940-42) and further extended for another five years (1942-47). ARL at Kollam had a field station at Kayamkulam and M.K. Varghese worked at the field station at Kayamkulam during that period.

In the meanwhile during 1943, the Government of India conducted an enquiry into the production aspects of coconut, regulating import of copra and coconut oil, improvement of quality copra and better utilization of shell and fiber. The enquiry commission recommended establishing a statutory body for coconut with powers and functions similar to Ceylon Coconut Board. Subsequently, Government of India passed the Indian Central Coconut Committee Act during 1944. Similar act was passed by other princely states where coconut was a major crop. During February 1945, the Indian Central Coconut Committee (ICCC) was constituted with Ernakulam as its Headquarters and Vice President of ICAR was ex-officio member of the ICCC. The Committee functioned under the administrative control of Ministry of Food and Agriculture, Govt. of India.

The Committee appointed Dr. C.M. John (Oil Seeds Expert) and Dr. K.P.V. Menon to identify suitable locations for establishing coconut research station in India. They surveyed entire India and submitted a report to establish two independent coconut stations one at Kasaragod and another at Kayamkulam. The foundation stone for Central Coconut Research Station (CCRS), Kayamkulam was laid on 24th April 1947 by His Highness Sree Uthradom Thirunal Marthanda Varma, Elayaraja of the State of Travancore.

The land acquisition (30 hectares) for establishing the research station at Kayamkulam was done by Mr. Kasim (Collector) and the gazette to this effect was issued by Sir. C.P. Ramaswami Iyer, Diwan of State of Travancore. The construction of the main building was done by the PWD of Travancore within eight months and Shri. K.M. Govinda Pillai was the Engineer. Shri. Dattar Singh, Vice President of ICAR came to Kayamkulam to see the completed building. The land was acquired and handed over to Indian Central Coconut Committee on lease for a period of 99 years

The Station at Kasaragod was established mainly for research on breeding, cultivation, manuring

and Dr. C. M. John became the first Director of CCRS, Kasaragod. The Station at Kayamkulam was established specifically for research work related to pest & disease management of coconut and Dr.K.P.V.Menon became the first Director. During 1966, Indian Council of Agricultural Research (ICAR) took over the Research Stations (both at Kasaragod and Kayamkulam) under the ICCC and later during 1970 the CCRS was renamed as Central Plantation Crops Research Institute (CPCRI).

Achievements

The Station was established with four major departments (Pathology, Entomology, Soil Chemistry & Physiology) and the total scientific strength was 16 with four scientists in each section. Plant Physiology under Prof. T.A. Davis, Entomology under Dr. K.K. Nirula and Soil Chemistry with Dr. K.M.Pandalai and Dr. K.P.V. Menon looked after Plant Pathology Section. Farm Section had one superintendent and four fieldmen. Mr. Thomas Kappen was the first farm Superintendent. The office staff consisted of one Superintendent, one accountant and four clerks. 'The

coconut palm-A monograph' considered as the bible of coconut was published by Drs. K.P.V. Menon &. K. M. Pandalai during 1958. This book was prepared based on the instruction from Dr. M.S. Randhawa (Vice President, ICAR) but they could not get it published by ICAR and hence Dr. K. P. V. Menon approached 'Times of India' Press at Bombay and got the book published in a short time. The publication of the monograph was a long-cherished desire and the jubilation after the publication by the authors knew no bounds.

Crop Protection: Work continued to elucidate the exact etiology of root (wilt) disease. Though, it was suggested as fungal origin, later bacterial and viral origin was proposed & in the year 1983 the phytoplasmal association with root (wilt) disease was confirmed based on Electron Microscopy. Research work on leaf rot disease management, a disease superimposed on root (wilt) diseased palm was also initiated. During the period 1960-1990 efforts were mainly focused towards developing management strategies for root (wilt) and leaf rot diseases. The building to house the Transmission Electron Microscope (TEM) was inaugurated in 1981 and the first TEM was purchased and installed during 1983 under the World Bank funded project and it was the first TEM installed in the State of Kerala. Two hemipteran insects, viz., the lace bug *(Stephanitis typica)* and the plant hopper *(Proutista moesta)* were established as insect vectors of root (wilt) disease through electron microscopy and transmission experiments. Of late in 2021, a lethal wilt disease, associated with phytoplasma *[Candidatus Phytoplasma asteris' (16SrI-B)]* was reported on coconut from East Coast of India which kills the palm after taking infection within a period of 3-5 months.

Investigations on describing the pests of coconut was done during 1950-1970 which includes bionomics and management of major pest viz., coconut rhinoceros beetle, red palm weevil, leaf eating caterpillar, coried bug, ash weevil, slug caterpillars, white grub etc. Research was focused on describing their bio-ecology, understanding the weak life-stages, management strategies including work on biocontrol of all major pests of coconut. The green muscardine fungus, *Metarhizium anisopliae* was found to cause epizootics on the grubs of rhinoceros beetle in 1955 and was later used as an effective bioagent in the management of rhinoceros beetle by area-wide delivery through farmer-participatory mode on breeding sites with a success realized in 2010. Biological pest suppression has been the central focus and augmentative release of stage-specific parasitoids viz., *Goniozus nephantidis, Bracon brevicornis, Elasmus nephantidis* and *Brachymeria nosatoi* in the bio-suppression of black headed caterpillar (*Opisina arenosella*) was a classical success story even quoted today. The threatening pest has now become a pest of no significance with the functioning of Parasite Breeding Stations in most of the districts in Kerala.

A biocontrol laboratory under the PL-480 scheme and a parasite breeding station was later established with facilities on mass production of parasitoids. An amplifier-based red palm weevil detector was designed in 1964 and the release of sterile males of red palm weevil in collaboration with BARC for the management of red palm weevil was attempted in 1973. The use of baculovirus and later christened as *Oryctes rhinoceros nudivirus* in 1983 was another success story in the bio-suppression of coconut rhinoceros beetle through release of virosed beetles in the Island system of Lakshadweep and Andamans. The discovery of coconut eriophyid mite in 1998 from Kochi was reported for the first time in the country. Botanical and nutrition-based pest management modules for the suppression of mite were evolved and recommended all over the country subsequently. Identification of the weed plant, *Clerodendrum infortunatum* with insect growth regulatory properties in 2000 and later its extract could become a part of botanical cake and paste used in the prophylactic leaf axil filling and spear leaf smearing, respectively in the management of coconut rhinoceros beetle in juvenile palms

during 2011. Occurrence of exotic whitefly complex with the report of rugose spiralling whitefly *(Aleurodicus rugiopercualtus)* in 2016 and later the first report of nesting whiteflies (Paraleyrodes bondari and Paraleyrodes minei) in 2018 and palm whitefly *(Aleurotrachelus atratus)* in 2019 created nation-wide attention. Discovery of the sooty mould scavenger beetle *(Leiochrinus nilgiranus)* was reported in 2018 for the first time involved in the bio-cleansing of palms infested by whitefly complex. Conservation biological control using the aphelinid parasitoid *(Encarsia guadeloupae)*, the predator *(Apertochrysa sp., Cybocephalus sp. lady beetles*) and in situ conservation of sooty mould scavenger beetle (L. nilgiranus) was another success that reduced the invasive potential of exotic whitefly complex. An acoustics-based red palm weevil detector embedded with machine learning algorithm and artificial intelligence realizing 80% field efficacy is pest diagnosis was launched in 2021. Agro-ecosystem based pest management through crop pluralism reduced pest incidence and increased farm income (>150 nuts/palm/year). Area-wide delivery of bioagents in the bio-suppression of coconut rhinoceros beetle, black headed caterpillar and exotic whitefly complex are success stories in pest management. A potent and novel entomopathogenic nematode, Steinernema sp. with high virulence and shelf life was found effective in the management of red palm weevil and Galleria mellonella cadaver based bio-capsule of EPN delivery was developed and field efficacy is in progress.

Crop Improvement: Sir. E.J. Butler suggested in his report that there could be resistance to coconut root (wilt) disease in the local cultivars grown in the diseased tract. During 1934, M.K. Varghese initiated the studies to identify coconut palms resistant/ tolerant to root (wilt) disease and surveyed about 10 sq. miles in and around Kayamkulam, but in vain. Way back in 1953, researchers reported occurrence of high yielding palms among the heavily diseased palms. Attempts to screen the available coconut germplasm from CPCRI-Kasaragod (a disease-free area) were made as early as 1961 at CPCRI, Regional Station, Kayamkulam. In the evaluation trials undertaken at the Regional Station as well as in cultivators' gardens during the period 1961-1987, wherein 50 varieties and 38 hybrid combination were evaluated, it was observed that none of the cultivars and hybrids were resistant to root (wilt) disease. During 1987-the classical 'Hot spot' breeding work in coconut was initiated based on recommendations of ISOCRAD-I. The systematic germplasm screening work and 'hot spot' breeding programme led to release of Kalparaksha variety during 2008 followed by release of Kalpasree & Kalpa Sankara during 2012. The later trials initiated includes evaluation of D X Ts, Green Dwarfs, Promising Tall accession and these trials were initiated during 2012.

During the last four years (2017-2021), approximately 20,000 seedlings of released varieties of coconut were annually distributed to farmers. This station also developed QR code imprinted durable labels for labelling coconut seedlings. The label has QR code on one side and variety name, batch number/ serial number/year of production and ICAR-CPCRI emblem on the reverse side. Scanning the QR code will enable the farmer to get specific information about the characteristics of each variety being distributed from CPCRI. Innovations to serve the farming community resulted in developing modified ground pollination technique wherein the control of assisted pollination was shifted from coconut crown to ground.

The work on coconut tissue culture was initiated during 1991-92. Induction of multiple shoots using embryos collected from West Coast Tall variety was done by mechanical and chemicals treatments. During 2000-01 root culture was initiated with the objective of long term preservation of root (wilt) disease-free palms in slow growth media. The work on direct organogenesis from floral primordia was initiated during 2003 and successfully

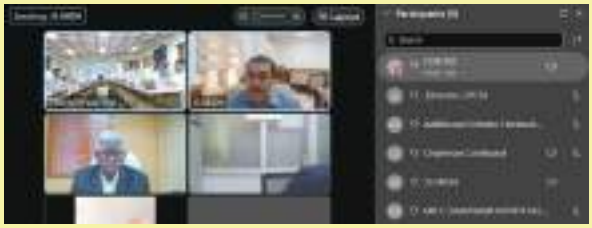
regenerated plantlets from rachillae bits. Tissue culture laboratory of the station was renovated during 2014 and efforts were continued to refine the protocol of direct organogenesis using immature inflorescence. Systematic work on tissue culture led to production and field planting of first tissue culture raised coconut plantlet during November 2020. The tissue culture plantlet was planted by Sri. V. Muraleedharan, Hon'ble Minister of State for External Affairs, Govt. of India on 25.11.2021.

Crop Production: Work for establishing a meterological observatory at Kayamkulam started during 1955. The station is providing daily weather data to Indian Meterological Department, Pune. Sand culture experiment with coconut seedlings was carried out during 1955-56 to study nutrient deficiencies in relation to leaf disease. Based on field trials, the dose of 500 g N, 300g P2O5 and 1000g K2O along with 500g MgO per palm per year was recommended during 1982 for optimum productivity of COD x WCT hybrids under rainfed conditions. Experiment on High Density Multi Species Cropping System (HDMSC) started in 1970 with coconut-pepper-nutmeg - cinnamon cropping system. During 2001, the experiment was remodelled with nutmeg, clove, pepper, banana, papaya, yams, amorphophallus, cassava and vanilla. The coconut productivity increased substantially and the system provided a stabilized income for coconut farmers even during periods of lower prevailing price for coconut. During 2010, intercropping trials were initiated in coconut with flower crops such as heliconia, marigold and gomphrena. Heliconia var. Kawauchii, She and Sunrise are suitable for intercropping in coconut gardens. Fertigation studies in Kalpa Sankara coconut hybrid was initiated during 2017. Initial results indicate higher nut production with higher doses of nutrition.

The role of soil on the expression of root (wilt) disease symptoms formed the basis of earlier research in Soil Science division. Systematic studies conducted during late 1970s ruled out the role of soil types on root (wilt) disease incidence. Role of heavy metals in root (wilt) disease was also studied during 1980s. During 1983, researchers found that N, P, K, Ca, Mg and all combinations of micronutrients had no effect on root (wilt) disease incidence and yield gradually decreased as the intensity of the disease increased. Boron was found as the limiting nutrient of crown choking disorder of coconut. Positive role of Magnesium on number of functional leaves, female flowers and nuts were established. Nutrient mixtures, Kalpa Poshak and Kalpa Vardhini, were developed for juvenile and adult palms respectively. During 2021, the total nutrient uptake of NPK in 25-years old apparently healthy coconut palms was studied through destructive sampling.

Social Sciences: Efforts for surveying the root (wilt) affected area in Kerala and developing extension strategies for adoption of improved management technologies were also in the forefront. Projects for demonstration of technologies in association with line departments have led to close contact with farmers and farming community. This helped the station to get Remandated Zonal Agricultural Research Station (RZARS) during 2000 and finally a Krishi Vigyan Kendra (KVK) during 2004 taking into account the achievements of this Regional Station in technology transfer.The station is operating the Farmer First Project implemented in Pathiyoor Village of Kerala as an effective farmer participatory technology outreach programme auguring responsive extension. The Odanadu Farmers Producers Company has now emerged as FPO to deliver farm inputs at farmer's doorstep. In addition, the flagship *Mera Gaon Mera Gaurav* programme translates technologies at farmer's doorstep reducing the gap in technology generation and field-level adoption. The station thus caters the need of the coconut community and has served to the society with technologies since 1947 and therefore befitting the Kalpa Vajra celebrations on 24th April 2022. ■

142nd Meeting of Coconut Development Board



The 142nd Meeting of Coconut Development Board was held on 21st March 2022 under the Chairmanship of Shri Rajbir Singh IFS, Chairman, Coconut Development Board, through hybrid mode.

The meeting was attended by Shri K. Narayanan Master, Vice Chairman and other members of the Board, Dr. Anitha Karun, Director, CPCRI, Shri D. Kuppuramu, Chairman, Coir Board, Shri Suresh Gopi, Member of Parliament (Rajya Sabha) , Agriculture Production Commissioner, Ministry of Agriculture & Farmers Welfare, Government of Kerala, Shri C. Samayamoorthy IAS,Agricultural Production Commissioner & Secretary to the Government of Tamilnadu,Director of Horticulture, Government of Karnataka, Commissioner of Horticulture, Government of Andhra Pradesh, Shri P. Reghunath (Kerala) , Shri S.V. Muthuramalingam (Tamilnadu) Shri Guruswamy D (Karnataka) and Shri R. Elango (Tamilnadu), Shri Rajbir Singh IFS, Chairman updated the meeting on the major activities of the Board and the progress made in the formation of FPOs , coconut price and also in the export of coconut products.

Advertisement Tariff of Coconut Journals

Indian Coconut Journal (English monthly), Indian Nalikeral Journal (Malayalam monthly), Bharatiya Nariyal Patrika (Hindi quarterly), Bharatiya Thengu Patrike (Kannada quarterly) and Indhia Thennai Idazh (Tamil quarterly) are the periodicals of the Coconut Development Board. These journals regularly feature popular articles on scientific cultivation and other aspects of coconut industry. The journals are subscribed by farmers, researchers, policy makers, industrialists, traders, libraries, etc.

Position	Indian Coconut Journal (English monthly) (Rs.)	Indian Nalikera Journal (Malayalam monthly) (Rs.)	Indhia Thennai Idhazh (Tamil quarterly) (Rs.)	Bharatiya Naral Patrika (Marathi Bi-annual) (Rs.)	Bharatiya Kobbari Patrika (Telugu Bi- annual) (Rs.)	Bharatiya Thengu Patrike (Kannada quarterly) (Rs.)	Bharatiya Nariyal Patrika (Hindi quarterly) (Rs.)
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Annadata Devo Bhava - Kisan Bhaghidari Prathmikta Hamari-

CDB organising Massive Awareness Campaign for Coconut Farmers

As part of the nationwide campaign "Annadata Devo Bhava -Kisan Bhaghidari Prathmikta Hamari" Coconut Development Board is organizing a nationwide awareness campaign on 'Scientific coconut cultivation, processing and value addition" from 26th April to 1st May 2022, for the coconut farmers of the country. Honb'le Union Minister of Agriculture & Farmers Welfare, Shri Narendra Singh Thomar will be inaugurating the programme on 26th April 2022 on virtual platform. Around 20000 coconut farmers are expected to participate in the programme.

As part of the programme, a Centre of Excellence in Coconut is being inaugurated in Dhali, Tiruppur District, Tamil Nadu and a Farmer Training-cum-Administrative Building of the Demonstration cum Seed Production Farm of the Board is being inaugurated in Hichachara, South Tripura. The "Centre of Excellence for Coconut" at Board's Farm in Dhali, Tamil Nadu is the first Centre of Excellence for Coconut in the country . Board's Farm at Dhali is blessed with its congenial climatic and geo-physical environment. The Centre is equipped to disseminate the latest available coconut technologies and would develop, store and disseminate knowledge gained and technology derived in coconut sector so as to reach every stakeholder.

The establishment of the Training Centre for Coconut in Tripura is a land mark in the development of coconut cultivation, particularly in the north eastern states. The climatic condition of the state is very much congenial for coconut cultivation. With the objective of bringing in more area under coconut in nontraditional areas and with an objective to undertake production and distribution of quality planting material and demonstrate good agricultural practices in coconut cultivation, Board has established its Demonstration cum Seed Production (DSP) Farm in Hichachara in Tripura in 2016. The establishment of the farm and the training centre for coconut in Tripura is a land mark in the development of coconut cultivation in the country particularly in nontraditional areas.

More than 80 seminars on various aspects of coconut cultivation, processing and value addition are being organized as part of the campaign. The awareness programmes are conducted in association with ICAR, CPCRI, State Agriculture/ Horticulture Departments, Krishi Vigyan Kendra's and Farmer Producer Organizations.

As part of the campaign, a three day Virtual Trade Fair on Coconut Products is being held from 26th to 28th April 2022. The fair will show case the multifarious utility of the wonder crop 'Coconut' - ranging from food, sweeteners and beverages to non food products. It provides an opportunity for potential buyers and traders from across the globe to undertake a three day sojourn through the diverse coconut products.

Dissemination of information among farmers, entrepreneurs, policymakers & other stakeholders on prospects of coconut cultivation and industry is the main objective of the campaign.

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Cultivation practices for coconut -May

Summer ploughing

Ploughing of interspace of coconut gardens can be taken up depending up on the receipt of summer showers.

Sowing of green manure seeds

• Wherever sufficient pre monsoon showers are received sowing of green manure seeds can be taken up towards the fag end of May. Sowing of green manure crops like Sunhemp (*Crotalaria juncea*) or Daincha (*Sesbania aculeate*) or Cow pea (*Vigna unguiculata*) or Wild Indigo (*Tephrosia purpurea*) can be done. In the interspace of coconut gardens under monocropping the following seed rate of green manure seeds is recommended.

Sunhemp – 20 kg/ha

Daincha – 30 kg/ha

Cow pea -25 kg/ha

Wild Indigo – 15 kg/ha

If intercrops are grown, seeds of green manure crops can be sown in the coconut basin of 1.8 m radius. For Cow pea and Daincha seed rate per basin is 100g while for other green manure crops 75 g seeds can be sown per basin.

Nursery management

Continue irrigation for the seedlings in the nursery until rains set in to provide sufficient moisture. Similarly, if rainfall is not received spray water on the lower surface of leaves of seedlings against spiralling white fly attack. Weeding has to be done wherever necessary. Land preparation is to be done for raising nursery beds.

Making pits for planting

Wherever new planting or gap filling of coconut seedlings are proposed dig pits of size 1m x 1m x 1m for planting. In laterite soils common salt can be applied to the pit @ 2 kg per pit for facilitating proper weathering of the soil. In such areas the pit size can be 1.2 m x 1.2 m x 1.2 m. Two layer of coconut husks can be spread at the bottom of the pit with concave surface up before filling the pit with soil up to 50 -60 cm for moisture conservation.

Generally the recommended spacing is 7.5 m x 7.5 m. However, wherever inter/mixed cropping is to be taken up coconut seedlings are to be planted at a wider spacing of 8-10 m.

Application of fertilizers

If pre monsoon showers combined with early onset of south west monsoon is experienced one third of the recommended dose of chemical fertilizers can be applied to the coconut palms under rainfed situation in the last week of May. Application of 500 g N, 320 g P_2O_5 and 1200 g K_2O

per palm per year is generally recommended for adult plantations. To supply one-third of the above nutrients it is necessary to apply about 0.36 kg urea, 0.5 kg rock phosphate (in acidic soil) or 0.7 kg Super Phosphate (in other soils) and 0.7 kg of Muriate of potash (MOP). After the receipt of summer showers, one-third of the recommended dose of fertilizers may be spread around the palms within the radius of 1.8 m and forked in. It is always advisable to test soil in the coconut garden periodically (once in 3 years) based on the results of which, type and dosage of chemical fertilizers can be decided.

Application of soil amendments

In soils with acidic nature (pH < 7), in addition to the recommended level of fertilizers, 1 kg of dolomite or 1 kg of lime may be applied per palm per year and gypsum can be applied in alkaline soils (pH >8.5) @ 1 kg per palm. Lime/dolomite/gypsum may be broadcasted during April - May in the coconut basins of 1.8 m radius and incorporated into the soil by forking. These soil amendments should be applied at least 15 days before the application of chemical fertilizers.

Irrigation

Irrigation has to be continued in coconut gardens until sufficient pre monsoon showers are received.

Pest and disease management

The month of May initiates with dry phase and during the latter phase the South-West monsoon could set in South India. Dryness of summer is so acute during 2019 and therefore sporadic outbreaks of invasive whiteflies and coconut eriophyid mites could be observed in several regions. Coconut palm not only needs water for its survival but also fills in nut water for quenching thirst for millions of mankind. Any moisture deficit situation could drastically affect the health status of palms as well and could aggravate problems due to pest invasion. The transition to wet period is very crucial for prophylactic treatment of crown cleaning, leaf axil filling with neem cake plus sand as well as application of 1% Bordeaux mixture. If timely prophylactic measures are attended, upsurge of monsoon pests and diseases could be effectively tackled. This period thus marks the beginning of all prophylactic treatments and the age-old practices still turn appropriate and relevant in the changing climate condition. Summer period could dominate with invasive whiteflies and this could significantly be suppressed in the monsoon time. The key pests and diseases of monsoon period would be discussed hereunder.

Leaf and inflorescence damage

Rhinoceros beetle (*Oryctes rhinoceros*)

Being a ubiquitous pest, the incidence of rhinoceros beetle is quite common during all period. However its damage is well felt during the planting season of coconut. Furthermore, coconut seedlings planted during May-June should be customarily shielded from pest incursion during this period. More than 0.5% natural incidence of Oryctes rhinoceros nudivirus (OrNV) was recorded in Peninsular India and therefore the OrNV-insensitive Coconut Rhinoceros Beetle-Guam (CRB-G) strain is not prevalent in our country, as this strain is taking a great toll in South-East Asian region causing great concern among International community making extensive damage. The pest invading juvenile palms and nuts is of greater concern these days. Moreover, the attack by rhinoceros beetle would invariable incite egg laying by red palm weevil as well as entry of bud rot pathogen

▶ *Management*

- Prophylactic treatment of top most three leaf axils with either botanical cake [Neem cake/marotti cake/pongamia cake (250 g)] admixed with equal volume of sand or placement of 12 g naphthalene balls covered with sand.

Shielding by fish net

- Routine palm scrutiny during morning hours along with brushing of teeth and hooking out the beetle from the infested site reduces the floating pest population. This strategy could reduce the pest population significantly.

- Shielding the spear leaf area of juvenile palms with fish net could effectively entangle alighting rhinoceros beetles and placement of perforated sachets containing 3 g chlorantraniliprole /fipronil on top most three leaf axils evade pest incursion.

- Dairy farmers could treat the manure pits with green muscardine fungus, Metarhizium anisopliae @ 5 x 1011 / m3 to induce epizootics on the developing grubs of rhinoceros beetle. Area-wide farmer-participatory approach in technology adoption could reduce the pest incidence very effectively and forms an eco-friendly approach in pest suppression.

Metarhizium infected grub

- Incorporation of the weed plant, Clerodendron infortunatum in to the breeding pits caused hormonal irregularities resulting in morphogenetic transformational aberration in the immature stages of the pest.

- Crop diversity induced by intercropping and ecological engineering principles would disorient pests and provide continuous income and employment as well.

Red palm weevil (*Rhynchophorus ferrugineus*)

Reduction in the incidences of rhinoceros beetle, would subsequently suppress the invasive potential of the killer pest, viz., the red palm weevil, which needs an injury for the weevils to orient towards the palm cue and lay eggs. Dwarf genotypes and palms aged between 5-15 years are relatively more susceptible. All life stages of the pest were noticed inside the infested palms. Being a fatal enemy of palms, 1% action threshold has been fixed. Correct geometry is very crucial for accommodating intercrops as well as pest avoidance due to multiple odour cues.

Adult weevils

▶ *Management*

- Field sanitation is very critical and all residual population in crown toppled palms should be destroyed

- Avoiding palm injury is very critical to disorient the gravid weevils away from the field and therefore leave out at least one metre from palm trunk when petioles are cut.

- Crop geometry and correct spacing is very crucial to reduce pest attack.

- Timely and targeted spot application of imidacloprid 0.002% (1 ml per litre of water) or indoxocarb 0.04% (2.5 ml per litre of water) on infested palms would kill the feeding grubs and induces recovery of palms by putting forth new spear leaf.

Toppling of palm

Crown entry

- Crop-habitat diversification (Ecological Bio-engineering) through coconut based cropping system strategy inciting defenders and pollinators would diffuse the palm-linked volatile cues and encouraged pest suppression. Diversified cropping system reduces pest incidence than mono-cropping.

Leaf rot disease (*Colletotrichum gloeosporioides, Exserohilum rostratum*)

It is commonly observed on palms affected by root (wilt) disease wherein foliar necrosis of terminal spear leaf and adjacent leaves are registered. The disease is prominently noticed in the post-monsoon phase during the month of December. Affected leaves turn necrotic and are not detachable from the palm and remain intact. This disease could be initially

Leaf rot disease in juvenile palm

observed as minute lesions which later enlarge, coalesce and cause extensive rotting affecting the photosynthetic efficiency of palms. The disease is endemic to root (wilt) affected regions of Southern Kerala.

▶ *Management*

- Need based pruning and destruction of disease affected regions of spear leaf and other adjacent leaves in the terminal region
- Spot application of hexaconazole 5 EC 2 ml in 300 ml water on the affected spear leaf region

Bud rot or immature nut fall (*Phytophthora palmivora*)

In certain humid locations bud rot occurred regularly killing hundreds of trees. In India, bud rot incidence is recorded as less than one per cent. Pathogen attacks the bud region leading to rotting of bud and death of palms. The first visible symptom is withering of the spindle marked by pale colour. The spear leaf or spindle turns brown and bends down. The affected spear leaf can easily be pulled out as the basal portion of the spindle is completely rotten emitting a foul smell. Temperature range of 20- 24ºC and relative humidity of 98% - 100% were found optimum for the development of the bud rot disease. Contiguous occurrence of such "favourable days" during rainy seasons determines the development of the disease and the intensity of infection. As Phytophthora diseases are known to be extremely fatal, a close scrutiny is mandatory during monsoon period to assess the health of the palm especially the spear leaf zone.

Withering of spear leaf

Bud rot affected palm

▶ *Management*

- Regular cleaning of the crown and prophylactic spraying of Bordeaux mixture (1%) to the crown just before the onset of monsoon and one more spray after 35-40 days help in reducing the bud rot incidence.
- Placement of two Trichoderma (Trichoderma harzianum CPTD28 isolate) enriched coir pith cakes in the inner most leaf axils just before the onset of monsoon and again after every two months.
- Remove the entire rotten portion of the spindle by cutting with a sharp knife and apply 10% Bordeaux paste to the wound and cover with polythene sheet to prevent entry of rain water. The protective covering has to be retained till normal shoot emerges.

Timely prophylactic application would equip palms to withstand the pressure of pest and diseases during monsoon period. As the adage says 'Prevention is better than cure" so should be our approach to avoid invasion by pest and diseases rather than seeking strategies for curing. ■

Market Review – March 2022

Domestic Price

Coconut Oil

During the month of March 2022 the price of coconut oil opened at Rs. 15600 per quintal at Kochi, and Rs. 15400 per quintal at Alappuzha and Rs. 15800 per quintal at Kozhikode market. The price closed with a net gain of Rs. 100 per quintal at Kochi and Rs. 300 per quintal at Alappuzha market.

The price of coconut oil closed at Rs. 15700 per quintal at Kochi and Alappuzha market and Rs. 15800 per quintal at Kozhikode market.

During the month, the price of coconut oil at Kangayam market opened at Rs. 13533 per quintal and closed at Rs. 13467 per quintal with a net loss of Rs. 66 per quintal.

Weekly price of coconut oil at major markets Rs/Quintal)				
	Kochi	Alappuzha	Kozhikode	Kangayam
01.03.2022	15600	15400	15800	13533
05.03.2022	15900	15900	16000	14533
12.03.2022	16100	16100	16300	13800
19.03.2022	16000	16000	16200	1400
26.03.2022	15700	15700	15800	13467
31.03.2022	15700	15700	15800	13467

Milling copra

During the month, the price of milling copra opened at Rs.9400 per quintal at Kochi and Rs.9100 per quintal at Alappuzha market and Rs. 9400 per quintal at Kozhikode market.

The prices of milling copra closed at Rs. 9500 per quintal at Kochi market, Rs. 9400 per quintal at Alappuzha market and Rs. 9400 per quintal at Kozhikode market with a net gain of Rs.100 at Kochi, Rs. 300 per quintal at Alappuzha and Kozhikode markets.

During the month the price of milling copra at Kangayam market opened at Rs.8900 and closed at the same price.

Weekly price of Milling Copra at major markets (Rs/Quintal)				
	Kochi	Alappuzha (Rasi Copra)	Kozhikode	Kangayam
01.03.2022	9400	9100	9400	8900
05.03.2022	9700	9650	9650	9400
12.03.2022	9900	9800	9800	9200
19.03.2022	9800	9650	9600	9200
26.03.2022	9500	9400	9400	8900
21.03.2022	9500	9400	9400	8900

Edible copra

During the month the price of Rajpur copra at Kozhikode market opened at Rs. 16800 per quintal and closed at Rs. 15200 per quintal with a net loss of Rs. 1600 per quintal.

Weekly price of edible copra at Kozhikode market (Rs/Quintal)	
01.03.2022	16800
05.03.2022	17100
12.03.2022	15700
19.03.2022	15600
26.03.2022	15350
31.03.2022	15200

Ball copra

The price of ball copra at Tiptur market opened at Rs. 17650 per quintal and closed at Rs.16500 per quintal.

Weekly price of Ball copra at major markets in Karnataka (Rs/Quintal) (Sorce: Krishimarata vahini)	
01.03.2022	17650
05.03.2022	17300
12.03.2022	17450
19.03.2022	17000
26.03.2022	16500
31.03.2022	NR

*NR-Not reported

Dry coconut

At Kozhikode market, the price of dry coconut opened and closed at the same price during the month.

Weekly price of Dry Coconut at Kozhikode market (Rs/Quintal)	
01.03.2022	13000
05.03.2022	13000
12.03.2022	13000
19.03.2022	13000
26.03.2022	13000
31.03.2022	13000

Coconut

At Nedumangad market in Kerala, the price of coconut opened at Rs. 16000 and closed at Rs. 17000 per thousand nuts during the month with a net gain of Rs. 1000 per thousand nuts.

At Pollachi market in Tamilnadu, the price of coconut opened Rs. 27000 per ton and closed at Rs.26000 per ton during the month with a net loss of Rs. 1000 per ton.

At Bangalore market in Karnataka, the price of coconut opened at Rs. 17500 and closed at Rs. 22500 per thousand nuts during the month with a net gain of Rs. 5000 per thousand nuts.

At Mangalore market in Karnataka, the price of coconut opened and closed at Rs.32000 per tonne during the month.

Weekly price of coconut at major markets				
	Nedumangad (Rs./1000 coconuts)#	Pollachi (Rs./MT) ##	Bangalore Grade-1 coconut,(Rs./ 1000 coconuts) ##	Mangalore Black coconut (1 tonne) ##
01.03.2022	16000	27000	17500	32000
05.03.2022	16000	28000	17500	34000
12.03.2022	16000	28000	17500	32000
19.03.2022	17000	27000	17500	32000
26.03.2022	17000	26000	17500	30000
31.03.2022	17000	26000	22500	32000

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*
05.03.2022	237	243	287	366
12.03.2022	234	226	244	366
19.03.2022	234	251	232	353
26.03.2022	NR	251	223	340
				*Pollachi market

Coconut Oil

International price and domestic price of coconut oil 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)	Philippines	Indonesia	Sri lanka	India*
05.03.2022	2343	NR	NR	3267	1901
12.03.2022	2381	NR	NR	2858	1806
19.03.2022	2110	NR	NR	2964	1832
26.03.2022	NR	NR	NR	2931	1762
					*Kangayam

Copra

The price of copra quoted at different domestic markets in Philippines, Srilanka, Indonesia, 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
05.03.2022	1218	1091	1720	1230
12.03.2022	1220	1055	1548	1204
19.03.2022	1226	1053	1446	1204
26.03.2022	NR	1044	1509	1165
				* Kangayam

#(Source: Epaper,Kerala Kaumudi),
##(Source: Star market bulletin)

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